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**NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY  
NAVAL AIR STATION, PENSACOLA, FL 32508-5700**

**NAMRL Special Report 92-3**

**AVIATION MEDICINE RESEARCH:**

**A HISTORICAL REVIEW**

**R. E. Mitchell**

**Fourth Lecture in the  
Ashton Graybiel Lecture Series**

**Compiled by R. E. Gadolin**

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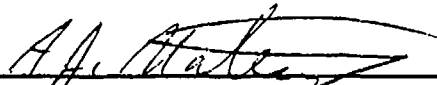
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Reviewed and approved 27 Oct 92

  
A. J. MATECZUN, CAPT, MC USN  
Commanding Officer



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## HISTORY OF THE NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

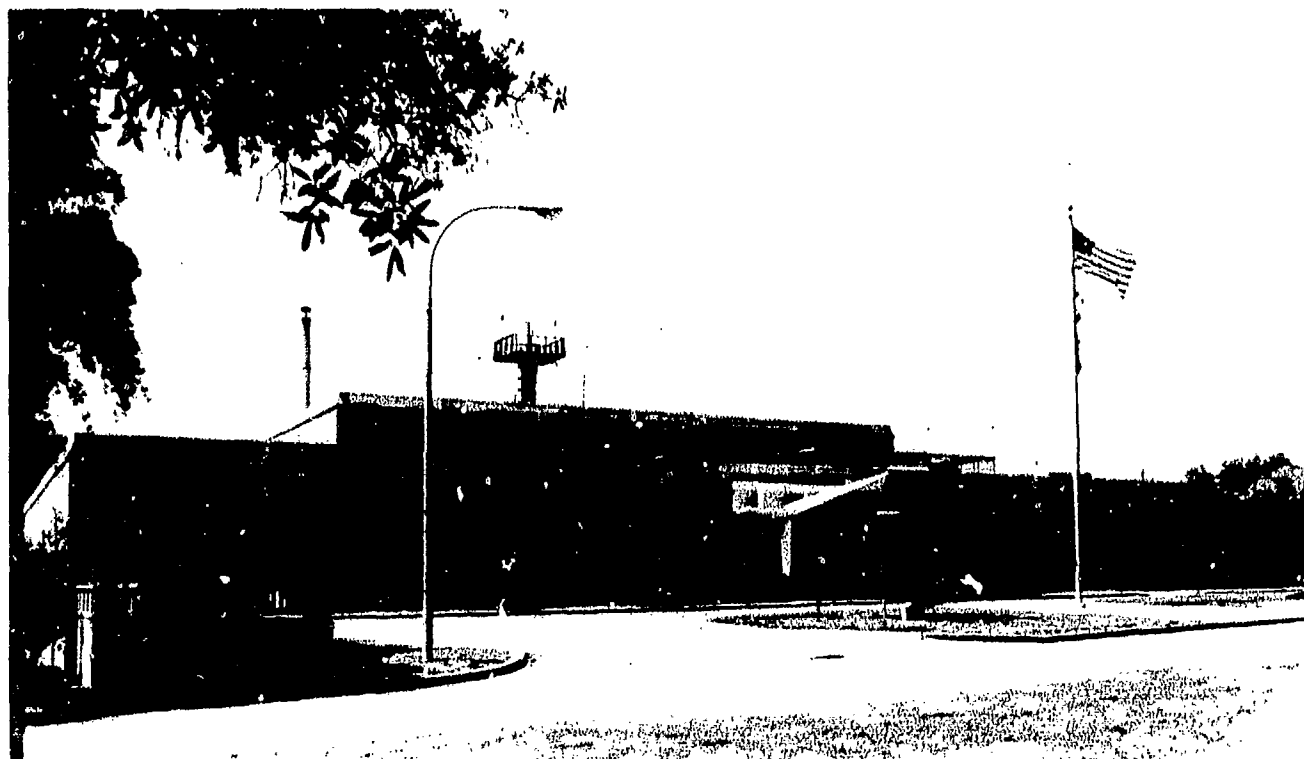
From 1939 to 1946, research in aviation medicine was a function of the Medical Department of the Naval Air Station, Pensacola, Florida. On 1 October 1946, the Secretary of the Navy established the Naval School of Aviation Medicine, with an Officer in Charge and research as a department. In July 1951, the School became a separate command under a commanding officer. On 30 April 1957, the Naval Aerospace Medical Center was established. The School and the Naval Hospital at Pensacola were component commands of the Center.

On 18 August 1965, the School was renamed the Naval Aerospace Medical Institute (NAMI) to reflect ongoing functions. The Naval Aerospace Medical Research Laboratory (NAMRL) was established, under an Officer in Charge, on 19 January 1970 as a component command of NAMI. A primary purpose in separating the research activities of the two commands was to facilitate funding of aviation medicine research projects.

On 1 July 1974, NAMRL was designated a command under the direction of the Naval Medical Research and Development Command with the title Commanding Officer officially designated 5 months later.

### MISSION

The mission of the Laboratory is to conduct research, development, test, and evaluation in aviation medicine and the allied sciences to enhance the health, safety, and readiness of Navy and Marine Corps personnel in the effective performance of peacetime and contingency missions, and to perform such other functions or tasks as may be required by higher authority.



Naval Aerospace Medical Research Laboratory

## ASHTON GRAYBIEL LECTURE SERIES



Ashton Graybiel, M.D.

On July 26, 1988, the commanding officer established the Ashton Graybiel Lecture Series to honor the former scientific director of the Naval Aerospace Medical Research Laboratory. Like Dr. Graybiel, this lecture series is intended to stimulate and challenge conventional research interests in naval aviation and aerospace medicine.

As a pioneer in the field of aviation medicine for over 40 years, Dr. Graybiel made many significant scientific contributions, which cannot be overstated. His world-renowned work advanced current aeromedical knowledge and established the reputation of this laboratory. Today, his expertise, foresight, and creativity remain as benchmarks in our aviation medicine research.

We are committed to the same level of excellence in meeting the "needs of the fleet" that Dr. Graybiel accomplished during four decades of research. We are delighted that you are able to join us for this unique opportunity to meet and share information with some of the most noted scientists in the fields of naval aviation, aerospace medicine, and environmental physiology.



**ROBERT E. MITCHELL  
CAPTAIN, MEDICAL CORPS, UNITED STATES NAVY (RETIRED)**



*from the*

**CONGRESSIONAL RECORD**

*Proceedings and Debates on the 101st Congress, First Session  
Volume 135, Number 150  
Washington, Tuesday, October 31, 1989*

**CAREER TRIBUTE TO DR. ROBERT E. MITCHELL,  
MEDICAL CORPS, U.S. NAVY**

by

**The Honorable John Glenn, Senator from Ohio**

Mr. Glenn: Mr. President. Today, I invite the attention of the Senate and the American people to an outstanding American and aerospace medical authority, Captain Robert E. Mitchell, Medical Corps, U.S. Navy. Though I would like to claim Dr. Mitchell as a native Ohioan, I must admit that he was born and raised in Merced in the great State of California.

I think that the characteristic that has so distinguished Dr. Mitchell over his long, illustrious and continuing career, is his unceasing and selfless dedication to his country and the well-being of his fellow man. Today, he continues to pursue a very active career as a recognized authority in aerospace medicine, as a well-published author, and as an extremely productive member of numerous professional societies and organizations.

As a veteran of two wars myself, I particularly want to recognize Dr. Mitchell's outstanding service in the rehabilitation of American prisoners-of-war from the Vietnam conflict, an effort he still is heavily involved in today as a staff member of the Naval Aerospace Medical Institute in Pensacola, FL.

I commend to all Americans as close consideration of the superb record of service that Dr. Mitchell has compiled over the last 45 years.

Prior to his entering the Navy as an ensign in 1944, Captain Mitchell received his bachelor and master of arts degrees in 1942 from the University of California at Berkeley.

In 1947 he received his doctor of medicine and his master of surgery degrees from McGill University in Montreal, and from there reported to U.S. Naval Hospital, San Diego, for his internship. He followed this with residency training in internal medicine at Naval Hospitals San Diego (1948-49) and Oakland (1950-52), and further graduate training at Walter Reed Army Medical Center in Washington (1952-53), Navy Diving School in Washington (1961), and London Heart Hospital in England (1962).

Doctor Mitchell was designated a naval flight surgeon in 1955. Upon designation, he reported to the research division of the School of Aviation Medicine at Pensacola, FL, where he served until 1958. Subsequently he had two more tours at the laboratory, from 1960 to 1965 and again from 1969 to 1980. During these tours he was heavily involved in major research efforts in the "Thousand Aviators" project which was designed to track the careers and lives of 1,000 Naval aviators-both Navy and Marine pilots-over an extended period to assess the impact of such a career in both personal and professional terms; this study is now in its 50th year.

Dr. Mitchell was a prime researcher in the program assessing the health of repatriated Navy-Marine Corps prisoners in the Vietnam war; this program started in 1973, with a comparison group study initiated in 1976. During much of this period he was head of the medical sciences department of the Naval Aviation Medical Research Laboratory [NAMRL], a position he held from 1970 until he assumed command of the laboratory in August 1975.

Captain Mitchell retired from the Navy in 1980, but was immediately recalled to active duty in order to serve at the Naval Aerospace Medical Institute in Pensacola, FL, where he continues to serve today. There, among other projects, he continued his follow-up of the "Thousand Aviators" project, and of the POW repatriate and comparable groups; during this he also became an original member of the medical team which worked with the American hostages who had been held in Iran.

During his career, Captain Mitchell has served extensively in overseas assignments: Kwagalein, the Marshall Islands 1949-1950; Naples, Italy 1953-54; U.S.S. SHANGRI-LA (CVA 38) 1958-1960; 1st Marine Aircraft Wing, Vietnam 1965-66; and at Naval Station, Rota, Spain 1966-68, where he commissioned Naval Hospital Rota in 1968 as its first commanding officer.

He is the recipient of many professional honors in the field of medicine: He was elected a Fellow of the Aerospace Medical Association in 1966; elected to the International Academy of Aviation and Space Medicine in 1971; elected to the International Academy of Astronautics in 1978; and elected a Fellow of the Royal Society of Medicine in England in 1985. In 1980 he received the Theodore C. Lyster Award of the Aerospace Medical Association "For outstanding Achievements in the General Field of Aerospace Medicine";



In 1982 he was elected an honorary member of NAMPOW, Inc., and the organization later installed a plaque in his honor in the naval aviation museum in 1986; and in 1989 he was elected an honorary member of the Pioneer and Early Naval Aviator's Association.

Dr. Mitchell is a member of the American Medical Association; the Aerospace Medical Association; The American Association for the Advancement of Science; the American Heart Association, in which he was president of the West Florida Chapter 1975-76 and again in 1977-78, and a member of the association's Florida affiliate board of directors; the Naval Aviation Museum Foundation, where he is chairman of the medical exhibit committee; the Association of Naval Aviation, where he sat on the first national board of trustees and also is the flight surgeon member of the local executive board of that organization; the Society of U.S. Naval Flight Surgeons; and the United States Naval Institute, where he is a life member.

He has written extensively on medical and aerospace issues, and is the author or coauthor of numerous published works. He also has made, and continues to make, many presentations on these matters to various groups all over the country.

He is married to the former Elizabeth Miller of Dalhousie, New Brunswick, Canada, and they have two children.

I know that we can all agree that this is the biographic profile of an outstanding American who has benefitted our Nation and its citizens in numerous ways over some 45 year as a naval officer, medical doctor, flight surgeon, aerospace scientist, and humanitarian, and who even today continues his hectic schedule to the great benefit of his countrymen and the world.

Dr. Mitchell, we salute you.

1991: Designated Honorary, Naval Aviator #21 by CNO

## AVIATION MEDICINE RESEARCH: A HISTORICAL REVIEW

This presentation is not going to be a scientific treatise, discussing some breakthrough in the field of aviation medicine; rather it will encompass a subject which has been of interest to me in recent years: the history of aviation medicine, with emphasis today on aviation medicine research.

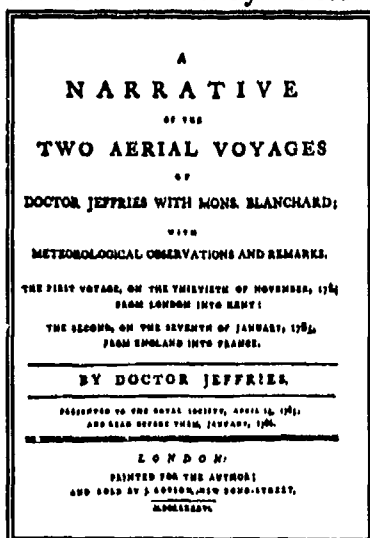
### IN THE BEGINNING. . . .

Credit as the first American physician involved in aviation must go to John Jeffries of Boston, who was airborne with Jean Pierre Blanchard over London for 81 minutes on 30 November 1784 and flew across the English Channel on 7 January 1785. During each of the flights, he made scientific observations and authored the first published book on aeronautics.



John Jeffries

Prior to Doctor Jeffrie's flights, however, recognition that there might be problems related to human flight, and therefore a need for research, appears to have been depicted in a story written in 1759 by Doctor Samuel Johnson, an English author.



Two Aerial Voyages

In the tale a fictional character, Rasselas, indicated concern about certain physiological limitations of altitude as related to flight, problems not recognized by an engineer working with him who was interested only in the mechanical aspects of his machine. Unfortunately, like Icarus before him, whose wings melted, the engineer fell into the sea, the latter because he lacked the power to move the wings which he had devised.



Blanchard's Balloon

It is interesting that Doctor Johnson recorded his vision of the future of air travel 145 years before the Wright brothers' flight. To quote John Fulton in his book "Aviation Medicine in its Preventive Aspects," "That Johnson did not himself have the talent for experiment does not lessen the significance of the idea propounded, for the idea often proves to be more important historically than the method by which it was validated."

Of interest, apropos of the medical literature, is the fact that the first aviation

The time will come, when thou shalt lift thine eyes  
To watch a long-drawn battle in the skies,  
While aged peasants, too amazed for words,  
Stare at the flying fleets of wondrous birds

Thomas Grey, 1737

medicine paper in the period following the Wright brothers' flight was published in 1907 and by the time World War I began, 11 years after their flight, the world literature on the subject of the medical aspects of flight consisted of only 31 papers and 1 small book.

Aviation medicine had its beginnings in World War I. It was, however, considered only a transient necessity and for 10 years following the war was again almost nonexistent. Such research as was done during the war years was related only to oxygen and restraint systems. Fortunately, because of the efforts of a small group of individuals, U.S. Army aviation medicine survived the neglect of the period, and in the late 1920s there was a revival of interest in the field because of the need for civilian flight surgeons to do the physical examinations required by the Department of Commerce on civil aviators. Following this, in the 1930s, military and civilian institutions expanded the scope of aviation medicine. To quote General Harry Armstrong, later Surgeon General of the Air Force, "The increased performance of aircraft attained by about 1930 resulted in a situation wherein the human element in flight was becoming the weakest link in the chain and created an urgent need for further medical studies." Because of this need for research, to strengthen the "weakest link," laboratories were established in various places throughout the country during the 1930s and 1940s. When World War II brought with it the need for rapid research and development, it was these laboratories which spearheaded the investigations.

Unfortunately, there were conflicts between the engineers and the physiologists in the development of aircraft and equipment. As expressed by Doctor John Fulton in a lecture given at the University of London in 1947: "The most critical problem of aviation medicine, as we see it now, nearly two hundred years after Samuel Johnson's prescient pronouncements, is still to bring the engineer and the physiologist together in settling upon a design and other specifications essential to keep man, when in his machine, at the peak of his performance."

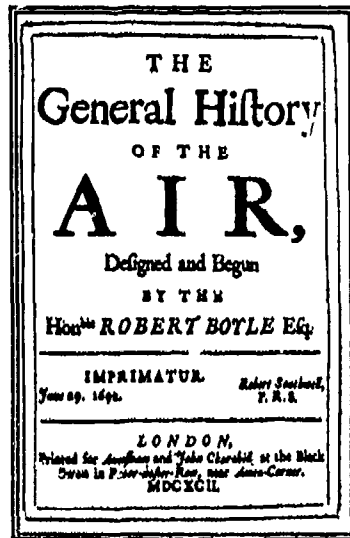
The problem was further related by Captain C.E. Gell, MC USN, one of our early researchers: "Early medical research and development in the Navy was not a planned or orderly function. Development was the rare request by the engineers for help or by aviation medicine people inserting themselves by brute force or conniving into programs."

Early on, during balloon flights, it became obvious there were physiological limitations to flight, related to altitude. Later, during and after World War I, it became apparent that there were also certain physiological limitations to flying airplanes and as the airplanes became more sophisticated those problems increased. Historically, those problems have been: The effects of altitude (hypoxia, decompression sickness, cold); the

effects of acceleration (G-induced loss of consciousness); disorientation (vertigo, visual illusions, motion sickness); and selection of aviators (physical standards, psychological standards, aeronautical adaptability). It is these problem areas that I will touch upon today.

## EFFECTS OF ALTITUDE - HYPOXIA

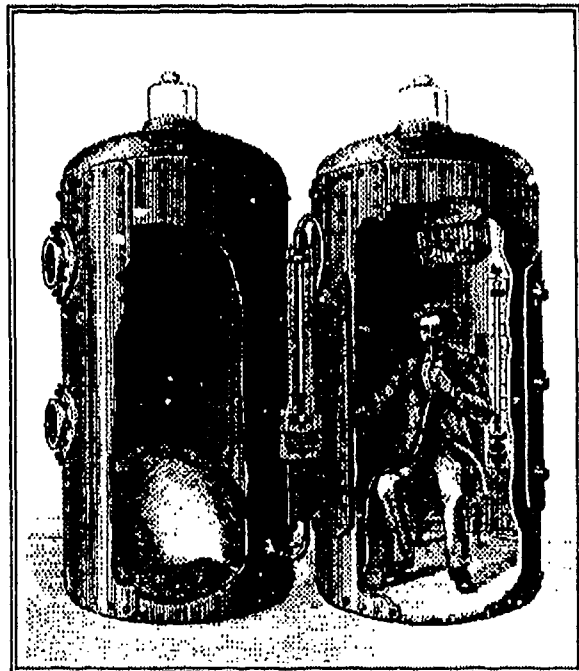
The first problems seen in aviation were those related to altitude. Although not known at the time to be caused by a lack of oxygen, the early balloonists had symptoms (now called hypoxia) at altitude. This is not altogether surprising in that the effects of altitude, the so-called "mountain sickness," had been described as far back as the Renaissance and may even have been known in ancient times. One of the most detailed descriptions of the syndrome was published by a Spanish priest in 1590, describing his experiences in the high mountains of Peru.



General History, Robert Boyle

It was not until the work of Robert Boyle in England in the latter part of the 17th century that it became obvious that there was something in the

air that sustained life and that at altitude that "something" was lacking. In 1774 Joseph Priestly, also in England, isolated that "something," and in 1777 Antoine Lavoissier, a Frenchman, coined the name oxygen for it. One hundred years later, in 1878, Paul Bert, a physiologist working in Paris, showed that the symptoms at altitude were due to decreased oxygen pressure. All of this has relevance to present day aviation in that it is the basis for the use of oxygen in our aircraft.



Paul Bert, 1878

The first fatalities from aviation hypoxia, and possibly the true beginning of the history of aviation medicine, occurred as the result of the flights of two Frenchmen, Croce-Spinelli and Sivel. These men made simulated flights to 23,000 feet in a pressure chamber made by Paul Bert. On 15 April 1875, they went to an altitude of 28,000 feet in a balloon and died of hypoxia. A third man, Tissandier, survived the flight.

Interestingly, it has been shown that with slow acclimatization, a healthy young adult can perform heavy work at altitudes of 25,000 feet, a level that would produce unconsciousness in anyone not acclimatized. In order to prove this under scientific conditions, an experiment named "Everest" was conducted here in the School of Aviation Medicine in 1945 by Commander C.S. Houston, MC USN, under the direction of Doctor Graybiel, and showed that one can, in fact, become acclimatized. Unfortunately, this has little practical use in aviation because the acclimatization cannot be maintained and, besides, present-day flight levels greatly exceed the 25,000 feet used in the experiment.



Early Balloon Flight

Even at the relatively low altitudes to which aircraft were flown in World War I, it was known that supplemental oxygen was beneficial, and both gaseous and liquid oxygen was used. After World War I, the altitudes to which aircraft could climb increased, and the use of oxygen became a necessity. Early in World War II, one of the most pressing problems of aviation was that of an oxygen supply in aircraft, but it was not until the late 1940s that oxygen systems were really improved, to meet the needs of the new jet aircraft.

#### **EFFECTS OF ALTITUDE - DECOMPRESSION SICKNESS**

Although there were allusions to the possibility of decompression sickness at altitude by the physiologist Yardell Henderson in 1917, the pain of what was undoubtedly "bends" was described in a paper published in 1931, followed by another paper in 1938 describing paralysis from the waist down in a subject taken to an altitude of 35,000 feet in a hypobaric chamber. His symptoms disappeared after returning to sea level.

In 1939, Doctor H.G. Armstrong, whom I have mentioned before, contended that decompression sickness could be related to altitude and that the symptoms were caused by gas bubbles in small blood vessels.

As low pressure chambers became more numerous in 1939, used more and more for altitude indoctrination, cases of decompression sickness became more common and reports of the condition began to appear in the aviation medicine literature.

In 1931 Professor August Piccard, of Belgium, used a sealed sphere to go to altitudes over 50,000 feet. Then as early as 1935, Doctor Armstrong recognized that pressurization of aircraft cabins might be the solution to protecting personnel against decompression sickness while flying at altitude. The first successful pressurization of a plane was the XC 35 in April 1937; by 1939, pressurization of passenger aircraft was

undertaken, and in 1941-1942 bombers were pressurized. In the meantime, pressure suits were being developed in case there was a failure of aircraft pressurization.

One of the first suggestions that a pressurized suit could be protective at altitude is seen in the writings of Jules Verne, who in 1872 described pressure suits to protect space travelers, and later, in 1920, by an English physiologist, John S. Haldane. It was not until 1933, however, that the first significant efforts were made to develop such a suit, motivated by Mark Ridge, an American balloonist. A suit designed and fabricated for



Wiley Post

Ridge by Haldane and Sir Robert H. Davis, the latter a diving specialist, was used in a number of low-pressure chamber tests in London--the first time a human was successfully protected against simulated extremely high altitude. He went to 90,000 feet.

The initial use of a pressure suit in an aircraft was by Wiley Post in 1934. Post made a number of flights using a pressure suit made by Russ E. Colley, who later directed the development of suits for NASA and for the military.

The Navy initiated work on the development of pressure suits on 27 June 1942, but it was not until 30 June 1955 that the first operational full-pressure suits were placed in service. Later, in 1958, the feasibility of using the suits in a space environment was demonstrated by Lieutenant R.H. Tabor, MC USN, when he made a 72-hour simulated flight to an altitude of 139,000 feet. The Navy's Mark IV full-pressure suit, which ultimately became the first suit worn by the Mercury astronauts, was developed at Naval Aircrew Equipment Laboratory under the direction of Wayne Galway of the Goodrich Company; Captain W.L. Jones, MC USN; Captain R.H. Bosee, MSC USN; Lee Snyder; and James Coreale, the latter later head of NASA's space suit program.

## **EFFECTS OF ALTITUDE - COLD**

As concerns cold as a problem of flight, clothing adequate to prevent impairment of function is, of course, necessary. Various methods of heating have been used, including engine bleed-off, warmwater circulation, and electrical heating. The latter is the only system that has received widespread practical use.

## **EFFECTS OF ACCELERATION - G FORCES**

The second major problem encountered in the aviation environment is that of the effects of acceleration--changes in the direction of the aircraft. To quote Armstrong: "No other physiologic change, occurring as a result of airplane flight, appears with such dramatic suddenness or exhibits such profound manifestations as those accompanying high acceleration."

Before I enter into the discussion of centrifugal forces, a bit of early history: Erasmus Darwin, Charles Darwin's grandfather and a physician in England, used a centrifuge to treat mental patients in 1794, and in 1818 a centrifuge was built at Charite Hospital in Berlin for the same purpose.

The first observations that centrifugal forces produced by changes of direction of an aircraft could cause loss of consciousness were published during World War I and by Doctor L.H. Bauer, an American physician, in 1926. In 1932, flight surgeons of the German Luftwaffe, under the direction of Doctor Heinz von Diringhofen, began systematic studies of the reactions of animals to high acceleratory forces, and in 1935 studies on humans were started, the latter on a centrifuge constructed in Berlin. In early 1942, the first allied nation centrifuge became operational in Toronto, Canada, followed by centrifuges at the Mayo Clinic in 1942, at the Army's Wright Field in Ohio in 1943, at



G-suit

the University of California in Los Angeles in 1944, and at Naval Air Station Pensacola in 1945. All of these centrifuges were designed to produce forces similar to those encountered in aircraft. In 1952, the Naval Aviation Medical Acceleration Laboratory at Johnsville, Pennsylvania, was commissioned and a human centrifuge capable of producing 40 Gs was built. This latter equipment was used in 1959 for simulation by Mercury astronauts of Atlas rocket launches, re-entries, and abort conditions ranging up to 18 Gs transversely.

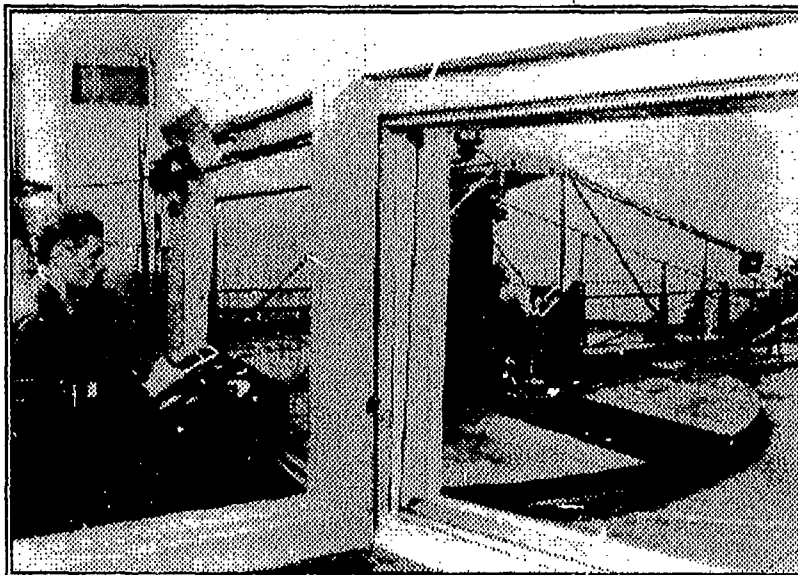
Prevention of the effects of G forces on the human body have included straining maneuvers and pressure devices designed to compress dependent parts of the body during positive acceleration. The first reference to the latter was in 1918, when the question was raised as to whether a restraining abdominal belt would be of use to pilots. The suggestion was not taken seriously until 1932 when Lieutenant Commander J.R. Poppen, MC USN, undertook research into the physiological effects of high acceleration and deceleration, as encountered in dive bombing or other violent maneuvers. This work pointed out the need for a protective device, and he proposed an inflatable abdominal corset for use by fighter pilots. Nothing was done about the report until 1940 when the Navy approached

the makers of Spencer corsets (Berger Brothers) in New Haven, Connecticut, with the suggestion that they design an inflatable pneumatic belt along the lines proposed by Doctor Poppen. They produced a belt, incorporating a valve designed by them that varied the pressure in the belt according to the G load. Later that same year, Doctor John Fulton, who has been mentioned earlier, suggested pressurized leggings that could be tied into the abdominal belt and inflated from a common source. Present day G suits utilize the principles of the latter configuration. The first suit used operationally was developed by a Canadian, Doctor W.B. Franks, and used water as the compression agent.

Unfortunately, a major problem with some of the most effective suits has been the occurrence of very slow heart rates and potentially dangerous irregularities of the beating of the heart, necessitating discontinuation of testing.

Despite all of the efforts to make them so, present day G suits are not completely effective. Inasmuch as some of the earlier suits provided more protection than the current suits, the former need to be reconsidered.

The work done with the various centrifuges and with G suits is superbly documented in a report by Doctor Earl H. Wood, published by the Mayo Foundation in 1990. The extent of the investigation of the problem of G-induced loss of consciousness is evident in the bibliography of the report--a complete summary of the attempts to develop satisfactory protection.



Pensacola Centrifuge

The recommendations of the Mayo group, relevant to both the Navy and the Air Force, include the development of a better G suit, the development of a system that will immediately warn the pilot of impending loss of consciousness, and the development of a prone cockpit arrangement, which would obviate the need for other protection.

Whereas acceleration is a major problem in aviation, deceleration is a problem of the earth-bound population and aviation: vehicular and aircraft accidents. A great deal of research, both military and civilian, has been conducted in an attempt to protect the



susceptible population--some of the work done at Naval Biodynamics Laboratory at Michoud.

I will mention deceleration only very briefly, mainly to point out some practical applications in everyday life that have resulted from aviation research, primarily having to do with restraint systems.

It became apparent about 1910 that a belt was necessary in the cockpit, not only to keep the individual from falling out but also to protect him from injury in the event of a crash landing. At first, only a lap belt was used. Then, in 1939, the shoulder harness was added. Because the restraint harness was so effective in aircraft, it came to be realized that a restraint system would also be effective in automobiles--such that most states now require them.

Although air bags are not now used in aircraft, they were developed in a Navy laboratory and are commonly used in late model automobiles. Now used only for front end collisions, I think we will eventually see them for side protection.

## DISORIENTATION

About 500 B.C. Aesop is said to have written: "Appearances often are deceiving." Whether he did or did not say it, it is certainly a truism when it refers to some of the events that occur in flight.



Dr. Ashton Graybiel

In addition to G forces, positive and negative, acceleration can produce disorientation, which is probably the single most important physiologic abnormality in aviation. The disorientation results "from sensory conflicts which occur in response to conditions to which one is not accustomed which exist in one's motional environment." The latter includes all the linear and angular positions, velocities, and accelerations that are directly sensed or secondarily perceived by an individual as determining his spatial orientation. Disorientation can manifest itself as vertigo, various visual illusions, or motion sickness.

Doctor Graybiel's interest in disorientation phenomena goes back to the early 1940s, and the subject has been a major field of inquiry in the local laboratory almost since the beginning of the old School of Aviation Medicine, the primary areas of interest being the visual illusions and motion sickness.

## DISORIENTATION - VERTIGO

Vertigo, as pilots use the term, is any form of spatial disorientation including that caused by 1) pressure changes (alternobaric vertigo); 2) various visual conditions (absence of a good visual reference, such as sloping cloud banks and rays of sunlight; 3) 'photic-driving' generated by flicker from helicopter blades or from slowly turning propellers of fixed wing aircraft; 4) accelerations from almost every deviation of a flight from straight-and-level-constant-speed flight, which alter the direction of the resultant force from the direction of gravity; the mechanoreceptors of the body respond to the resultant force vector.

## DISORIENTATION - VISUAL ILLUSIONS

Visual illusions can occur, as pointed out before, when an individual is "exposed to force environments that differ from those experienced during normal activity on the surface of the earth." These visual illusions can be hazardous to flight inasmuch as the individual is not doing what he perceives himself as doing.

Illusions studied have been: the somatogravic illusion, in which there is a false perception of attitude on exposure to a force vector that differs in direction and/or magnitude from the normal gravitational forces; the oculogravic illusion, a visual component of the somatogravic illusion; the "G-force" illusion, in which head movements in pitch, roll, or yaw situations of the aircraft can induce false sensations of the aircraft's attitude; the elevator illusion, occurring when there is a change in the magnitude of the

### PRACTICAL ADVICE TO AIRCREW

Preventative advice may be summarized as follows:

1. Remain convinced that you cannot fly by the 'seat of the pants.'
2. Do not allow control of the aircraft to be based at any time on 'seat of the pants' sensations even when you are temporarily deprived of visual cues.
3. Do not unnecessarily mix flying by instruments with flying by external visual cues.
4. Aim to make an early transition to instruments in poor visibility; once on instruments, stay on instruments until external cues are unambiguous.
5. Maintain a high proficiency and be in practice at flight in IMC.
6. Avoid unnecessary manoeuvres of aircraft or head movements that are known to induce disorientation.
7. Be particularly vigilant in high-risk situations, such as at night and in poor visibility, in order to maintain intellectual command of the orientation and position of the aircraft.
8. Do not fly:
  - (a) With an upper respiratory tract infection.
  - (b) When under the influence of drugs or alcohol.
  - (c) When mentally or physically debilitated.
9. Make your first flight after a period off flying a simple day Visual Meteorological Conditions (VMC) sortie.
10. Remember: experience does not make you immune.

Taken from Ernsting: Aviation Medicine

Practical Advice

force vector without rotation of the vector; the somatogyral illusions (the basis of the 'graveyard spiral') caused by stimulation of the semicircular canals during sustained turns, and the so-called Coriolis illusions when angular movements of the head are made in an aircraft that is turning.

Another form of disorientation was described by Doctors Clark and Graybiel in 1957, called the "break-off phenomenon." This is a situation in which there is an altered perception of the pilot's own orientation with respect to the aircraft and to the ground-- a feeling of separation from the earth experienced by pilots at high altitude. Graybiel and Clark conducted several early experiments in flight, documenting flight conditions that engendered dangerous illusions.

### **DISORIENTATION - MOTION SICKNESS**

Related to spatial orientation is motion sickness, which undoubtedly has been a problem for thousands of years. Until relatively recently, however, the cause of the condition was not understood and little could be done about it.

Motion sickness usually results from the sensory conflicts mentioned before. In addition to a "motional" environment as a causative factor, however, there can be an "emotional" factor, completely unrelated to acceleration. This latter is seen in those individuals who get sick when they see an airplane in which they have had an unfortunate experience or who get sick immediately after boarding a vessel pierside. As Doctor Guedry pointed out to me recently, motion sickness, along with the effects of acceleration can be an extremely complex situation.

Air sickness, per se, was first discussed in a French publication in 1907. Subsequent to that time, the condition has been a problem to every nation involved in training air crew, afflicting approximately 40% of all trainees.

A variation of motion sickness is a condition called the "sopite syndrome" by Doctor Graybiel and Mr. Jim Knepton. The condition is manifested by drowsiness and a disinclination to do anything. A major difference between the usual nausea and vomiting syndrome and the "sopite" syndrome is that the former is pathognomonic of motion sickness, and the latter can be confused with other conditions, requiring a differential diagnosis.

As one might expect, much research has been done relative to motion sickness, a considerable part of which has been done by individuals who are here today. As a result of this research, means to control motion sickness have been developed, using pharmacologic and desensitization techniques. An effective pharmacologic remedy is scopolamine, and Doctor Graybiel holds the patent on a commonly used patch that incorporates the drug.

Desensitization of motion sickness is a technique that has been used here at Pensacola, utilizing the slow-rotation room in building 1811. While it is not 100% effective, a number of individuals have been returned to flying status, saving careers and a sizable number of dollars. It should be pointed out that the British and Canadian forces have used the technique more effectively than have the United States forces. Our attitude seems to be that the manpower pool is such that we don't have to take the time with anyone who is motion sick.

## **SELECTION OF AVIATORS - PHYSICAL AND PSYCHIATRIC STANDARDS**

The first aircraft were strictly for straight and level flying at relatively low altitudes; thus, the physical standards for pilots needed to be only the same as for general military service: no detectable disease and physically strong. Finally, on 8 October 1912, the Surgeon General of the Navy promulgated a circular letter setting forth the standards for naval aviators, standards which had no provision for testing to determine the psychological fitness of an individual for an aviation career. If there was no significant psychiatric history, the man was accepted for training. Over the next 25 years, some of the physical standards were revised by means of "circular letters," but there was still no testing for aeronautical adaptability.

Because of the time and expense involved in training aviators, reliable and easily performed tests for selecting the most promising candidates had long been a necessity. After an initial interest during the first World War, however, there was little research in this field until 1939, at which time the Committee on Selection and Training of Civilian Aircraft Pilots of the National Research Council received funds from the Civil Aeronautic Authority (now the Federal Aviation Administration) for use in planning and supervising research on the human aspects of aviation. In the summer of 1940, the Council expanded its field to include military aviation and in cooperation with the U.S. Navy began a study known as the "Pensacola Study of Naval Aviators," in later years called the "Thousand Aviator Study."

The 1940 study involved 12 investigators, the most prominent of whom were Doctors Ashton Graybiel and Ross A. McFarland. The study explored the value of psychological and physiological testing in the prediction of success in the flight training program. Criteria were measured in terms of passing or failing the flight course and the appearance before the Commandant's Board. The program was designed to provide for the administration of a wide variety of tests deemed promising for selecting candidates for flight training. The tests finally selected were known as the Flight Aptitude Rating and the Aviation Qualification Test, both of which are still used today, with some modifications, for the selection of candidates.

Although physical standards were developed, selection did not assure good pilots. It was realized as early as 1914 that there was a need for medical officers trained to interpret the standards and to watch over the pilots after they were selected. During the

first year of World War I, the British recognized the need for such training when it became apparent that 90% of the casualties were due to physical defects, recklessness, and carelessness, 60% being related to physical defects. Following the establishment of an independent air medical service, specializing in the care of the flier, statistics changed immediately, and in the next year the 90% was reduced to 20%, with a drop to 12% the following year. When the United States entered the war in 1917, there was a similar appalling death rate until flight surgeons were trained.

Apropos of selection, the Royal Flying Service in Great Britain decided that the best predictor of ability to fly airplanes was the ability to ride a horse.

A follow-on to the "Thousand Aviator" study mentioned before is what we call the "Special Studies." These are long-term studies of the men repatriated after being (1) prisoners of war in Vietnam from 1964 to 1973, (2) hostages in Iran in 1980 and 1981, and (3) prisoners of war in Iraq in 1991. Added to the above is a group of men matched with the Navy Vietnam repatriates, followed since 1976. It is hoped that these studies will continue as long as the "Thousand Aviator" study, the latter now in the 53rd year.

#### **AS AN ADDENDUM**

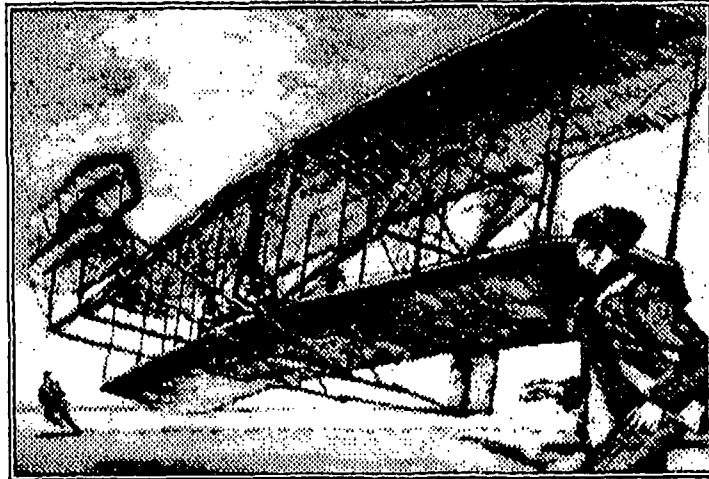
Having mentioned the physiological problems related to flying, I am going to digress very briefly to another development that played a major roll in aviation medicine research, biotelemetry.

In the mid-1940s, as we began to look at the possibility of space flight, there came a need for a physiological data transmission system that would collect data on a subject while in flight and make it available in "real time" to ground bases. One man who played a major part in developing such a system was Captain Norman Lee Barr, MC USN. Doctor Barr, who had been a physicist, then a naval aviator, and finally a flight surgeon, established a project called Research Aerospace Medicine, which utilized an R5D aircraft from which data were transmitted at varying altitudes and distances, demonstrating the practicality of the technique. Biotelemetry then became an essential tool for aviation medicine research, particularly as we moved into the space age.

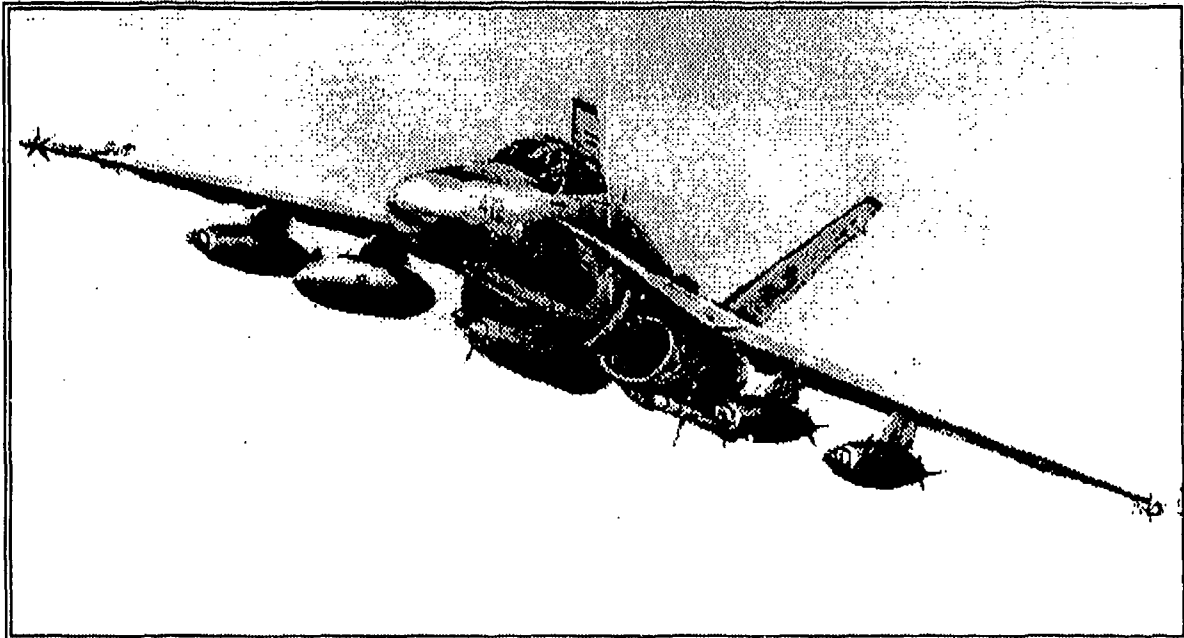
Reluctantly, I must call a halt to this presentation. It would take much more time than I have here this afternoon to discuss the whole gamut of aviation medicine research. I have, therefore, touched on only a few areas. There are so many things that could have been addressed: acoustics, ophthalmology, and equipment such as helmets, goggles, oxygen masks, armor, ejection seats, survival equipment, and the list goes on and on. It is interesting to see when perusing the literature how many things in some way involved Doctor Graybiel.

## IN CLOSING. . .

When I planned this afternoon's paper, I intended to limit it to the Navy's contributions to aviation medicine research. As I got deeper into the writing, however, I began to realize that such a limitation would be difficult inasmuch as there has been so much overlap of the work done by the various domestic and foreign laboratories. The fact that I have, therefore, highlighted contributions by the Navy is not meant in any way to diminish the work done by the investigators of the other military, civilian, or foreign laboratories.

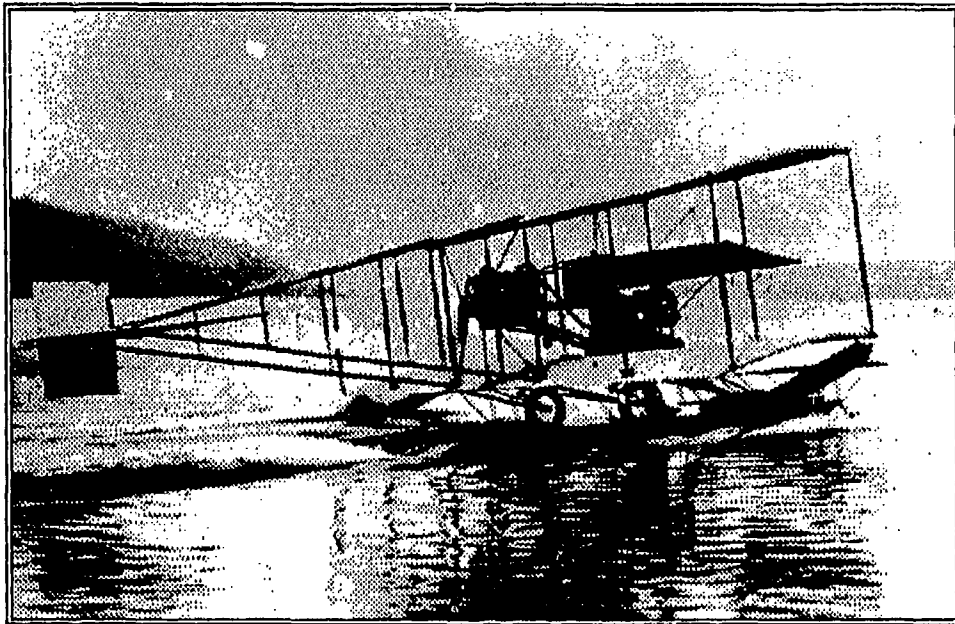


The Wright Brothers' Flight at Kitty Hawk

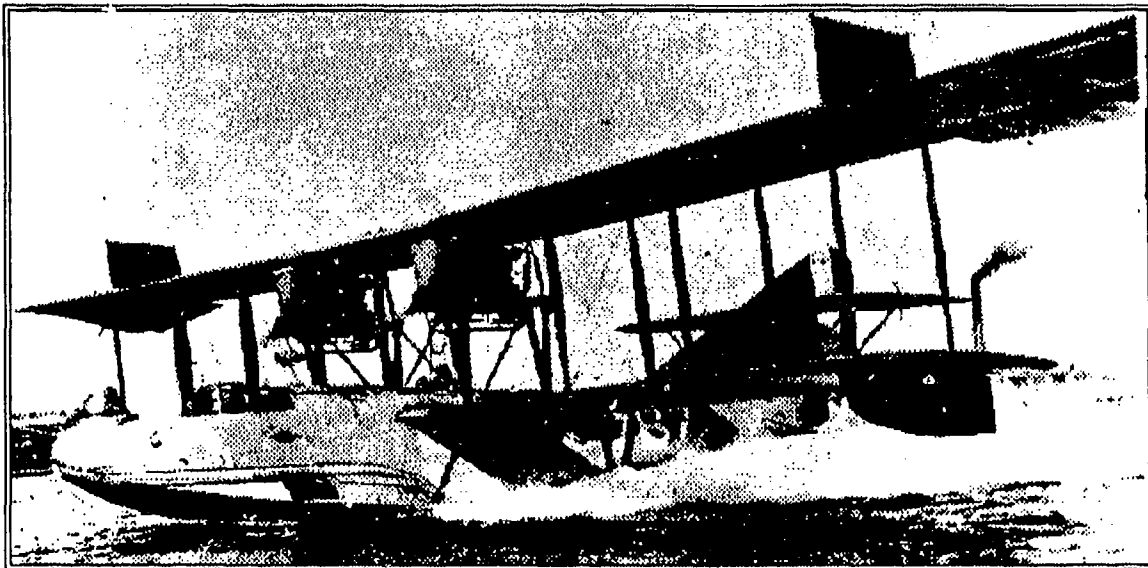


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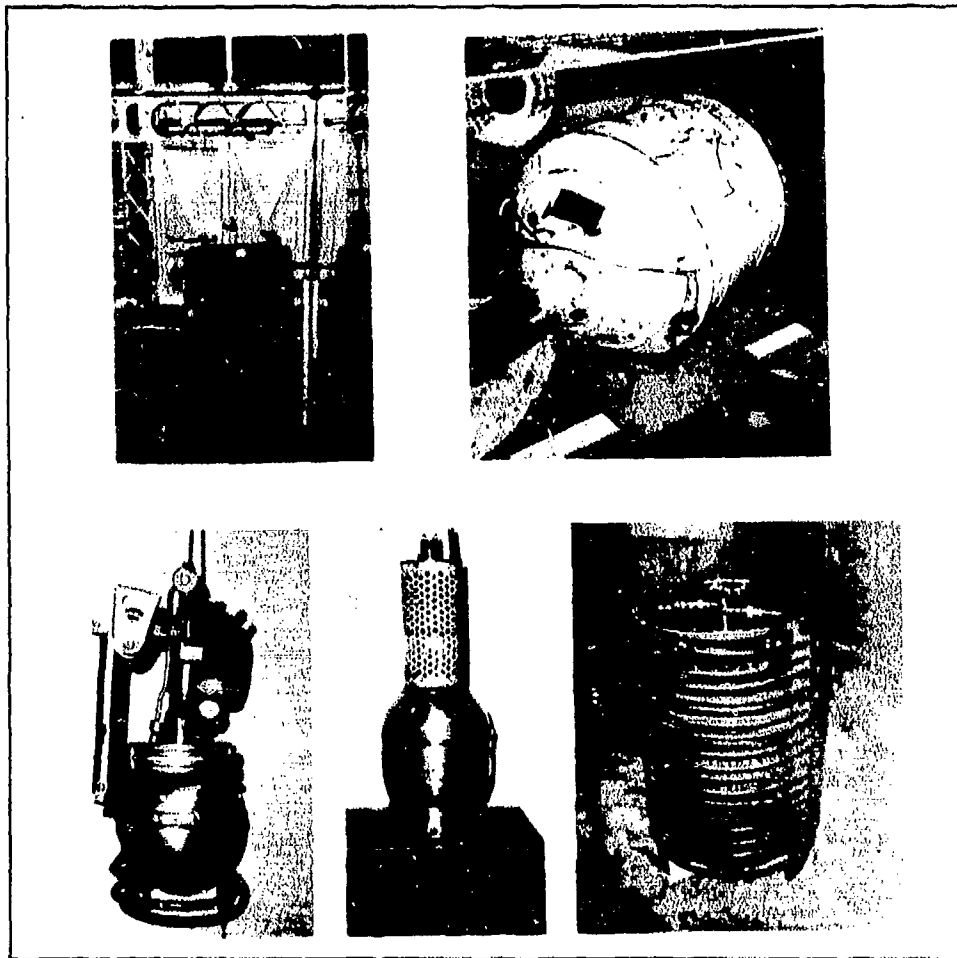
PHOTOGRAPHS AND EXHIBITS



World War I Aircraft

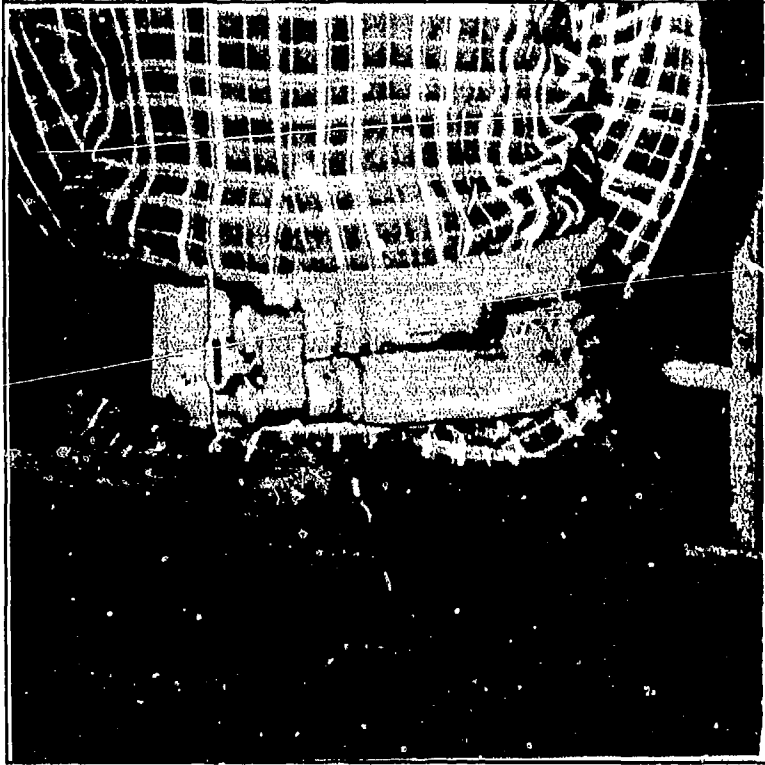


World War I Aircraft

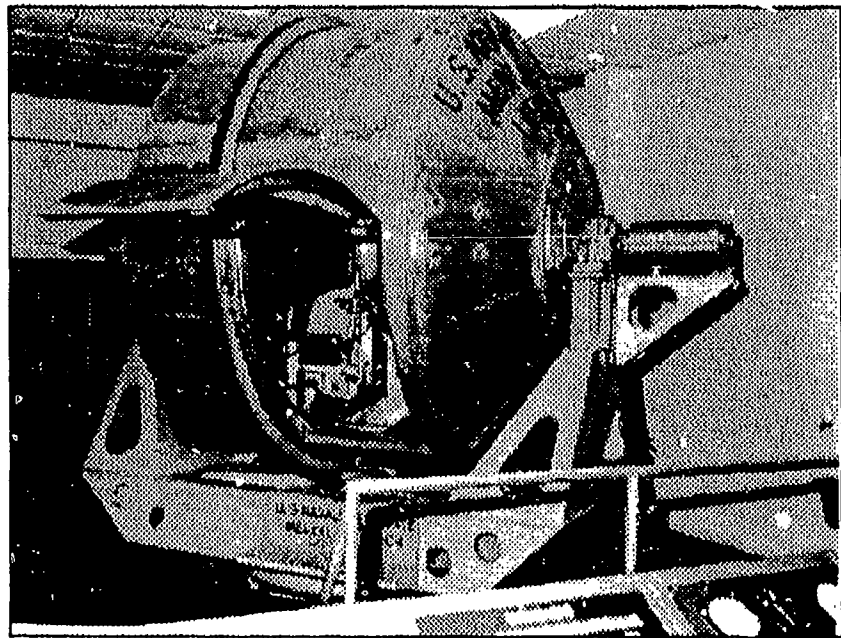


Early Liquid Oxygen Converters

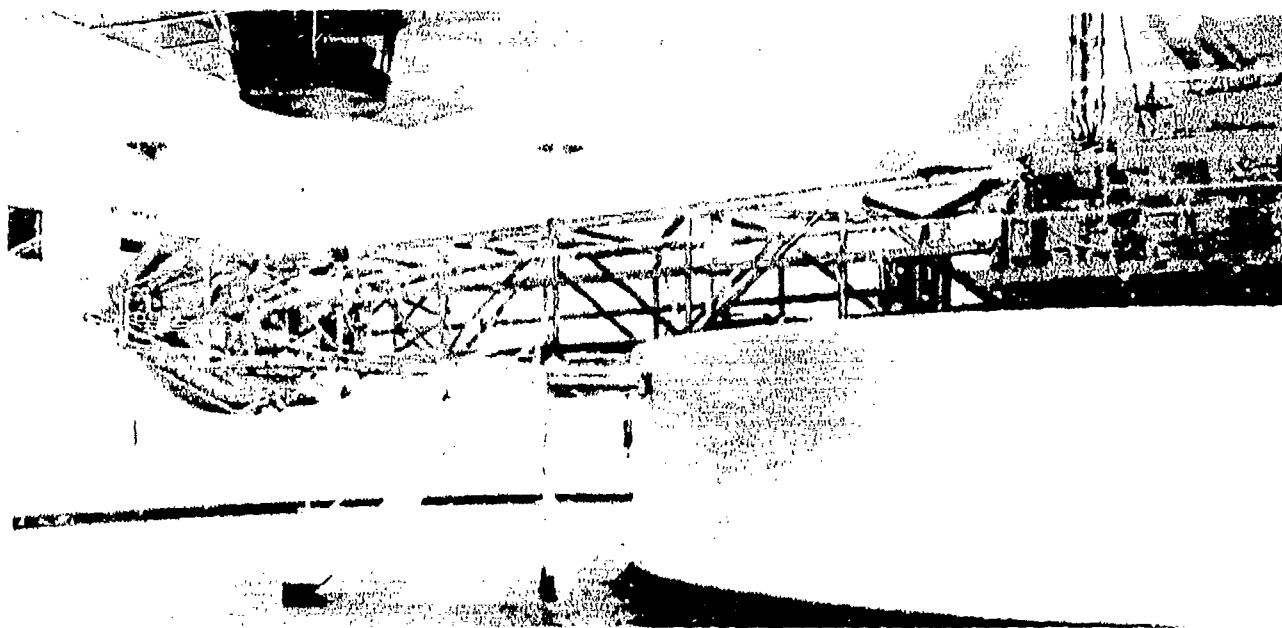




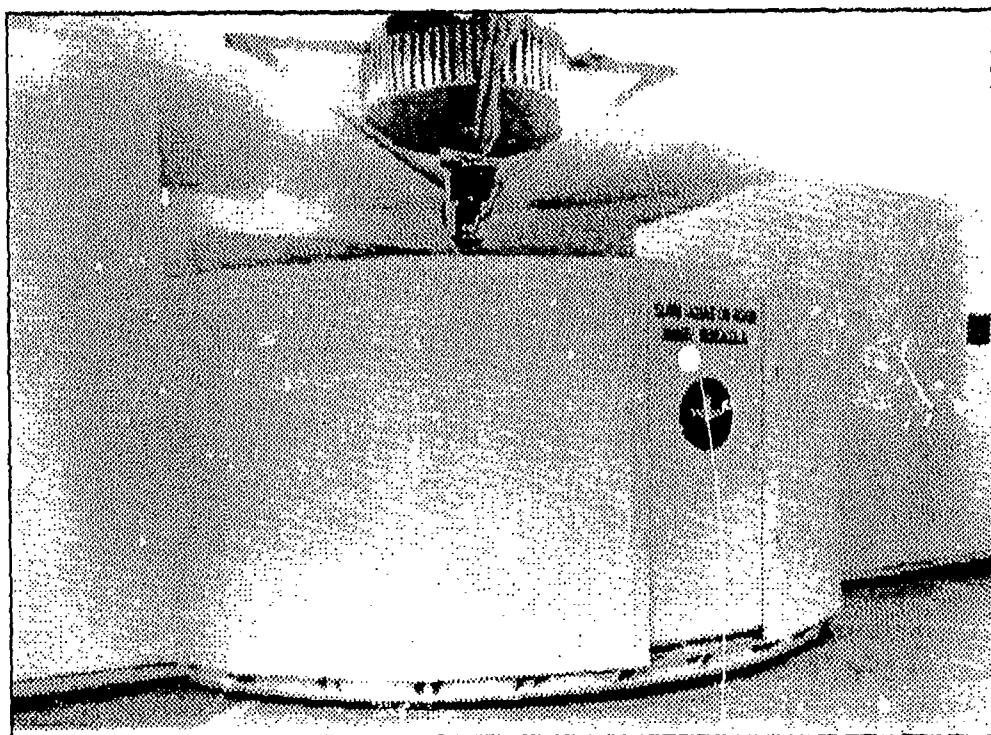
Poppen Belt



Disorientation Device, HDD at Pensacola



Centrifuge, Johnsville, PA



Slow Rotation Room at Pensacola



## CIRCULAR LETTER.

Washington, D.C., October 8, 1912

From: Surgeon General.  
To: All Medical Officers (via Official Channels).

SUBJECT: Aviation Duty: Physical Examination of Candidates.

By direction of the Department (No. 5901-73) the following instructions are issued to all medical officers with regard to the physical examination of candidates for aviation duty:

1. All candidates for aviation duty shall be subjected to a rigorous physical examination to determine their fitness for such duty. Physical qualifications shall conform to the standard set in "Instructions for Medical Officers of the United States Navy, 1909," chapters 11 and 12, with the additional requirements as follows:

2. The visual acuity without glasses should be normal. Any error of refractions requiring correction by glasses or any other cause diminishing acuity of vision below normal will be a cause for rejection. The candidate's ability to estimate distances will be determined. Color blindness for red, green, or violet is a cause for rejection. If the candidate wears glasses, so state, and give the necessity therefor.

3. The acuity of hearing should be carefully tested and the ears carefully examined with the aid of the speculum and mirror. Any diminution of the acuity of hearing below normal will be a cause for rejection. Any disease whatever of the middle ear, either acute or chronic, or any sclerosed condition of the ear drum resulting from a former acute condition, will be a cause for rejection. Any disease of the internal ear or of the auditory nerve will be a cause for rejection.

4. The following tests for equilibrium to detect otherwise obscure diseased conditions of the internal ear should be made:

- (a) Have the candidate stand with knees, heels, and toes touching.
- (b) Have the candidate walk forward, backward, and in a circle.
- (c) Have the candidate hop around the room.

5. All these tests should be made with the eyes open, and then closed; the third test on both feet, and then on one foot; hopping forward and backward, the candidate trying to hop or walk in a straight line. Any deviation to the right or left from the straight line or from the arc of the circle should be noted. Any persistent deviation, either to the right or left, is evidence of a diseased condition of the internal ear, and nystagmus is also frequently associated with such condition. These symptoms, therefore, should be regarded as cause for rejection.

6. The organs of respiration and the circulatory system should be carefully examined. Any diseased condition of the circulatory system, either of the heart or arterial system, is a cause for rejection. Any disease of the nervous system is a cause for rejection.

7. The precision of the movement of the limbs should be especially carefully tested as follows:

8. The elbows should be brought firmly to the sides of the body and the forearms extended to the front, palms of the hands uppermost; extend and flex each finger separately; bring the points of the thumbs to the base of the little fingers; close the hands, with the thumbs covering the fingers; extend and flex the hands on the wrists; rotate the hands so that the finger nails will first be up and then down; move the

hands from side to side. Extend the arms and forearms fully to the front and rotate them at the shoulders; flex the forearms on the arms sharply, striking the shoulders with the fists. Extend the arms at right angles with the body; place the thumbs on the points of the shoulders; raise and lower the arms, bringing them sharply to the side at each motion. Let the arms hang loosely by the sides; swing the right arm in a circle rapidly from the shoulder, first to the front and then to the rear; swing the left arm in the same manner. Extend the arms fully to the front, keeping the palms of the hands together and the thumbs up; carry the arms quickly back as far as possible, keeping the thumbs up, and at the same time raise the body on the toes. Extend the arms above the head, locking the thumbs, and bend over to touch the ground with the hands, keeping the knees straight.

9. Extend one leg, lifting the heel from the floor, and move all the toes freely; move the foot up and down, and from side to side, bending the ankle joint, the knee being kept rigid; bend the knee freely; kick forcibly backward and forward; throw the leg out to the side as far as possible, keeping the body squarely to the front; repeat all these movements with the other foot and leg; strike the breast first with one knee and then with the other; stand upon the toes of both feet; squat sharply several times; kneel upon both knees at the same time (if the man comes down on one knee after the other there is reason to suspect infirmity).

10. Take the position to "fire kneeling;" stand erect, present the back to the examiner, and then hold up to view the sole of each foot; leap directly up, striking the buttocks with both heels at the same time; hop the length of the room on the ball of first one foot and then the other; make a standing jump as far as possible and repeat it several times; run the length of the room in double time several times.

11. While the exercises hereinbefore prescribed may cause some breathlessness and accelerated throbbing of the blood vessels, they should not cause manifest exhaustion or great distress in a healthy man. Lack of ability to perform any of these exercises indicates some defect or deformity that should be further investigated.

12. Any candidate whose history may show that he is afflicted with chronic digestive disturbances, chronic constipation, or indigestion, or intestinal disorders tending to produce dizziness, headache, or to impair his vision, and any candidate whose condition shows that he is inclined to any except that may disturb his mental balance or to alcoholism, should be rejected.

13. Any marked departure from normal blood pressure will be considered a cause for rejection.

**C. F. STOKES.**

**PRINCIPAL INVESTIGATORS IN THE THOUSAND AVIATORS STUDY**

1940 Study	Drs. Ashton Graybiel, Ross A. McFarland, Hudson Hoagland, Hallowell Davis, Alexander Forbes, R. A. Phillips, Donald C. Gates, Robert Peckham, Stanley Bennett, Craig Wilson, LT Ralph Channell, LTJG Fred Webster
1951 Study	CAPT Ashton Graybiel, LT John M. Packard, LT John S. Graettinger
1957 Study	CAPT Ashton Graybiel, LT William R. Harlan, Jr., LT Robert K. Osborne, and Associated Investigator CDR Robert E. Mitchell
1963 Study	CAPT Ashton Graybiel, CAPT Robert E. Mitchell, LCDR Albert Oberman, and Associated Investigator Dr. William R. Harlan, Jr.
1969 Study	CAPT Robert E. Mitchell, LCDR Neil R. MacIntyre, Dr. Albert Oberman, Dr. Ashton Graybiel, and Associated Investigator Dr. William R. Harlan, Jr.
1972-1982	CAPT Robert E. Mitchell, CAPT Elihu York, Dr. Ashton Graybiel, Dr. Albert Oberman, and Associated Investigator Dr. William R. Harlan, Jr.
1982-1986	CAPT Robert E. Mitchell and Associated Investigators Dr. Albert Oberman, Dr. William R. Harlan, Jr.
1986-1989	CAPT Robert E. Mitchell, LT James T. White, and Associated Investigators Dr. Albert Oberman, Dr. William R. Harlan, Jr.

**NUMBER OF STUDENTS AND INSTRUCTORS TESTED AT PENSACOLA**

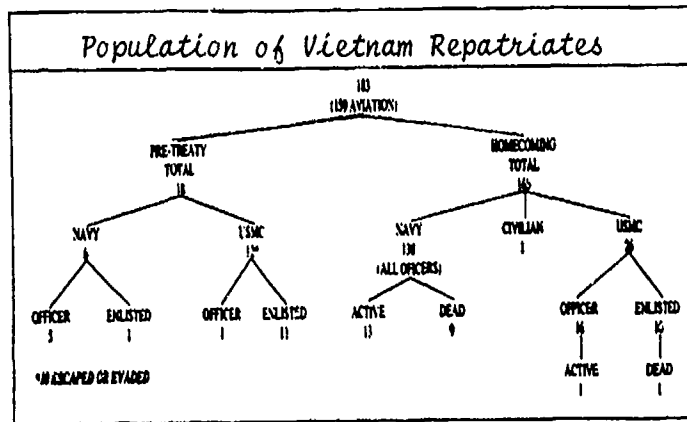
Part	Classes	Average Age	Dates Tested	Completed Program	Washouts	Board Appearance But Retained
I	147-151	24	Jul-Sep '40	390	55*	34
II	152-165	23	Oct-May '41	529	125†	96
Instructors		27	Jul-Sep '40	83		
Total						1312

\* Total number of washouts include 16 who left at their own request or for reasons other than aptitude.  
 † Total number of washouts include 23 who left at their own request or for reasons other than aptitude.

**MEDICAL EVALUATION TEST USED FOR THE THOUSAND AVIATOR PROGRAM <sup>a</sup>**

TESTS	EVALUATION PERIOD					
	1940	1951	1957	1963	1969	1972 +
Interview: Personal and Medical Histories <sup>b</sup>	✓	✓	✓	✓	✓	✓
Physical Examination	o	✓	✓	✓	✓	✓
Cardiovascular						
Routine Electrocardiogram	✓	✓	✓	✓	✓	✓
Startle Electrocardiogram	✓					
Computer-processed Electrocardiogram				✓	✓	✓
Exercise Electrocardiogram			✓	✓	✓	✓
Ballistocardiogram			d	✓	✓	✓
Vectrocardiogram				✓	✓	✓
Plethysmogram			✓			
Cold Pressor Test			d		✓	
Other	✓			✓		
Laboratory Determinations			✓	✓	✓	✓
Pulmonary and Metabolic						
Spirometry	✓			✓	✓	✓
Basal Metabolic Rate	✓					
Other	✓			✓		
Anthropometry						
Somatotype	✓			✓	✓	
Measurements (in addition to height and weight)			e	✓	✓	✓
Teleoroentgenogram		✓	✓	✓	✓	✓
Psychologic-Psychomotor						
Guilford-Zimmerman Temperament Survey				✓	✓	
Ataxia Test	✓			✓		
Tilt Chair	✓			✓		
Other	✓			✓		
Vision	✓			✓	✓	✓
Neurophysiologic						
Electroencephalogram	✓			✓		
Skin Resistance	✓					
Audiometry				✓	✓	✓

- <sup>a</sup> Completion of the tests is noted by an asterisk; if a procedure was not performed during an evaluation, the appropriate column is blank.
- <sup>b</sup> Personal and medical histories include alcohol, smoking, and exercise histories.
- <sup>c</sup> Only blood pressures were recorded because each member had qualified medically before inclusion in the study.
- <sup>d</sup> Examinations were performed on less than 25% of the study group.
- <sup>e</sup> Arm circumference only.



Population of Vietnam Repatriates

MEDICAL EVALUATION TEST USED FOR THE REPATRIATED PRISONERS OF WAR		
Tests	Evaluation Period	
	1974	1975-1980
<b>LABORATORY DETERMINATIONS</b>		
hematology	X	X
total eosinophile counts	X	
urinalysis	X	X
SMAC (18 or 24)	X	X
glucose tolerance test	1974-1979 then only as indicated	
stool studies	X	
ova and parasites		
occult blood		X
total lipids (electrophoresis)	X	1977
total proteins (electrophoresis)	X	
immunoglobulin	X	
Southeast Asia screen (malaria, etc)	X	
<b>X-RAYS</b>		
cardiac series	X	
PA, lateral chest	X	X
flat plate abdomen	X	
hands	(and 1975)	
<b>ELECTROCARDIOGRAMS</b>		
routine fasting	X	X
treadmill stress (Bruce protocol)	X	X
<b>VECTORCARDIOGRAM</b>	1974-1977	X
<b>BALLISTOCARDIOGRAM</b>	X	
<b>PULMONARY FUNCTION STUDIES</b>	X	X
<b>AUDIOGRAM</b>	X	X
<b>VESTIBULAR AND SPECIAL VISUAL STUDIES</b>	X	
<b>PSYCHOLOGY TESTING</b>		X

VARIABLES USED TO MATCH COMPARISON GROUP WITH REPATRIATES
HAD TO HAVE HAD COMBAT MISSIONS OVER NORTH VIETNAM WITHIN ONE YEAR OF CASUALTY OF THE MATCHED REPATRIATE
AGE AT TIME OF CASUALTY
RANK AT TIME OF CASUALTY
PAY ENTRY BASE DATE
PILOT VERSUS BOMBARDIER/NAVIGATOR OR RADAR INTERCEPT OFFICER
EDUCATION
MARITAL STATUS
NUMBER OF FLIGHT HOURS
TYPE OF AIRCRAFT FLOWN



# **SUMMARY OF AVIATION MEDICAL RESEARCH**

## **A HISTORY OF UNITED STATES NAVAL AVIATION MEDICAL RESEARCH DURING WORLD WAR II**

Compiled by  
Aviation Branch, Research Division  
Bureau of Medicine and Surgery  
Navy Department

1 June 1946

Reprinted by  
Biological Sciences Division  
Office of Naval Research

1 December 1975

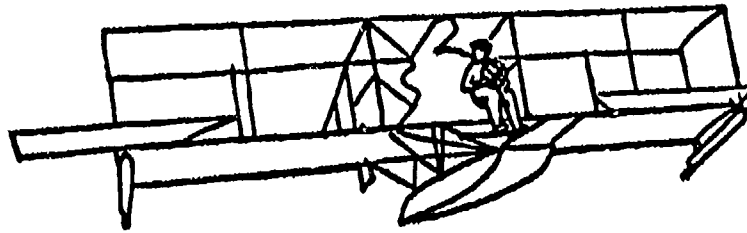
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## FROM YEARS GONE BY\*



The following requirements to attain a navy air pilot certificate are designated:

1. Attain an altitude of 2500 feet, as recorded by a maximum altimeter, or barometer, adjusted to local conditions before starting, there being no restrictions as to load carried.
2. Carry, to a height of at least 500 feet, a weight strapped to the passenger seat, equivalent to that which, combined with the weight of the aviator, will total 275 lbs. During this maneuver, the motor being cut off at 500-300 feet altitude, execute a volplane to the water on which a landing must be made within 150-300 feet of a designated mark or buoys without upsetting. Then, with the power shut off and the propeller at rest, the machine must be started again, made to rise from the water and, after a short flight, must be made to land on the water, from a low altitude, within fifty feet of the mark. The power being shut off only on landing.
3. Make a straight course flight in air, over water, by compass, at an altitude of at least 500 feet between two designated points, out and back, at least 5 miles apart, with the wind blowing across the course at least 10 miles per hour, as recorded by an anemometer at the starting point. The atmospheric conditions existing at the time of the test will be taken into consideration by the board in judging whether the courses made were sufficiently straight to pass the test.
4. Make a reconnaissance flight at the minimum height of 1000 feet for a distance of 20 miles, ten miles out, ten miles back, one half of which will be over land, but in sufficient proximity to water to enable a volplane to the water to be made at any time. During this flight, observations, bearings and estimated distances of objects of interest on shore must be made at least every five minutes, recorded and later located on a sketch chart which show a track of the courses made good and which should accompany a report of the flight to the board. Any of the tests may be repeated if necessary to satisfy the board. The board will make its report to the Navy Department, forwarding the report of the applicant, with recommendations as to the issue of a certificate.

\*Reproduced verbatim from an early training directive

NAVAL AVIATION MUSEUM FOUNDATION ORAL HISTORY  
ROBERT E. MITCHELL

RECORDED: October 4, 1990

NARRATOR: CAPT Robert E. Mitchell, MC, USN (Ret)

INTERVIEWER: LT Bruce D. Gamble, USNR (Ret)

LT Gamble: Could you tell us a little bit about where you were born, your childhood?

CAPT Mitchell: Well, I was born in the great Navy town of San Diego, on the 19th of May, 1918. I did not live there for more than about a year after I was born, because the family moved up into northern California, in the San Joaquin Valley. My dad was in the restaurant business in those days; he had almost a fetish of buying restaurants, fixing them up and then selling them, so we moved fairly frequently during my younger years. In fact, I think we lived in almost every town in the San Joaquin Valley at one time or another (laughing). That is, the bigger towns.

Most of my early schooling was in Merced, California. I went through much of grammar school and all of high school in Merced. I mentioned that we moved a good bit, but it was mostly during grammar school, because when I got into high school and the folks moved, I stayed right there; they continued to move around, but I lived in the Merced County Hospital, and completed my high school years there in Merced. I went from Merced High School to the University of California at Berkeley, and started there in 1937. I was at "Cal" when the Japanese attacked Pearl Harbor. I had gone to the gymnasium to help set up for spring registration and was working there when the announcement of the attack came over the radio. The following morning I went to San Francisco to sign up for the PT boats, but they wouldn't take me because I didn't have clearance from my draft board. The latter, in turn, wouldn't clear me because I was going into medicine, and they felt there was a greater need for doctors than for PT boat crewmen.

Gamble: Were you interested in medicine right from the start?

Mitchell: Yes, yes. In fact, I was interested in medicine from really early in childhood, and that's why, when the chance came to live out at the county hospital, I lived there. And in fact, I was doing things as a high school student that, if you did those things these days, you'd probably get racked up for malpractice.

G: So, you actually resided at a county hospital while you went to school?

M: Yes. I was assisting in surgery and working in the emergency room. In those days, in the 30s, they did not have a resident physician at the hospital. It was an arrangement whereby the doctors in town had a rotating watch list, and they would cover the hospitals in town for about a month at a time. Any time we had any emergencies or had any need for a physician, we would just call the duty physician and he would come out. So in many instances, when we had accidents admitted to the emergency room, I would work with the nurses while we waited for him to arrive.

G: So you learned a lot of on-the-job training before you had formal schooling?

M: That's right. Before I ever got into medical school. Then, when I went to the University of California, I continued working in a hospital, at the Cowell Hospital there, which was the university hospital. I worked there for the four years that I was an undergraduate. I had an interest in medicine from a long way back, so of course that was my ultimate goal.

At the same time, I also had--and I can't really explain why--a great interest in the Navy. I had the intention very early on of combining the Navy and medicine. If they had the course in those days where you could go to the Academy and then go into medicine, that's what I would have tried for. Of course, they didn't start that until recent years, where 2% of Academy classes can go into medicine through the University of Health Sciences. But in my younger days they didn't have that sort of thing, so I had to get into medicine and then get into the Navy after that.

G: Did you go directly from completion of your medical schooling into the Navy?

M: Yes. Let's see, I actually came in the Navy in 1945. I was at McGill University in Montreal and I went down to New York City, to the office of Naval Officer Procurement, and signed up. Then when I finished McGill in '47 I immediately came on active duty.

G: So you were being paid as an Ensign?

M: No, no. I was not part of the V-12 program, because it was not in place in foreign schools.

G: You went from Cal Berkeley directly to Montreal?

M: That's right.

G: And in 1947 you completed your degree in Montreal, and then you started your internship in San Diego (Naval Hospital).

M: Yes, that's right.

G: Could you tell me a little bit about that experience?

M: Well, that was an interesting experience, because being right after the war there weren't very many medical officers left. We were supposed to have 25 interns at San Diego, and there were nine of us, which meant there was a tremendous patient load. There was one period when I was the head of the Ear, Nose and Throat department, mind you, as an intern. Fortunately, I had some very good training in ENT from when I lived in a hospital

while I was in medical school. I'd gotten to know the Ear, Nose and Throat man there quite well, and he took me into quite a few things like tonsillectomies and a lot of ear, nose and throat work. So when I got to San Diego, it wasn't something for which I really wasn't trained. I'd had enough of a background. But I was the only ear, nose and throat man at San Diego for something like three months. Another time, they had no one in the Psychiatry Department, so during that rotation--which I think was also three months--I was the head of psychiatry. Now there, of course, I'd had no training, so all we did was put people in a locked ward and I would look after their needs. We had a psychiatrist who came in from town once a week to do the actual psychiatry.

There were so few medical officers there in those days, that it was a problem getting anybody to do the work! (laughing).

**G:** Were a lot of the patients there directly as a result of the combat of World War II?

**M:** No, by that time they had pretty well been weeded out. One group of patients that we had were what they called the VAB--the Veterans Administration Beneficiaries. San Diego did not have a VA hospital, and these people were taken in at the San Diego (naval) hospital. That was a big part of our patient load, really. But combat related (injuries), no. Oh, we had a few people who were undergoing plastic surgeries, for example, real long drawn-out surgery, and they were coming into there. But, for the most part, it was just pretty much what you'd have on a current day-to-day basis. 'Course, even the patient load wasn't always that heavy. Right after the war there had been a tremendous draw-down in the number of personnel who were still on active duty. Everybody had gotten out.

I was almost court-martialled during that tour because of a pay dispute. In 1948 the DOD (or whatever it was called in those days) decided on special pay for medical officers. The directive was worded in such a way that those of us who were interns felt we should have been entitled to the pay. We wrote letters to BUPERS, through the chain of command, seeking clarification, but never got any response. We then wrote to a Senator. Fortunately the letter was signed by all nine interns, so no one individual (me) was pinpointed as the instigator of the letter. A few weeks later we were all hauled before a very irate commanding officer who read us the riot act. Had it not been for the fact that we had copies of endorsed correspondence showing we had been ignored by the chain of command, the CO would have had us up on charges. As it turned out, he had to back down on his threats--but we never did receive the extra pay.

**G:** Once your internship at San Diego Naval Hospital was finished, was that when you were transferred overseas?

**M:** Well, no. I stayed on at San Diego for my first year of residency in Internal Medicine. I went from that to the overseas assignment at Kwajalein. That's where I really became interested in the aviation medicine end of things; because, although we had an Air Force medical officer who was assigned with us out there, he had very little interest in such things as medical evacuation or the aviation aspects of medicine. In the event a medical evacuation was required, then I was the one who took care of things. I was not a Flight Surgeon in those days, of course, but I

was performing Flight Surgeon duties and I became very much interested in aviation medicine.

I got part of the way to Kwajalein, incidentally, by riding in the old "Mars" flying boat from Alameda to Hawaii. That was my first time in a plane and it was a tremendous thrill.

**G:** How did you feel about duty at a remote base like Kwajalein?

**M:** Oh, I really loved it out there, I really did! When I got the orders out there, people asked me whose toes I had stepped on to get duty like that. But we got out there and really enjoyed it. In fact, for about three years after that, I put it down as my second choice on the Wish Card.

**G:** What sort of medical facility did they have there?

**M:** It was the crudest sort. During the Bikini bomb tests they had built "Kwaj" up to a rather high degree and had a big medical facility as part of that operation. But after the bomb test were over everything just deteriorated. By the time I got out there we had about only three Quonset huts out of the original 10 or 12 that were used as a hospital. To show you the state of deterioration, they decided to move the Admin Office out of one of the buildings because it was leaking rather badly. When they pulled all of the filing cabinets out of the building, why, the building collapsed! The filing cabinets were literally holding the Quonset Hut up.

**G:** Was there a large population on Kwaj at the time?

**M:** We had about three thousand to 3500 there. It was a joint Navy and Air Force operation. The Air Force was at the south end of the island and the Navy was at the north end. And we had a large native population--there was a native village right in the middle of the island. We took care of quite a few of them. In fact, there was a Gilbertese man who had been trained over at the medical school on Guam, and he worked with us and looked after the natives. Of course we did the surgery, anesthesia, and that sort of thing, but he really was responsible for them. Subsequently they moved all the natives to Ebye which is the next island north in the Kwaj chain.

**G:** Were you still single, or were you married at that time?

**M:** I was married, and my wife was out there with me. I married a Canadian gal while I was at Montreal, so she was with me through San Diego and Kwaj and subsequently ... in fact, we'll have our 44th wedding anniversary this next year.

**G:** That sounds like it was really interesting duty.

**M:** Oh, it really was, because in those days we were using the old PBMs for support of the other islands in the Marshalls. As far as actually practicing medicine on Kwaj, it really didn't take that much time--it had quite a healthy population. For example at the morning sick call one might see one individual and that would be the day's work! There was a lot of time to do other things, so I did a lot of moving around in the PBMs, doing sick call on other islands. I went down to Majuro and over to Likiep, even as far as Wake. We were able to get up and down the chain.

One of things we enjoyed doing was sailing. The Boston Missionary Society had a sixty-five foot schooner that they used for travelling about the islands. When they weren't using it, they left it with the people at the dispensary. We'd take it up and down the Kwajalein Atoll. I spent a fair amount of time sailing.

During the later part of that tour business picked up for us when we became a transit point for casualties being evacuated from Korea. We had planeloads going through daily, heading for the States. It was during this period that a C-54 heading for Japan with a group of Navy nurses crashed in the ocean while taking off. We picked up a number of bodies in the crash boat and had to get them to Hawaii.

**G: What came next after Kwajalein?**

**M:** We went from Kwaj back to Oakland and another two years of residency in Internal Medicine. That was a busy tour since they still didn't have the number of medical officers that they really needed. That kept us pretty doggone busy. I did some things there that were rather interesting. We were doing some of the first heart catheterizations that were done on the west coast. I became involved in that, so in a sense I really did some of the first heart catheterizations that were done in the Navy, working with a doctor who had worked with the people at Johns Hopkins.

I was at the old Oak Knoll Hospital, which was made up of a number of supposedly temporary buildings, scattered all over the hillside. On the hill above Oakland was the old San Leandro hospital, which was subsequently demolished. During the Korean War they had planned to activate San Leandro and had completely refurbished it, ready to take in casualties. But before they opened it, something happened as far as the war was concerned, and they never did open the hospital. It sat up there for several years just rotting away, then was finally demolished.

A highlight of the Oakland tour was knowing Admiral Chester Nimitz. I had charge of the SOQ (Sick Officer's Quarters) and the Admiral would frequently come to see his old buddies there. When he came he would stop at the office, and invariably there were sea stories. One of the stories he told me was of getting his ship underway at Tsingtao, and inadvertently leaving the "flag" on the beach--which created total consternation when it was discovered.

I went from Oakland to Walter Reed Army Medical Center in Washington. I took a course there and at the same time was working with Colonel Thomas Mattingly, who was later Eisenhower's physician. I worked with him in cardiology for a time.

Then I went directly to Naples, where we had the only "infirmary" in the U.S. Navy. Why they called it that, I don't know, but that was the term used for the hospital over there. That was quite a tour, and we thoroughly enjoyed it. It was close enough after the end of the war, that things were still extremely inexpensive. You could get the best hotels over there for fifteen dollars a night for example. Things you'd pay two hundred dollars for now, so we really took advantage of it. The Naples tour was delightful.

During that tour I was assigned as medical officer to travel with AFSOUTH (Air Force Southern Europe), Lt. Gen. Laurence Craigie. Any time he went anywhere I went with him, and so did a fair amount of traveling to Turkey, Greece, Germany, France, England, etc.

One of the more gruesome episodes of the tour occurred when a TBM with 6-8 men aboard crashed into an apartment building while taking off from Capodichino airport, our aviation base there in Naples. In addition to the Navy men, some Italian civilians in the apartment building were killed. It was a mess!

It was in Naples that I met Dr. Ashton Graybiel, who later made arrangements for me to come to Pensacola. He had gone to Naples for a meeting and could not get a hotel room. He had gone to our hospital and was given a bed on one of the wards, where I found him while making rounds on Easter Sunday morning. I invited him to stay with us at our apartment, and we became very close friends.

Then from Naples I came here (to Pensacola). Dr. Graybiel was Director of Research for what was the old School of Aviation Medicine in those days. He invited me to come and work with him, because I was very interested in the "Thousand Aviator" study. So he got me orders here, and that's when I became a flight surgeon. I came here, went through the flight training program, and became a flight surgeon.

**G: What was the course of instruction to become a flight surgeon then?**

**M:** It was just as it is today; it's a six month course. Well, actually it's a little longer today, but during the last six weeks they put you through the basic flight training program. In those days though, we couldn't solo; nowadays they solo the flight surgeons, but we didn't solo. They didn't think the old "J-bird" was a safe enough plane for us! (laughing).

**G: Do you mean SNJs?**

**M:** That's right. The old SNJs, yes. I started flight training down on Chevalier Field, and we were about halfway through the course when they opened up Sherman here, and we moved out to here.

**G: You were actually in the first group of any type to train here at Sherman Field, then.**

**M:** Yes, that's right.

**G: Once you started flying, did you get a big kick out of it? You probably wished you could keep flying like I know a lot of the Flight Surgeons do.**

**M:** Oh, yes.

**G: Okay, so from here in Pensacola, that's when you started into the Thousand Aviator Study?**

**M:** Yes, here in Pensacola, I started with the Study; that's about thirty-five years ago, now. I have continued to work with them right on through to the present time. It was from that tour that I went to the Shangri-La.

**G: What can you fill in about that tour?**

**M:** It was another delightful tour! I could do that tour over again at the drop of a hat. I picked up the ship in Yokosuka, with no turnover from the fellow that I was relieving. In fact, they had a Japanese Admiral on board the ship that morning, and they wouldn't let me come on until his tour was completed; thus I stood there by the brow for, I guess, about an hour. Finally, when I was allowed to come aboard, I started up the brow just as the guy I was relieving came down the brow with his bags in hand. He said, "Have a good tour!" And that was the turnover! I literally had to learn the system from scratch.

It was a very exciting ship. There was always something going on. We became involved with things off of Taiwan, for example, down in the South China Sea. Let's see, we had three WestPac cruises out there. Each one was quite an experience!

**G: That was still at the beginning of the Jet Age. Did you have a chance to do any flying?**

**M:** Yes, but not in the jets. We had the AD-5Ms on board, and that was how I got my flight time. At some point in the day the ship's company would get their flight time, and I would go along in the rear seat. We ran into the interesting situation one day, when we were off of Taiwan, in that they couldn't get the ADs gear down. We circled around for a couple of hours while consulting with the people in the ship's tower, trying to figure out how to get those doggone wheels down. They had just about decided that we would have to bingo over to Taipei and make a wheels-up landing. Right then the wheels came down and we got back aboard.

**G: Was this the first duty in which you worked with aviators directly, on a daily basis, and do you have any particular recollections?**

**M:** Yes, it was. Our CAG in those days was Zeke Cormier. He was boss of the Blue Angels out here at one time. Quite a colorful character, lives out in San Diego now. The most exciting things that happened were like having to take the A-3D into the barricade, 'cause the guy had lost his nerve and couldn't land the damn thing. He made five passes, and by that time was below bingo fuel. He was going to have to come aboard regardless, so they rigged the barricade and took him into that.

**G: I flew in A-3s, and came close to that situation once myself. I did not realize that they'd successfully barricaded an A-3; we'd always heard that it hadn't been done, but now you're disproving that one.**

**M:** I can guarantee that it's been done.

There were a couple of firsts on the ship. I had only been aboard for a very short period of time when I realized there was a certain hazard on the flight deck: there were no safety nets around the bridle arresters up forward. I went to the CO and made the recommendation to put safety nets around those things. That was subsequently a ShipAlt which I think is now used on all the carriers.

The other thing that we did, (it's interesting that) two of us came up with the same idea at the same time. Dick Luehrs was with the Atlantic Fleet at the time and of course I was with the Pacific Fleet. We both came up with the idea that there really was no reason to have a Flight Surgeon on the flight deck through all the Air Ops. It really was a waste of manpower, so we came up with the idea of putting an alarm from PriFly down to the Sick Bay. Before we made the recommendation on it (and again, we both had the same idea at the same time), we timed how long it took the Flight Surgeon to get from the sick bay to the flight deck. We found that he could be up there in about 30 to 45 seconds. Once that alarm went off, he had a route where he could be up there quickly. God, the debris hadn't even stopped settling by that time, so a Flight surgeon even on the flight deck would not have been able to get close to the plane. Once we had established this, I went to the CO of the ship, and made a recommendation that we put an alarm running from PriFly down into the sick bay. He bought it, and AirPac bought it, and that, too, is something that is standard practice nowadays on the carriers.

There are a couple of other things from the "Shang" that are probably worth mentioning. Being a big-deck carrier, of course she couldn't go through the Panama Canal. She went into the yard at Bremerton--we were up there for six months--and when she came out of the yard we took her around the Horn; to Bayonne first, then subsequently to Mayport. During the transit we had put in at Callao, Peru, and the CO was relieved "For Cause"--they brought in a new CO who took over down there. I might add that the "cause" was unjustified; they made some allegations against the old Commanding Officer that were not really true, because I was with him the night that this supposedly happened, and it didn't happen. But no one would pay any attention to me, so... he was relieved.

We had left Callao and were down off of Valdivia, Chile, where we had an explosion down in the special weapons spaces. An air flask blew up down there, killed one man outright and injured four others. So we ended up having to put into Valdivia, into the river, where they took the injured off and flew them from there to Gorges hospital in Panama. Then we went on around the Horn, hitting one of the few days when the weather was just absolutely perfect. It was just like glass, which I guess is really unusual, so we had a real fine transit of the Straits of Magellan.

Then we went up to Rio, got in there Easter weekend, and had a very nice in-port period except that we lost a man there. As the ship came up the coast of South America, we kept hearing thumping on the bottom of the hull; we couldn't figure out what this was. After we got into Rio harbor, they sent a diver down to see if he could find out what it was, but the man never came up. To this day they don't know what happened to him down there. Nor do they know what was on the underside of that hull.

**G: Did the noise stop?**

**M:** The noise stopped. And the man was never recovered. As I said, to this day we still don't know what happened to him. Drowned... and that was it.

The other interesting thing about that trip was that the ship was carrying sixteen million dollars--as I recall it--in gold, that they were moving from the San Francisco Reserve Bank to the New

York Reserve Bank. They carried that gold around the Horn and off-loaded it at Bayonne, New Jersey.

G: I suppose that's the best-defended kind of ship to put that much gold in!

M: Yep! I subsequently left the ship at Gitmo, and came back here (to Pensacola) for my second tour, continuing with the Thousand Aviators. During that tour I was given a building down at the lower end of the compound to develop for our Internal Medicine Department--cardiology and such--so during most of that tour I worked in that building. In '63 we started construction of the present Aerospace Medical Institute, where it is now, and opened it up in '65. It was at that point that I went to Vietnam with the Air Wing.

G: So, now we're at 1965 and you're on your way overseas.

M: '65 and the 1st Marine Air Wing. I went to the Wing just at the time that they were moving in-country. We had very crude facilities out there at that time, because we were in strong-back tents and really not set up to do top-notch work. During that year we built up our medical team. The Wing had the responsibility for the Headquarters at DaNang and the Tango sector there. We also had the responsibility for Chu Lai, Ky Ha, Nha Trang and up to Hue in the northern part of I Corps. I had medical facilities scattered all over the place, including Marble Mountain on the coast, where we had a helo base.

One of the really exciting experiences of the Vietnam tour occurred one night when I had gone to Marble Mountain to check out my people there. After I had finished with them in the late afternoon, I went across the road to the site where the new Naval Hospital was being built, to see an old friend who was the commanding officer there. Shortly after dark a squad of VC went through the hospital area, attacking the airfield. My friend and I dived into a bunker, which is how I injured my neck, later requiring surgery. Fortunately the VC were so intent on the airfield they didn't stop at the hospital. One of my chiefs was killed by a satchel charge, which was thrown into the helo he was sitting in as "ready crew."

I did a fair amount of flying, having my medical facilities scattered over such a wide area. From Nha Trang to Hue was about 150 miles, so to cover this much territory I did a fair amount of flying, most of which was in H-34s, and occasionally in the Hueys. I did some MedEvac work with the Hueys, getting into fire zones on a few occasions when we went in to pick up casualties that were the result of a firefight. Most of it though, you could call administrative flying. I'd take off from DaNang and go over to Chu Lai, and look over their facilities, just to see how things were going. Also did some flying in C-130s, because we were using those for transport from DaNang to Futima; also up to Japan.

There's a story about the '130s, in that in August of '65 we had one crash over in Hong Kong. They had one that stalled out and killed 69 men in the bay there. I had to go over there and supervise the removal of all the bodies from the plane; it took us about 10 days to get them all out.

G: Sounds like a gruesome experience.

M: Yeah, it was. We had six survivors from the crash--all of the flight deck crew survived, and one man who was down in the after-compartment. The latter man died in the Queen Elizabeth hospital about the second or third day after the crash. So really only five individuals survived: all of the flight deck crew. The pilots subsequently lost their wings. The investigation proved negligence on their part.

G: Did you witness or experience any of the negative political feelings from that time, which are so well publicized today?

M: No, the single greatest problem that we had in my outfit, politically, was the fact that the military was not allowed to run the war. As you know, we were very restricted in the areas that we could bomb, or that we could even fly over, for that matter. I think one of the most frustrating things in the world was that the commanding generals--General McCutcheon being the Commanding Officer of the Air Wing--would get the word that they could not, for example, bomb a certain area up in North Vietnam. During Operation "Rolling Thunder" there were only certain targets that they could go after. They couldn't go after airfields up there, which is where the MiGs were parked. If they could've gone in and strafed those, and destroyed airplanes, I'm sure the war would've been a lot shorter than it was. I'd go to the briefings and listen to General McCutcheon literally cussing up and down because of the restrictions on the Wing as to what they could do.

G: Belonging to a MAW, did you experience the paradox of being a medical officer in the middle of a war, where there was an awful lot of injury and death?

M: No, not really. In fact the night that I left DaNang, I got boo'ed roundly because I stood up in the Mess--they had sort of a farewell ceremony--and said that I really regretted that I had to go, because this is what I'd been trained for. They almost boo'ed me right out of the place (laughing) because I was saying I wanted to stay, and most everyone couldn't wait to leave. I felt that I was really being fulfilled, getting in a combat situation, that I was finally doing what I was being paid for.

There was more than just the military out there, of course. We had what was called the MEDCAP Program, in which we were looking after the civilians in the villages around DaNang. Many of these people were Viet Cong; you had to watch behind you all the time, because you never knew who was coming up behind you. It was quite an experience. In fact, based on what I saw in the MEDCAP, there was a tremendous incidence of tuberculosis. We lined up a village one day to do X-rays on them, and the first eight individuals who came through the line had active tuberculosis. I mention this because later on when we were involved in Operation Egress recap with our prisoners of war, we expected to see a tremendous amount of TB in that group. So much so that we recommended that they mask both the air crews going in, and the men coming out to avoid any danger of transmission. Once they got on the ground at Hanoi it was discovered that there was no tuberculosis in our people. I have not seen a single case of TB in any of our Navy and Marine POWs. I don't think it was luck, necessarily, I think it was because these men were so isolated from the native population that they were never exposed to it.

G: What followed your overseas tour?



M: I went directly from DaNang to Rota, Spain. I stopped off here in Pensacola to take care of some household goods that were in a warehouse, but other than that we went directly over. We were given transportation aboard the Constitution, which was one of the American Export Lines' cruise ships, from New York to Gibraltar. It made for a really delightful experience. We got to Rota during a time of transition, in that the base was being expanded. In fact we expanded the medical facilities.

G: Any particular experiences from that tour that you'd like to recap?

M: It was a great tour. The medical facilities, again, were not the fanciest in the world but were certainly functional. They have since put up a 16 million dollar facility, which was opened just this last year. But it worked out very nicely for us. We had responsibility for seventeen commands in southeastern Spain, and it was quite a responsible job. In 1968 we were commissioned as a Naval Hospital, and I took over as the Commanding Officer of the hospital at that time. Up to that point I was the Senior Medical Officer for the base.

I came back here from Rota, and took up the "Thousand Aviator" study again. Then in '72 we started planning for what was called "Egress Recap"--subsequently it became "Operation Homecoming." A group of us went out to San Diego and put together the program for follow-up of the repatriated prisoners. We had Navy, Air Force and Army putting this thing together. In those days they had what they called the Center for Prisoner of War Studies at Point Loma, as part of the Health Research Center. When the men were actually repatriated in '73 we started the follow up of them.

One of the biggest disappointments that I had after the planning was that I wasn't part of the team that went to bring those people back out of Hanoi. That's the one thing I have regretted more than anything else through the years, because I would like to have been there literally from the first minute. They sent the Residents in Aerospace Medicine there to bring them back. I would have loved to have been there.

G: What was the general plan for the POW study?

M: We based the Repatriate study on the "Thousand Aviator" study, having had 34 years experience at that time with the "Thousand Aviators" in a longitudinal study. We used many of the same tests and techniques, although some of the tests that were used were not available in the early days of the "Thousand Aviator" group. But basically it was just a follow-through.

G: What were some of those basic tests and techniques?

M: I need to give a little historical background on the "Thousand Aviators." Through the '30s, there was a fairly high attrition rate in the student population that was going through the flight training program. It was much higher than was acceptable, and it was felt that some kind of screening was needed to weed out the individuals who were not good candidates for flight training. A series of tests of a psychological nature were developed which they felt might serve the purpose of weeding these people out. It was those tests which the "Thousand Aviators" were to validate. In July of 1940 they began to give these tests to entire classes going

through the flight training program. From July through about early October they gave these tests to all the classes going through; then they realized they didn't have enough individuals. So, in the spring they picked up again taking parts of classes, such that the total number tested came to 1,056. Of the total group, 92 were designated Naval Aviators that they wanted to use as a control group. In addition to the psychological testing they did some physiological testing: some electrocardiograms, some lung testing, some balance tests--a whole battery of the tests that they did in those days.

The intent was that this would be a one-time affair--they would test these people one time and that would be it. In 1952, Dr. Graybiel, who was Director of Research at the time, decided that it would be nice to follow these people, and see what had happened to them through the years. They were able to contact most of the individuals and get them back. Subsequently, at five year intervals we brought them back up through '69. We're still seeing them, incidentally; we see between a hundred and 150 a year. They come here at their own expense and we run them through.

With the passage of time we started using more sophisticated tests. We were somewhat limited in what we could do back in the forties. For example, we didn't do the exercise testing or some of the fancy blood work that we can do today. Through the years, we gradually worked in some of these newer techniques, which are the things that we use today.

G: What are some of the findings to this point?

M: Based on the data obtained from the Thousand Aviator study, we have completely revised the physical standards for Naval Aviation. Back in the '40s at the inception of the program, there were certain electrocardiographic standards, some of which were considered to be disqualifying for aviation. With the passage of the years we have discovered that some of those things are really not a problem. Any individual who was found to have an electrocardiographic abnormality, for example, in 1940 was allowed to continue, because there was an understanding that anything that was picked up (abnormality) in this experimental program would not be considered disqualifying. So the individuals were allowed to continue. Over the years we found that a lot of these electrocardiographic findings were totally insignificant, such that today if you see those "abnormalities" the individual is taken into the flight training program.

Some of the other areas of significance which have been altered as a result of the "Thousand Aviator" program include visual standards, hearing standards, blood pressure and, as I have said, electrocardiographic standards. In many instances we found that the standards, as they existed in 1940, were really too stringent, and have been relaxed over time. People are being taken in nowadays, who--under normal circumstances--would not have been accepted in the earlier years.

Let me cite one specific example. Back in the early days, we used to feel that what we called "lability" of blood pressure should be disqualifying. The reason for that was, if a person had labile blood pressure, he would go on to become hypertensive in later years. By "lability" what I mean is, a person's blood pressure is normal one minute, and abnormal the next, or on one

examination a person's pressure would be normal, and on another it would be elevated beyond acceptable limits. In the fifty years, we have discovered that the individuals who had labile pressure in their early years are not necessarily hypertensive; in fact most of them have gone on to have perfectly normal blood pressures.

With electrocardiograms, we found that what was "abnormal" in the 1940s was not detrimental to the individual (and would be acceptable today). conversely, there are a few things that we'd consider "abnormal" today (which were considered acceptable then) and probably would not accept an individual.

We have pretty much altered the standards for naval aviation based on what was picked up from the "Thousand Aviators." This has more than paid for what it has cost to run the program, by not training people that would later become disqualified for medical reasons.

**G: Were there any long term findings on aviators as related to their flight duties; for example, long periods at high altitude, or on oxygen?**

M: One of the things which has interested us through the years--and one of the areas which we have looked at quite closely--is whether there is any relation between flying and what has happened to these individuals over the long term--and we really haven't found anything that has been detrimental as far as flying is concerned. In other words, there is no particular disability in the older individuals that we can say is related to flying; whether hypoxia, gravity, altitude, or whatever.

**G: There seem to be enough flyers that are into extreme longevity that suggests that the ones that were vigorous enough to undergo the training to begin with, were probably going to last a long time anyway!**

M: One of the interesting things that we have seen is that the individuals who have maintained their fitness through the years are the ones who have done the best. If you were to compare a comparable civilian population, I think you would see a difference, because the aviators knew they had to maintain a certain amount of physical fitness.

**G: When you did the repatriated POW studies in the early '70s, you used a lot of the same testing procedures?**

M: Yes. The repatriated study, at its inception, sort of took up with the "Thousand Aviator" group, except that by '73, we were using some of the more sophisticated testing techniques: things like treadmill testing, vectorcardiograms, and lung testing, that sort of thing.

**G: Have there been some notable effects from their incarceration on them?**

M: That, of course, has been our major concern with the repatriated group, and is one reason why we set up a comparison group to go with them. We have a matched comparison group that we see along with the repatriated group. Our reason for this was to try to determine what, if any, effects might have been caused by the captivity situation. In other words, was there anything detrimental? As it turns out, we are seeing more in the

way of pathology--or abnormalities, if you will--in the comparison group than we're seeing in the POW group.

**G: That's incredible. Was the comparison group made up of military people?**

M: Yes, it's a matched group. What we did was took ten variables and used computers to match up these people as closely as we could. Most of the individuals in the repatriated group have a matched companion. I don't know who the comparisons are; we deliberately kept that a secret so that we wouldn't be biased. Now there are some of them, we have a pretty good idea who's matched up: after all, we have seven "flags" (rank) in the group, and you can pretty much figure who the match is in the comparison group. But for the most part we don't know.

**G: I've heard that there are some interesting differences psychologically between people who were captives for a long period versus the ones who were only in for a few months prior to being released.**

M: The individuals who were the late shoot-downs did not do as well as those who were long-term prisoners. Ev Alvarez was the first aviation POW to be taken in the course of the war. If you compare him with some of the very late shoot-downs, it's quite interesting to see what an adjustment Ev has made. He's really a solid citizen, there's no doubt about it. The fellows who went down late really didn't adapt to the captivity situation. The early ones, as time went by, began to accept it, and it didn't bother them quite so much. By the time they got out they were like, "Well, I'm okay; so what's new?" Whereas the people who went down in '70/'71, or the first part of '72, never really adapted, didn't get to the point where they were saying, "Well, so what's new." It was still bothering them, first of all, that they were shot down. Secondly, they were having a hard time adjusting to prison life, even though by '71 and '72 it was a considerably different situation than it was in the earlier years. By that time they were getting more food, and they weren't being tortured or hassled like the early ones were.

**G: So in many ways the early shoot-downs actually had a more difficult time, but they had a longer period of captivity to adjust.**

M: I've got a large library of the books these fellows have written, and I think if you read through them you catch their trend of adapting.

**G: Both of these studies are still on-going, right?**

M: Yes. Personally, I'd like to see the Repatriated Study keep going as long as the Thousand Aviator study, which is in its 50th year. We're in the 17th year of the repatriated group.

I'm no longer doing the physical examinations, of course, since I "supposedly" retired in June (1990). I turned it over to George Atwell, who is doing the physical exams at the present time. The intent is to continue the program for as long as possible.

**G: Have you stayed in Pensacola since you began the repatriated study?**

M: Yes, I've been here 21 years on this tour. I've been here on this tour longer than most people are in the Navy! The repatriates are supposedly my main "reason for being", along with the comparison group. The "Thousand Aviators" is just sort of piggybacking on that program now.

We pay all of the expenses for the repatriates and the comparison group to come here. We don't have money for travel or per diem for the Thousand Aviators, but once they do get here, we have money to cover their lab costs and any tests that we do. Those people come at their own expense, and some come from fairly great distances, such as Seattle. We have a couple that come from Hawaii, and one that comes from Paris, just to get this annual examination.

We also see 16 Navy and Marines who were hostages in Iran. The participation there has been pretty spotty, in that of the 16, only about half a dozen come in regularly

Another big part of what I have done in addition to these authorized studies, is that I see a lot of flag officers who have heard about our programs, and want to come and get physical exams. I had two Commandants of the Marine Corps; a number of the flags from Washington come down. And in addition to the Navy and Marine people, we also see 16 Air Force repatriates. The Army disestablished its Repatriate program in '80--it lasted only about 5 years. The Army medical officer who was looking after them decided that they were interfering with his practice of medicine, so he recommended to his Surgeon General that their program be disestablished, and it was. The Air Force supposedly has a program, but when you talk to their people you find out that it doesn't really amount to much. That's why we have the Air Force people: they asked if they could come over here.

G: Was it because of your experience with the repatriated group that you got involved with the Iran hostages?

M: Yes. In fact, originally, after the hostages came back, the plan was that we would even see the State Department people down here. But they decided that they wanted to do their own program. As it happens, they never did anything; there's been no follow-up of their people.

G: Were you involved with the hostages right after they were brought back?

M: Very shortly after they were repatriated, yes.

G: How did they compare to the Vietnam repatriates?

M: The Iran hostage group was not mistreated, really. The worst thing that happened to them, for the most part, was just being hostages. If you read a book by Sickman, who was one of the Marine security guards, you'll see that they really did not endure the problems that the repatriates from Vietnam had. For example, they were kept in an apartment building, where they had hot water to shave with and bathe. Food was brought in and they cooked their own meals. They had recreation facilities and books; some of the Iranian students would come by and "shoot the bull" with them. There were a few who had bad experiences, like having a gun held to the head and the hammer snapped. But for the

most part, they really didn't suffer; there's no comparison between the Iran hostages and the Vietnam repatriates.

One thing that became very obvious a short time after we began seeing them was that some of those Marine security guards were pretty unstable. Makes me wonder why they were sent to be security guards, to be very honest with you. I think some of them were psychiatrically maladjusted before they ever became hostages. I think it was simply in their character. One of the interesting things is that the Iran hostages were--for the most part--enlisted. There were only two or three officers in that group. With the Vietnam group, the majority were officer personnel, and I honestly feel that the level of education had a lot to do with the way that these people survived.

In 1975 I became the Commanding Officer of the Naval Aerospace Medical Research Laboratory, a job I held until I retired (the first time) in 1980. During that time I continued the follow-up of the repatriated prisoner of war group in addition to the administrative work of the laboratory, the group having been moved from the Aerospace Medical Institute. Being CO of the laboratory meant involvement in many national and international organizations, requiring much travel. Sandwiching the repatriate examinations in between the rest of the work took some rather elaborate planning.

G: We're pretty close to the end of your service history, but there is one highlight which happened right here recently. How did it feel to become an honorary Naval Aviator?

M: There were actually four things that happened in recent years that were really the highlights. The first was being made an honorary member of the NAMPOW group; the repatriated group. I think I'm only the fifth honorary member.

In 1986 they surprised me at the Navy symposium banquet when they presented me with a great big bronze plaque. It's out in the Museum now. Then the next thing was to be made an honorary member of the Golden Eagles. That's the early pioneer naval aviator's association, and I'm the only medical officer in that group. And the last thing, of course, was being given the wings as Honorary Naval Aviator number 21, which was a tremendous surprise.

G: CAPT (Earle) Rogers told me how you reacted on the podium when they made that presentation. He said you took a couple of involuntary steps backward! That was a total surprise to you, then?

M: Absolutely! That and the presentation of that plaque during the symposium. They asked me to come up to the front, and unveiled that plaque there. So the two things have been total surprises. The interesting thing is that at least 150 people kept that plaque a secret for about nine months. The same thing with the Wings; I didn't have the foggiest notion of what they were up to.

G: As we come to a close, is there any little philosophy that you've gained over the years, or any sort of closing statement that you'd like to share?

M: It has been a tremendous career. If I had to do it over again, I'd do exactly what I've done. I've had combat duty, sea duty, aviation duty, command of two activities: who could ask for anything more? As I've said more than once, I've never had a bad commanding officer, and I've never had a bad duty station, and I think that says a lot. It's just been a tremendous opportunity to work with a wonderful group of people.

G: It's grand to see you still wear a uniform and come in to an office. That's got to be a great feeling.

M: Well, that's a story in itself. I don't know for a fact, but I think the people in NAVPERS forgot that I was on active duty. When the time came to leave, they didn't send any orders down to separate me. So when I went through the retirement ceremony with considerable embarrassment, since I'd discovered that I was not really inactive. We're just waiting now to see what's going to happen on a medical board.

G: Well, I guess this is a good place to wrap it up, unless there are any gaps you'd like to fill.

M: There are still lots of stories I could tell, but I don't think they need to necessarily go into this piece (laughing)!

G: Okay! It's been a real pleasure! Thank you very much.

## ROBERT E. MITCHELL

### AWARDS AND PROFESSIONAL ORGANIZATIONS

#### AWARDS

Legion of Merit, Bronze Star with Combat V, Meritorious Service and Air Medals; Combat Action, Navy Unit Citation, Navy Expeditionary, and area Ribbons

Theodore C. Lyster Award of the Aerospace Medical Association 1980 ("For Outstanding Achievements in the General Field of Aerospace Medicine")

Honorary Member, NAM-POW, INC., 1982

Honorary Member, Early and Pioneer Naval Aviators Association, 1989

Honorary Naval Aviator #21, 1991

#### PROFESSIONAL ORGANIZATIONS

Fellow: Aerospace Medical Association. Elected 1966

Member: International Academy of Aviation and Space Medicine. Elected 1970

Member: International Academy of Astronautics. Elected 1978

Fellow: Royal Society of Medicine. Elected 1985

NATO/AGARD Aerospace Medical Panel (Member, Committee on Special Clinical problems, 1974-1977)

Aerospace Medical Association (Member, Arrangements Committee and exhibitor, 1964 meeting); (Member, Scientific Committee 1972-1978 meetings); Session Chairman 1974-1978 meetings); (Member, Historical Committee 1977-1980); (Member, Science and Technology Committee 1979, 1980); (Member, Corporate and Sustaining Membership Committee 1977-1979).

#### PROFESSIONAL ORGANIZATIONS (Continued)

American Medical Association, 1947-1976

American Association for the Advancement of Science

American Heart Association (Member, Council on Epidemiology)

American Heart Association, Florida Affiliate (Past member, Board of Directors; Professional Activities Committee; Stroke Council; Audit Subcommittee)

American Heart Association, West Florida Chapter (Member, Board of Trustees; President 1975-1976, 1977-1978)

Naval Aviation Museum Foundation (Life Member; Chairman, Medical Exhibit Committee)

Society of U.S. Navy Flight Surgeons

United States Naval Institute (Life Member)

Association of Naval Aviation (Charter Member; Past Member, National Board of Trustees; Member Executive Board, Pensacola Squadron)

## ROBERT E. MITCHELL

### PUBLICATIONS AND PRESENTATIONS

#### PERSONAL PUBLICATIONS

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- Mitchell, R.E.: Attrition in the Naval Aviation Basic Training Program Due to Physical Disqualification. Special Report No. 57-2. Pensacola, Florida: Naval School of Aviation Medicine, 1957.
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White, J.T., Mitchell, R.E., Morin, L.M.E., Pettyjohn, F.S., McDonough, J.L., Ambrose, M.R.: Efficacy of Routine Chest X-rays for Aviation Personnel - Data From U.S. Navy Applicants and Repatriated Prisoner of War Study. Abstracts of 1989 Annual Scientific Meeting of Aerospace Medical Association, 1989.

Mitchell, R.E.: The Thousand Aviators - A Half Century. *Foundation*: 11(2): 76-83, 1990.

Mitchell, R.E.: The Vietnam Prisoners of War - a Follow-up. *Foundation*: 12(2): 28-36, 1991.

**PAPERS PRESENTED** (numerous presentations, including as below:)

First Mexican Congress of Naval Medicine, Mexico City 1963: Circulatory Effects and Cardiopulmonary Adaptation During Flights to Great Heights.

International Academy of Aviation and Space Medicine XIII Congress, Dublin, Ireland 1964: The Thousand Aviators - A 23 Year Follow-up

Federal Aviation Agency Symposium, Little Rock, Arkansas 1964: two papers: The Thousand Aviators; The Aviator and Cardiovascular Disease

NATO/AGARD Medical Panel, Pensacola, Florida 1973: The Thousand Aviators: Aging and Blood Pressure

Triservice Repatriated Prisoner of War Committee, San Diego, California 1975: Status of the Second Year of Follow-up of the Repatriate Program

Triservice Aeromedical Research Panel, Warminster, Pennsylvania, 1976: Status of Research at the Pensacola Complex

Also, frequent talks to naval aviation and lay groups relative to physical fitness and cardiovascular disease.



## INVITATION

The Naval Aerospace Medical Research Laboratory

Cordially invites you to the Fourth in a Series of  
Ashton Graybiel Lectures

**Aviation Medicine Research: A Historical Review**

given by

**Robert E. Mitchell**

Captain, Medical Corps, United States Navy (Retired)

4:30 p.m., Wednesday, 18 November 1992

Mustin Beach Officer's Club  
Goshawk Room  
Naval Air Station, Pensacola, Florida

Cash Bar, 5:30

Public Cordially Invited

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