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THOUSAND AVIATOR STUDY METHODOLOGY

Albert Oberman, Robert E. Mitchell, and Ashton Graybiel

JOINT REPORT

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THOUSAND AVIATOR STUDY: METHODOLOGY*

Albert Oberman, Robert E. Mitchell, and Ashton Graybiel

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U. S. NAVAL SCHOOL OF AVIATION MEDICINE
U. S. NAVAL AVIATION MEDICAL CENTER
PENSACOLA, FLORIDA

FOREWORD

The Pensacola Study of Naval Aviators, commonly termed the "Thousand Aviator Study," began in July, 1940 as a survey to validate techniques for preselecting pilot trainees in order to reduce the large attrition rate in the flight training program at that time. More than one thousand preselected men were given a large battery of psychological and physiological tests and measures for the purpose of improving the criteria then in use for selection of candidates for flight training. Captain Ashton Graybiel, one of the original investigators, foresaw the potential yield of continuous physiologic information on a group of healthy males from youth to senescence, and initiated re-examinations of these former aviators in 1951, 1957, and 1963. Each successive evaluation increased in scope as new physiologic measures became available, and in significance as the subjects grew older.

From this original exploratory study of pilot selection evolved a longitudinal study with cardiovascular emphasis unique in several respects: 1) The mean age of its participants at inception of the program was 23.6 years, and all except thirteen were between 20 and 30 years of age. 2) The entire group was remarkably homogeneous. All were white males in the military serving as flight instructors or students. All were of similar health, size, education, and social background. 3) All candidates were physically fit, without visual or motor defects, of "normal" intelligence, and very competitive in spirit. It was perhaps these latter qualities which made them a highly motivated experimental group.

The inherent problems of such a project were myriad. Administrative endorsement, available physical facilities, and even general perspectives differed at each succeeding evaluation period, with resultant modifications of the testing program. The interest and enthusiasm of the examiners have varied over the years, as have that of the subjects who are now spread over the four corners of the world. Yet the desirability and benefits to be gleaned from such a study are evidenced by the development of similar longitudinal studies during the past decade.

The Thousand Aviator Study now in its 25th year has fulfilled its obligations in part, namely, evaluating certain physiologic functions from youth to middle age; but only through a vigilant look at the group thus far,can future determinants of disease and health be established. This involves a scrupulous organization of collected data from the evaluations and thorough analyses of trends and relationships. Then perhaps factors can be related to present and future criterial events such as coronary heart disease with the hope of ultimate isolation and prevention of the perpetrators.

Concurrent with this experimental approach there has been a growing concern about the diversity of criteria and methods used in cardiovascular epidemiology. An appeal has been made for standards so that data might be pooled, criteria sharpened, techniques interchanged, and central references established.

In view of all the above considerations this report purports to accomplish the following:

1) Present and unify the procedures and methods of all the examinations carried out on the group.

2) Offer standard material for cooperative studies.

3) Serve as a guide for future evaluations.

4) Display the methodology employed in a fashion which lends itself to perusal by critical reviewers.

5) Suggest by retrospection necessary modifications.

6) Provide a basis for scrutinizing the material in search of new avenues of investigation.

The material contained in this Monograph falls into the natural division of the four different examinations carried out to date. Chapter I includes data regarding procedures used in the original study in 1940-1941; Chapter II, those of 1951-1953; Chapter III, those of 1957-1959; Chapter IV, 1963-1965. Corresponding to each of these four chapters is an Appendix which contains the various forms or questionnaires relative to their particular time period; e.g., Appendix A relates to Chapter I, or 1940-1941, et cetera.

The sparseness of Chapters II and III does not truly reflect their importance but rather the limitations imposed on those examinations carried out in the "field." Sufficient support was not available during those follow-up studies for a more comprehensive examination. Such was made possible for the 1963 study, however, by the combined financial assistance of the Bureau of Medicine and Surgery, Navy Department, and the United States Public Health Service.

No findings of any of the evaluations are presented; for these the reader is referred to the Thousand Aviator Study Bibliography (Chapter V).

ACKNOWLEDGMENTS

Many persons of good will have contributed immeasurably over the 25 years to the Pensacola Study of Naval Aviators. It is not the intent of the authors to slight any of these persons, but the names of many of them have been lost to history. Included here are only those who lent technical assistance in the early studies, but because of the recency of the third follow-up, names of participants in every phase were more readily available.

The original research group is pictured and identified in Chapter I. Not shown are Dr. Hallowell Davis and Dr. Hudson Hoagland. In the first follow-up study (Chapter II) the hospital corpsman who traveled about the country with the principal investigators, Doctors Packard and Graettinger, and who also independently took electrocardiograms and x-rays was John L. Buthod. The task of seeking out, identifying, and corresponding with the subjects was successfully carried out by several individuals at the Naval School of Aviation Medicine.

Charles W. Padgett and William J. Moates served as corpsmen for Doctors Harlan and Osborne, respectively, in the second follow-up (Chapter III), and secretarial duties were performed by members of the School staff.

Investigators in the third follow-up study (Chapter IV) were fortunate in having available the guidance of a former principal investigator, Doctor William R. Harlan, Jr., Director of Clinical Research Center, Medical College of Virginia. Information relative to previous evaluations was also provided by Mrs. Catherine Kasparek who participated in many aspects of the other follow-up studies and who also has given valuable editorial assistance.

We are also indebted to Doctor Samuel M. Fox, III, Chief of the Heart Disease Control Program, U. S. Public Health Service, for his support and assistance in sponsoring the program; to Doctor James E. Banta, Director, Medical Program Division, U. S. Peace Corps, for encouragement and over-all guidance; to Doctor Albert Damon, Harvard University, for advice in many areas, especially with the anthropometric studies; to Doctors Stuart W. Rosner, Caesar A. Caceres, Gerald R. Cooper, Mr. Alan Palmer, and Mr. Sidney Abraham, Heart Disease Control Program, U. S. Public Health Service; to Doctor Reid H. Leonard for the bulk of the laboratory work; and to the following individuals at the U. S. Naval School of Aviation Medicine:

Captain Newton W. Allebach, Lieutenant David Jackson, and Lieutenant Richard E. Doll who assisted in specific projects; Doctors Harlow W. Ades, Vernon C. Bragg, Alfred R. Fregly, and Earl F. Miller, II, Lieutenant Raphael F. Smith, and Mr. James K. Colehour, who played an active role in the evaluation; Doctor Robert J. Wherry, Jr., Ensign Norman E. Lane, Mr. Richard Irons, Miss Mary Ann Overman, Miss Edna Marques, and members of the biometrics and statistical staffs who provided invaluable assistance; Mrs. Margaret Duty without whose knowledge and assistance the task of reorganizing and analyzing the data would have been almost insurmountable; Mrs. Wilma Bredt who furnished the illustrations used in this monograph; Hospital Corpsmen Bergdorf, Coyle, Courtemanche, Dent, DeSalvo, Gubanich, Kars, Kent, Morrow, Olsen, Peery, Redmond, Roberts, Sampia, Valverde, Van Cleave, and Young who served as laboratory assistants; Mrs. Peggy Stearns who typed and assembled this Monograph; and, above all, Miss Mary Duvall who bore the brunt of the immense volume of administrative and secretarial detail assisted by Miss Emogene Resmondo who also acted as a laboratory assistant.

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Chapter I. 1940 Study*

Principal Investigators: Doctors Ross A. McFarland, Ashton Graybiel, Hudson Hoagland, Hallowell Davis, Alexander Forbes, R. A.Phillips, Donald C. Gates, Robert Peckham, Stanley Bennett,and Craig Wilson, Lieutenant Ralph Channell, and Lieutenant(jg) Fred Webster

INTRODUCTION

Because of the time and expense involved in training aviators, reliable and easily performed measures for selecting the most promising candidates had long been sought. After initial interest during the first World War, little research was carried on 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 Aeronautics Authority (now Federal Aviation Agency) 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 which became known as "The Pensacola Study of Naval Aviators," or "The Thousand Aviator Study."

The original group of investigators and laboratory assistants are shown in the photograph of Figure I.1. Personnel were specially recruited for this purpose from several universities in addition to assigned Naval reserve officers, hospital corpsmen, and civilian laboratory assistants. A building at the Pensacola Naval Air Station was designated for use as a laboratory, and the necessary equipment was purchased or rented for the duration of the 1940 study. Testing of the subjects began during the third week of July, 1940 and was continued until May, 1941.

OBJECTIVES

The value of psychological and physiological testing in the prediction of success in the flight training program was explored. Criteria were measured in terms of passing or failing the flight course, and of appearance before the Commandant's Board. The study was designed to provide for the application of a wide variety of measures with a view of quickly arriving at those deemed promising for selection of candidates for flight training.

SUBJECTS

The experimental battery of tests was administered to all of the incoming cadets and officers in each flight class at Pensacola during the period from July 16 through September 20, 1940 (classes 147 through 151). Twelve cadets and officers were studied each day during their ground school period and before their flight training. The data collected during this period have been designated in an early report (1) as Part I.

Because of the small number of washouts in this group it was decided to extend the study. From October 1 to December 15, 1940, a representative sampling comprising about one fifth of each incoming class (classes 152 through 159) were tested. During this period only five subjects could be studied each day because of the reduction in the size of the research staff. From January 1 to May 15, 1941, only those cadets from classes 160 through 165 who appeared before the Commandant's Advisory Board took the tests. The data obtained after September 1940 were included in the early report (1) and designated as Part II.

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*In order not to inject any of the authors' interpretations on the material in this Chapter, the information regarding the original study has been taken almost verbatim from McFarland and Franzen, Final Summary Report (1).

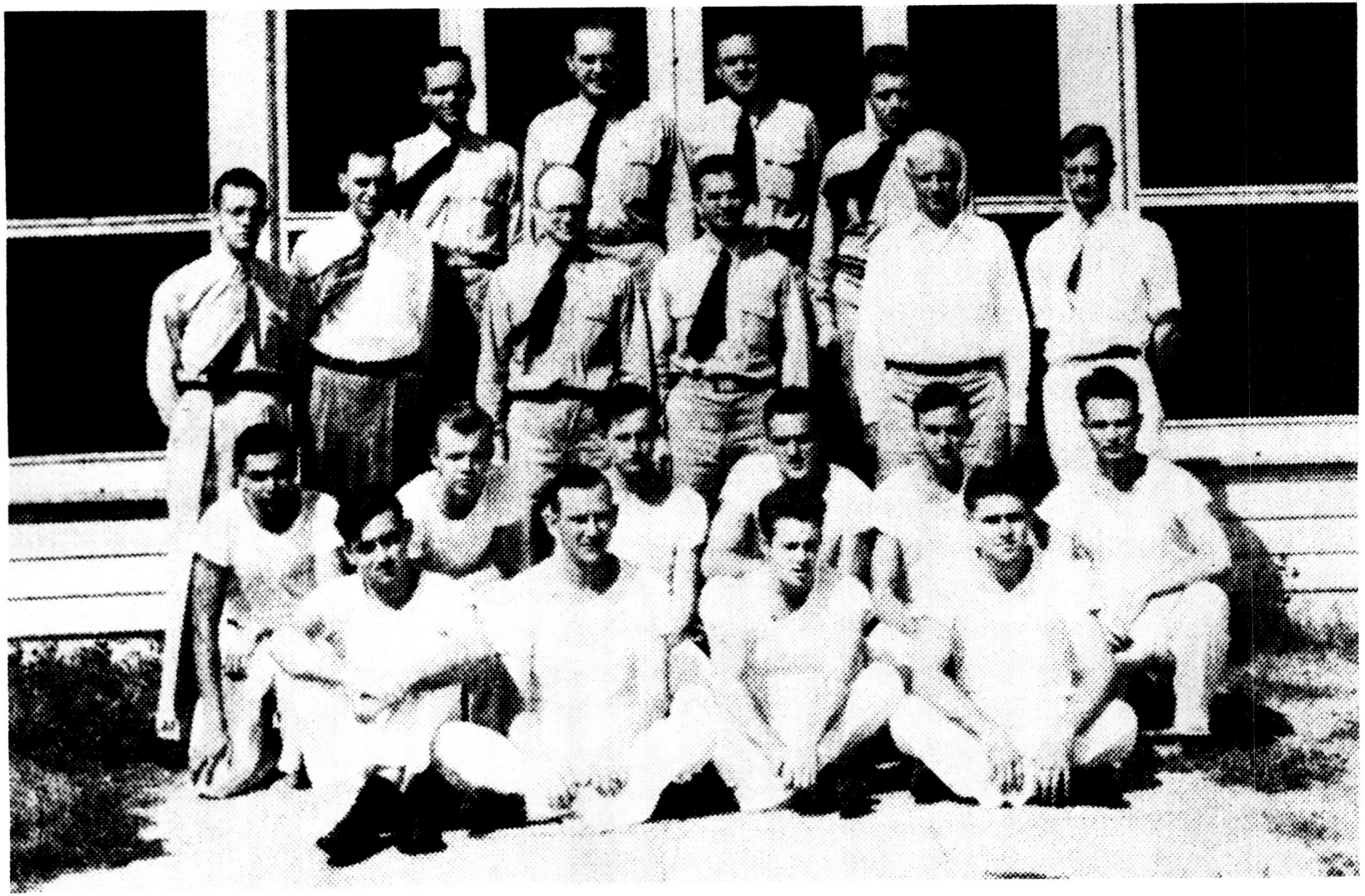


Figure 1.1.
Research Staff, 1940
Back row: Drs. Bennett, McFarland, Gates and Channell. Third row: Drs. Wilson, Peckham, Graybiel, Phillips, Forbes and Webster. Second row: Corpsmen: Babst, Kirkland, Riles, Baumgarten, Parrish and Schwartz. Front row: Corpsmen: Aller, Snowden, Van Meter and Backus. Not shown were Doctors Hoagland and Davis.

The examinees who ranged in age from 20 to 30 years were not comparable in all respects. The subjects in Part I, for instance, included 58 officers from the U. S. Naval Academy who had recently been commissioned as Ensigns. The cadets in Part I were college graduates, however, and since both cadets and officers had had the same amount of flight training before their entrance at Pensacola, they were treated as one group. Part II subjects included a considerable number of men, assigned to Pensacola from the Fleet, with only high school diplomas, but many others in Part II had two years of college. Because the subjects in Part II had less academic training than those in Part I, it was felt that the differences in education might be an important variable in that these men had had less experience in taking tests and examinations of this nature. The whole group was preselected inasmuch as each man had passed several rigorous medical examinations as well as a ten-hour flight training course, including solo flight, before being sent to Pensacola. The experimental population did not include those individuals who were "washed out" during the initial part of the training program.

A group of 83 instructors at the Naval Air Station were also given the tests so as to obtain normative data for pilots known to be successful. Their average age was 27 years, and they had had an average of 1,500 hours of flying. Table 1.1 shows the total number of students and instructors who took the test at Pensacola. Some of the total number examined were dropped from the final experimental group because of insufficient data on them. Others needed reexamination and could not be recalled, and some were found physically disqualified. Each subject in the final experimental group did not necessarily undergo all phases of the examination. In these instances, therefore, slight variations occurred in the number of subjects tested.

Table 1. 1.

Number of Students and Instructors Tested at Pensacola

Part	Classes	Average Age	Dates Tested	Completed Program	Wash-outs	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.

TESTS AND PROCEDURES

The testing program was organized so that each cadet was assigned to the Research Laboratory for one full day as an official part of his indoctrination into the Naval Air Station. This assignment occurred during the first week of his tour before any flight training. Only a few trainees had had more than ten hours of flight time before their entrance at Pensacola. From the official and routine nature of the program, the cadets were led to believe that their results on the tests would become an official part of their records. The motivation was high and the cooperation excellent throughout the study.

Each class of cadets of approximately 50 took the Otis Mental Test, the Minnesota Paper Form Board Test, and the Athletic Achievement Test as a group in a classroom at the cadet barracks.

Subjects came to the laboratory in groups of four at 6:00 a.m., 7:30 a.m., and 8:00 a.m. Each subject received a typed statement several days before taking the tests, which gave a brief account of the purpose of the tests and the time and place to report. These typed statements gave specific instructions indicating the amount of rest and the avoidance of alcohol and tobacco on the previous night, with no food or exercise on the morning of the tests, in order to provide optimal conditions for the basal metabolism test.

Partitions were constructed in the building assigned to the laboratory to permit the various tests to be given in separate rooms, thus avoiding distractions. Four sets of metabolism and electrocardiographic apparatus were available so that four subjects could be studied simultaneously.

After the cadets had reclined on the beds for thirty minutes, they were given the basal metabolism and breathing tests--two eight-minute records. Then vital capacity determinations were made. After a short rest, they were connected with the electrodes on the electrocardiograph, and records were obtained with four different leads. While still attached to the breathing apparatus and electrocardiograph, a very loud pistol shot was fired in the room, at a time unknown to the cadets, to obtain records of response to startle. They were then given the Schneider Index and Tilt Table Tests. Then each cadet was served a light standard test meal in the laboratory. Following this meal they were scheduled through the special rooms in the routine fashion for the various psychomotor tests, brain waves, somatotyping, aniseikonia, night vision test, and the response to the carotid sinus sensitivity, cold pressor, and skin resistance experiments. During rest periods they filled in the questionnaire relating to medical history, education, and aviation interests. The interviews were given by a physician in the afternoon. If the records of metabolism, brain waves, or electrocardiography were not satisfactory, they were recalled for retests as soon as convenient.

It was not possible to control the temperature in the laboratory rooms, even though electric fans were used to circulate the air. The mean temperature during the summer months, when the data of Part I were collected, remained fairly constant. In the fall and early winter (data for Part II) the temperature was cooler. The differences in climate during the two parts of the study were not extreme, but this variation might have given rise to certain differences in the respiratory and circulatory tests. Each subject received standardized instructions and appropriate practice periods before taking each of the psychomotor tests.

PERSONAL AND MEDICAL HISTORY

An interview and questionnaire (Appendix A, pages A1-A7) relating to personal and medical history as well as other items were given to each subject. The items in the questionnaire related to: 1) family history; 2) personal and medical history with special reference to accidents, illnesses, and nutritional habits; 3) environmental influences; 4) education; 5) vocational and aeronautical interest. A physician went over the answers and interviewed each cadet concerning the most significant clinical data such as the major illness, loss of consciousness from accidents, diet, and vocational interests, especially aviation.

PHYSICAL EXAMINATION

Since all examinees had qualified medically before inclusion in the study, a general physical examination was not done. Systolic blood pressure, diastolic blood pressure, and pulse rate were taken. The score for each of these measures was expressed as the mean of five readings taken when the subject was in a reclining position.

CARDIOVASCULAR TESTS

Schneider Index of Neurocirculatory Fitness

Data from six sets of observations were made, namely, the pulse rate during recumbency, pulse rate while standing, the increase in pulse rate when standing from the recumbent posture, the acceleration of the pulse after standardized exercise, the time required for the pulse rate to return to normal after exercise, and the change in the systolic arterial blood pressure from recumbency to standing. The index penalized the subject who showed a rapid pulse rate and who failed to show an increase in systolic blood pressure on standing. The test was designed to reveal the state of physical fatigue or fitness of the subject (2).

Tilt Table Response (Figure 1.2.)

After resting for fifteen minutes in the prone position on a table, the subject was tilted head up for a twenty-minute period at a 65-degree angle. The following measures were taken before and during tilt:

1) Baseline blood pressures and pulse rate. Scores represented the mean of five readings taken while the subject was in the supine position before being tilted.

2) Pulse pressure change was the change in pulse pressure, the difference between the average pulse pressure before the tilt, and the smallest pulse pressure after tilting.

3) Pulse rate change equaled the difference between the highest pulse rate reached during the tilt-up intervals and the average pulse rate before tilt.

4) Smallest pulse pressure was the least difference between the systolic and diastolic pressure during the tilt-up interval.

5) Time to smallest pulse pressure was the number of minutes elapsing between the time when the subject was tilted up and the time at which the smallest pulse pressure occurred.

Cold Pressor Test

This procedure was included to evaluate each cadet's blood pressure response to a standard painful stimulus (3). Each cadet in Part I of the study underwent this test. After the blood pressure had stabilized, the right hand was immersed in a pail of ice water for one minute. Scores consisted of the change in systolic and diastolic pressures before placing the right hand in ice water and the point at which the blood pressure was highest during the sixty-second period of immersion. In a few instances electrocardiograms were obtained during the test.

Electrocardiography

In this investigation Sanborn portable cardiettes (Figure I.3.) were employed. All of the electrocardiograms were obtained with the subject in the recumbent position and, with a small number of exceptions, in the basal state. Photographic tracings of the three standard leads as well as precordial leads IVF (precordial electrode at the outer border of the apex as determined by palpation or percussion; precordial lead wire attached to positive terminal and left leg lead wire to negative terminal) and IVR (precordial electrode placement and polarity the same as IVF but negative terminal attached to the right arm) were obtained (4). Electrocardiograms were also an integral part of two other procedures employed.

A. Response to startle: The subject was attached to the basal metabolism apparatus and to lead II of the electrocardiograph. A gun was fired without the subject's foreknowledge. An analysis was then made of the alterations observed in the spirogram and electrocardiogram. The following scores were compiled from the tracing (Figure I. 4.)

1) Heart rate
   a) Average control rate for the startle expressed as the average heart rate for 6 seconds before the startle.
   b) Average heart rate 0-6 seconds after startle.
   c) Average heart rate 6-12 seconds after startle.
   d) Average heart rate 12-18 seconds after startle.

2) Somatic tremor
   a) Total duration expressed in seconds.
   b) Initial amplitude expressed in millimeters.
   c) Amplitude 3/5 second after the startle expressed in millimeters.

3) Alteration in T wave
   a) Time of onset expressed in seconds.
   b) Maximum change in amplitude expressed in millimeters.
   c) Persistence of change in T waves expressed in seconds.

Figure 1.2.
Tilt Table Response

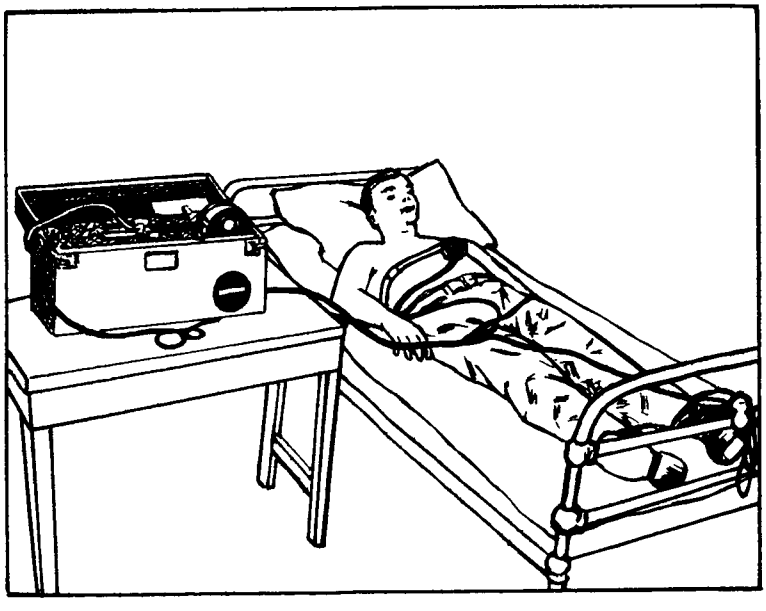
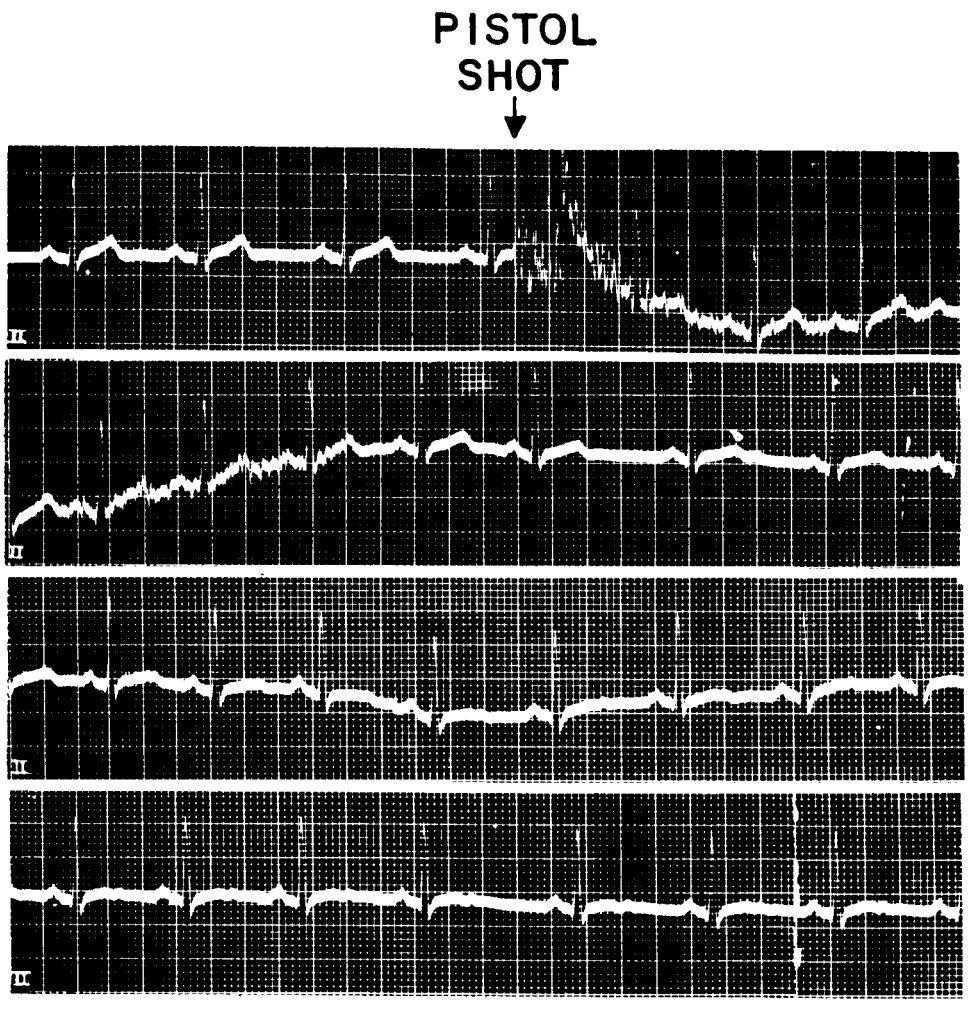


Figure 1.3
Electrocardiograph, Sanborn Portable Cardiette



T.L.H. ♂ 7-23-40 STARTLE

Figure 1.4

Startle Electrocardiogram - Lead II

A gun was fired at the point marked by the arrow. Note the somatic tremor and baseline shift immediately after the shot. The record also shows an increase in heart rate and a decrease in the amplitude of the T wave.

B. Carotid sinus sensitivity: The subject was seated, attached to an electrocardiograph with a blood pressure cuff in position. After two initial blood pressure readings a physician massaged the carotid sinus in the neck. Additional readings were made thirty seconds after pressure on the right carotid artery and thirty seconds after pressure on both carotid arteries. Electrocardiographic tracings were obtained at standard intervals during the experiment.

PULMONARY FUNCTION AND METABOLIC STUDIES

A detailed description of these measures may be found in a publication by Franzen and Blaine (5). Nine-liter Benedict closed-circuit spirometers constructed by the Sanborn Instrument Company were used. Each pilot was tested in the morning under basal conditions (Figure 1.5).

Breathing Pattern

The breathing pattern was studied from the spirogram for irregularities in a number of characteristics including variations in tidal air volume and respiratory rate (6). In addition, observations were made of the subject's reaction to a resistance placed in the breathing circuit which forced him to breathe through a small opening "pin head" in size.

Tidal Volume

This value was expressed in cubic centimeters, based on two runs of eight minutes duration with the subject in a recumbent position. An estimated correction for body surface to adjust for variations in body size was made by use of appropriate height-weight graphs (7).

Vital Capacity

The vital capacity was determined in the following manner. After a normal breathing period, the subject was asked to inhale as fully as possible and then to exhale as deeply as possible. Two records were made on the basal metabolism chart with the subject sitting. Values were given in cubic centimeters.

Basal Metabolic Rate

The score on the basal metabolism test was based on two runs of eight minutes duration each and was expressed in plus and minus values, the normal range considered to be plus 15 to minus 15.

ANTHROPOMETRY

Somatotype (8,9)

Each cadet was photographed in a standardized manner in the nude from the front, back, and side (Figure 1.6). The anthroscopic method was used in the study. It consists in somatotyping five regions by inspection: 1) head and neck, 2) upper trunk, 3) arms, 4) lower trunk, and 5) legs. For the somatotype the individual was rated with respect to endormorphy, dominance of visceral structures or soft roundness of body regions; mesomorphy, corresponding to the athletic type of build or dominance of bone and muscle; and ectomorphy, dominance of "linearity" and "fragility," especially the nervous system and sense organs. In the somatotyping procedure, each of these three primary components is classified on a seven-point scale. An inspectional estimate of the strength of each component was made from an examination of a photograph of the subject.

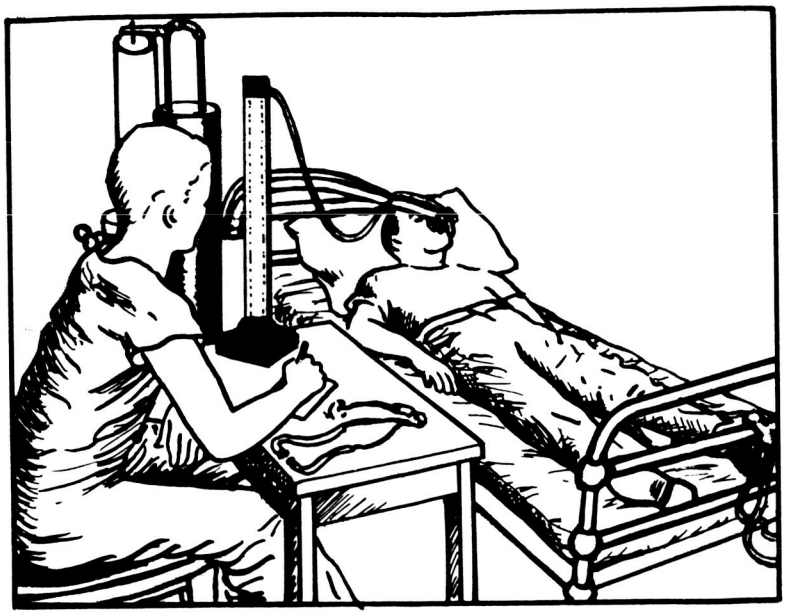


Figure 1.5
Benedict Closed-Circuit Spirometer

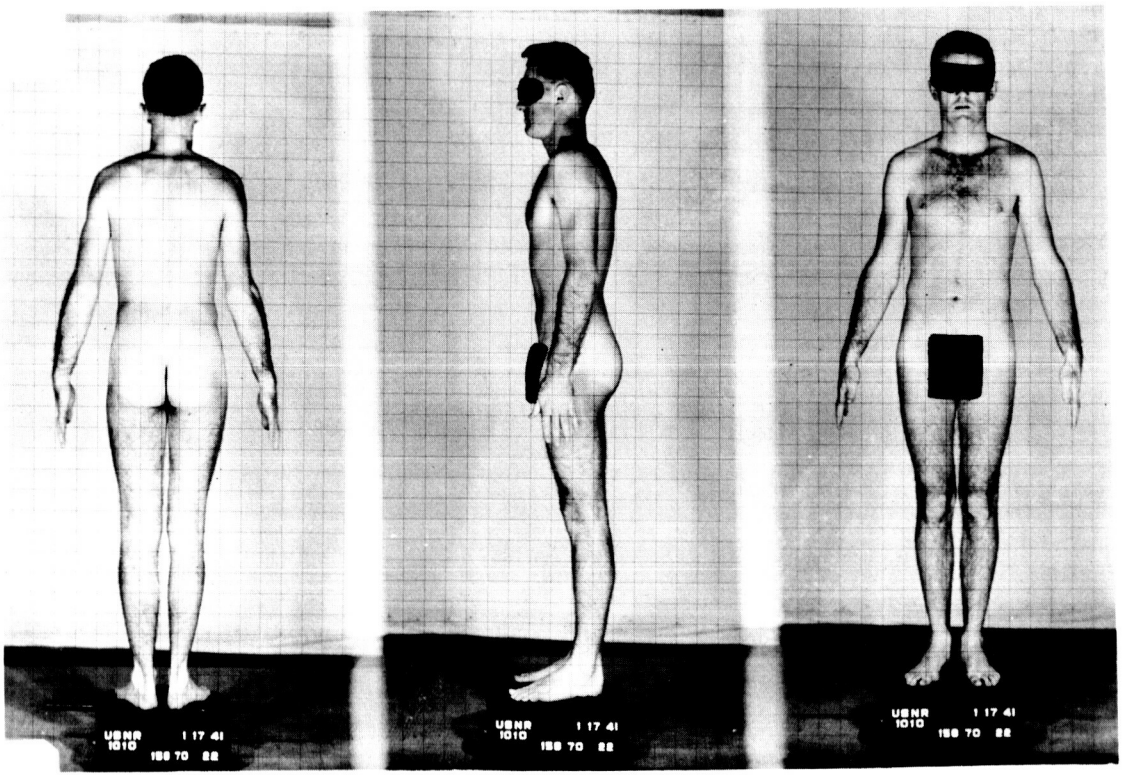


Figure 1.6
Somatotype Views

Numerals were assigned to each physique, including one for its position on the scale for each component. Thus, the physique of an individual classified as a 7-1-1 was extreme in endomorphy and at a minimum in the other two components. The 4-4-4 is an individual about at the mid-point of all three scales. The pattern of the three elemental morphological components, as expressed by the three numerals, represents the individual's "somatotype." The photographs were also scored for dysplasia, a term used to signify "disharmony between different regions of the same physique." When, for example, a physique is of one somatotype in the region of the head and neck and of another somatotype in the legs or trunk the individual is spoken of as dysplastic. Dysplasia is measured by totaling the differences among the somatotype designations for five regions of the body.

PSYCHOLOGICAL-PSYCHOMOTOR

Mental Ability

Otis Higher Examination Form D. This was a test of general intelligence containing 75 questions (10).

Mechanical Aptitude

Minnesota Paper Form Board--Revised Series AA. This test involved the perception of form relations and was supposed to be predictive of mechanical aptitude (11).

Athletic Achievement

Thorndike-Kelley. This test contained 42 questions relating to proficiency in various athletic events and to manual dexterity and coordination. A sample form is shown in Appendix A, page A8.

Eye-Hand Coordination Test

This procedure (Figure 1.7) was designed to measure motor dexterity and ability to coordinate the eyes and hands. A pointer, controlled by the subject, was to be kept opposite to a second pointer controlled by an irregular cam. The cumulative amount of deviation made by the subject while attempting to follow the moving pointer was recorded automatically. There were four different patterns on the cam which regulated the movements of the pointer. This test was essentially a motor learning task since improvement was shown in repeated trials (12). Eight successive trials were given in order to analyze the rapidity and skill with which a subject showed improvement, as well as to give a reliable total score.

Two-Hand Coordination Test

This test, constructed on the principle of a lathe, involved the rotation of two handles which controlled the movement of a disc (Figure 1.8). The handles had to be turned simultaneously in different directions in order to keep the two pointers together. One of these discs was activated in an irregular manner by a cam. The essential psychological principle involved the competition of simultaneous stimuli, i.e., attending to two different acts or movements at the same time (13).

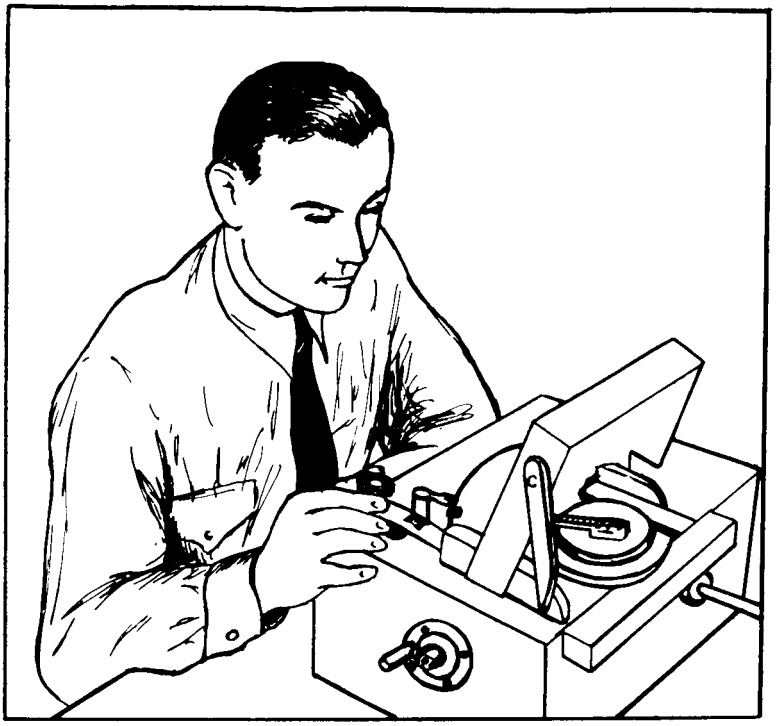


Figure 1.7
Eye-Hand Coordination Test

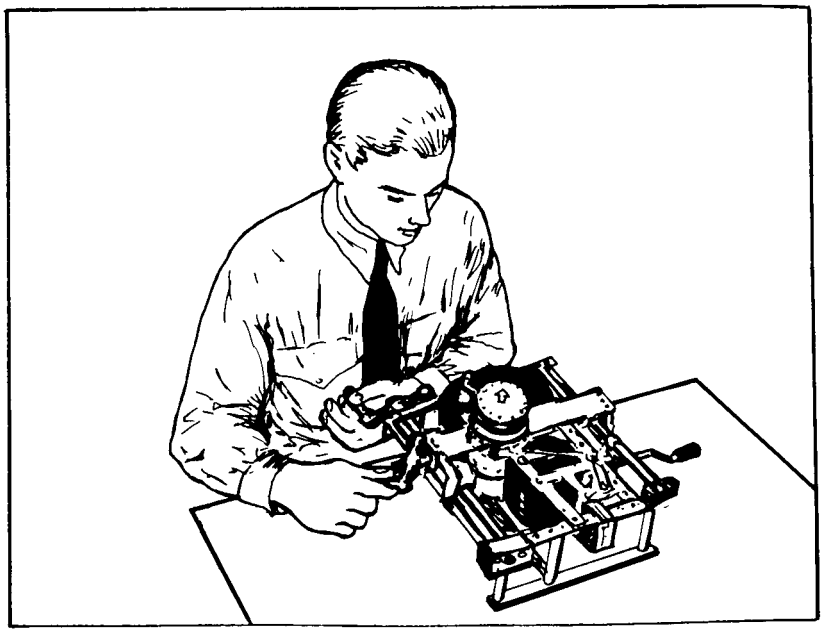


Figure 1.8
Two-Hand Coordination Test

Mashburn Serial Action Apparatus

This apparatus (Figure 1.9) roughly simulated the stick and rudder movements involved in flying. The subject reacted to a continuous series of red lights on the instrument panel; responses were made by movements of the set of controls operated by the hands and feet. As soon as the subject had made a correct response to a set of signals, another pattern of signals automatically appeared. There were 40 settings (14).

Dotting Test (McDougall)

The purpose of this test was to measure quickness of one type of reaction time and the facility for quickly and accurately coordinating eye-hand movements. The task involved striking small holes on a revolving disc with a stylus. The speed of rotation increased as the row of dots reached the external part of the revolving phonograph plate. The score was based on a mean of three trials (15).

Continuous Reaction Test (Cattell)

This test measured the speed and accuracy with which a subject could react to directions printed on a moving strip of paper (16). The subject was instructed to mark with pencil all the vertical lines on the strip as it moved by the aperture on the apparatus. He was instructed not to mark certain other lines which appeared at various intervals. The subject had to think and act simultaneously and with great rapidity. The test was designed to measure close attention, quick thinking, and accurate manual dexterity. It was scored in terms of the total number of correct markings on the strip of paper. It was given twice, once while the strip of paper was moving slowly and again while it was moving rapidly, the second time with different directions.

Ataxiameter (Miles)

This apparatus (Figure 1.10) measured the amount of vertical sway in the axis of the body while standing at attention with the eyes open or closed. A series of weights and pulleys was activated by cords attached to the subject's head. A movement in any direction was recorded by the counters at each corner of the metal framework. The subject was asked to stand as steadily as possible with heels together and feet turned outward at a 45-degree angle. The test was given first with the subject's eyes open as a practice period. The data were analyzed on the basis of movement during two readings of one minute each with eyes closed (17).

Tilt Chair

Perception of change in position while the subject was seated blindfolded in a chair was tested (Figure 1.11). The procedure was to have the subject signal the moment he was aware of the chair being tilted to the right or to the left, forward, or backward. The rate of tilting movements was controlled by a metronome set at approximately 7.4 beats per second. The mean of eight trials established the score.

VISION

Aniseikonia

Three tests developed by the Dartmouth Eye Institute were used for evaluation of this trait: 1) Eikonometer--This apparatus determined the difference in the size and shape of the

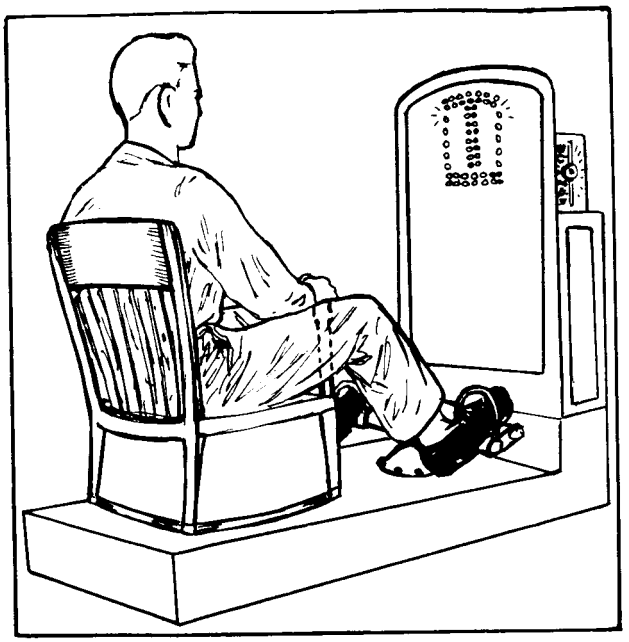


Figure 1.9

Mashburn Serial Action Apparatus

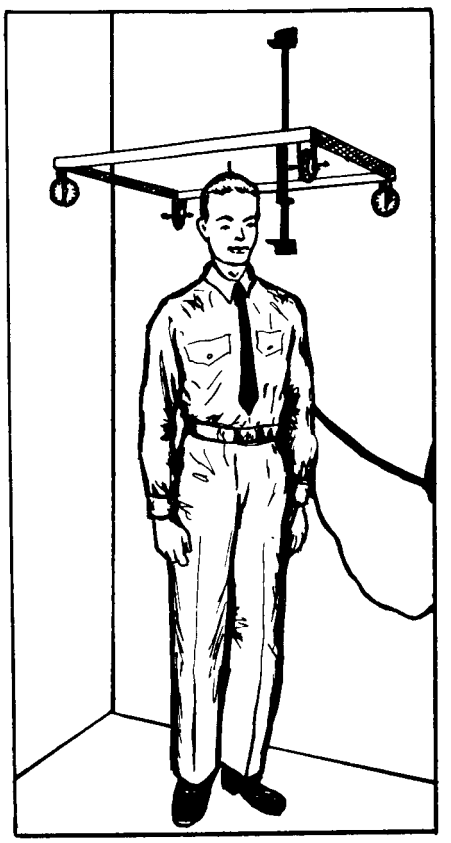


Figure 1.10

Miles Ataxiameter Apparatus

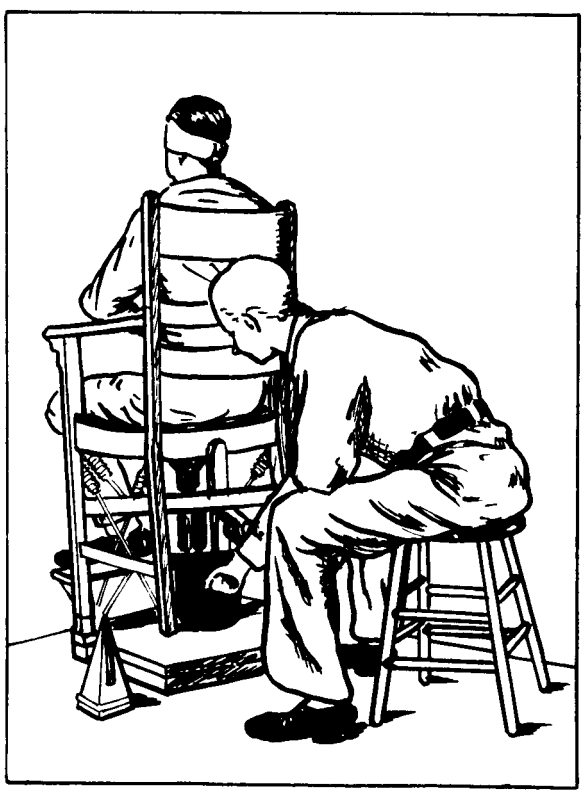


Figure 1. 11

Tilt Chair

ocular images by projection. The score represented the sum of the size differences in either the horizontal or vertical meridian and the size limits in the vertical and horizontal meridian; the measures were coded from 1 to 3. 2) Leaf Room--The subject was asked to judge the shape of a rectangular room, the surfaces of which were covered with oak leaves providing adequate contours yet weak perspective features. Failure to see the room in its proper perspective was considered evidence of distortion in space perception. The final score represented the sum of the "response score" coded 0 to 4 and the "plane lens test score" coded 0 to 2. 3) Frontal Plane Apparatus--The subject was required to set a series of rods in an apparent frontal plane under different test conditions, based on the same principle as the Howard-Dolman apparatus. The following parameters were scored: curvature of curve determined by rods, response to distortion lenses, scatter of data, response to cycle incongruities, response to various eye lenses, and displacement of data from normal.

Photographs of Eye Movements (Ophthalmograph)

Ocular motor anomalies while fixating on a target and the number of fixations while readings were recorded. The principle of the apparatus was as follows: A beam of light was focused on the cornea, and the reflection of the light was recorded on the film of a moving picture camera (Figure 1.12). The subject was asked first to fixate on a dot, then to focus alternatively on one dot and then on another at a rate determined by a metronome. Finally, he was asked to read printed lines from the page of a book. The score depended on the number of fixations per line (18).

Dark Adaptation (Wald)

Wald (19) devised a simple portable apparatus for field use which involved the determination of a number of points on the dark adaptation curve after the subject had remained in the dark for thirty minutes. A score based on the mean of four readings was expressed in micromillilamberts.

NEUROPHYSIOLOGIC

Electronencephalography

Records were obtained with a Grass apparatus (Figure 1.13) on each cadet in the recumbent position with the eyes open, and again while the eyes were closed. At the end of the test, each cadet was asked to hyperventilate to the beats of the metronome. A graphic record of the breathing was recorded with the spirometer. Four EEG measures were analyzed in this investigation: 1) Alpha Index, the average of the left and right scalp leads representing the number of centimeters in a standard length of record; 2) Alpha Frequency which ranges in frequency from 7 to 14 cycles per second; 3) Voltage, the average amplitude of the right and left scalp leads; and 4) the presence or absence of abnormalities expressed as ratings on a scale from 1, the best, to 4, the poorest. Care was taken in obtaining these records to make certain that the subjects did not become drowsy or fall asleep (20,21).

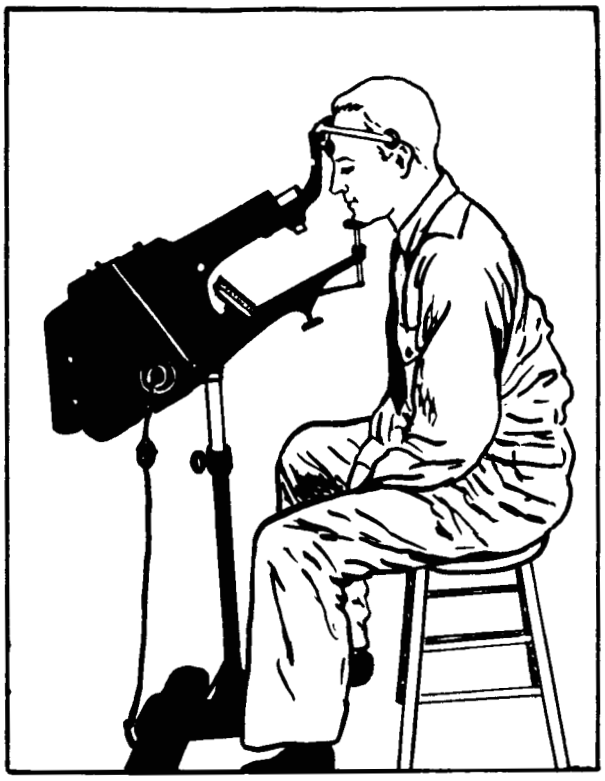


Figure 1.12

Ophthalmograph

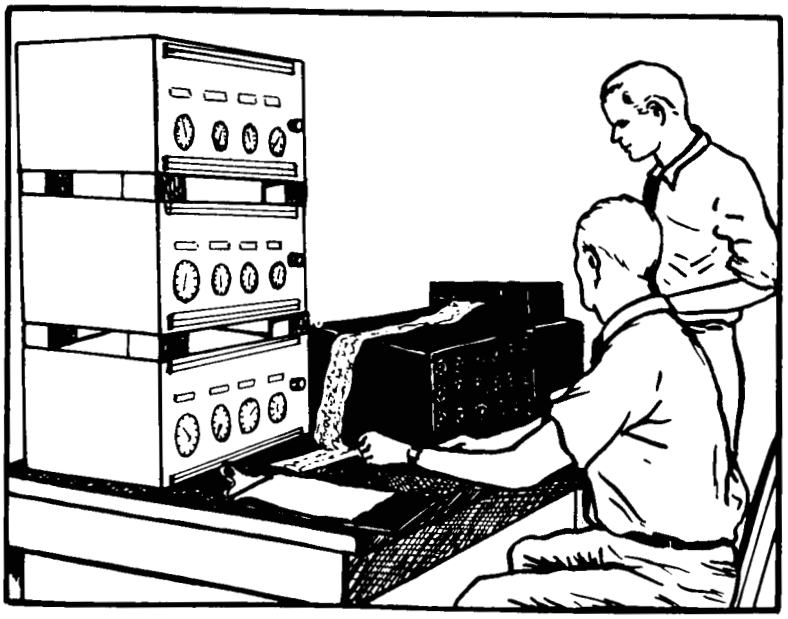


Figure 1.13

Electroencephalography (Grass Apparatus)

Skin Resistance

The galvanic skin response was included in the test battery for 119 cadets because of its possible value in revealing emotional reactions. The usual procedure in studying this reflex was used; one electrode was attached to the arm, and one recording electrode to the third finger of the right hand. The tests were carried out in the late afternoon when there were no distractions in the laboratory, or in the area, such as a large number of aircraft flying overhead. After a baseline for the galvanic response was determined and a number of readings recorded, the hand was placed in ice water for 30 seconds. Successive readings were taken during the recovery period, and the subject's response indicating pain, or when pain disappeared, was tabulated. After an interval of time, the subjects were asked questions relative to their difficulties in flying or other emotionally tinged questions, such as about illnesses or deaths in the family, about their fiancees, or about questions from the medical history which the physician obtained during a previous interview. Interest centered on whether the cadets who had failed their flight training course would have more extreme responses than those who were successful.

Chapter II: 1951 Study

Principal Investigators: Captain Ashton Graybiel, Lieutenant John M. Packard, and Lieutenant John S. Graettinger

INTRODUCTION

At the time of the original study (Chapter I) no thought was given to the possibility of a long range follow-up study but, after a lapse of ten years, it seemed clearly desirable to attempt it. The effort was rewarding although considerable difficulties were encountered. Since one of the objectives of the study was to compare the electrocardiograms over a ten-year period, it was decided to re-examine as many of the men as possible. Although analysis of the original 1940-41 data included only 1002 men on whom complete studies were carried out, a review of the records indicated that 1056 men had been examined in the cardiovascular laboratory. Therefore this larger group of 1056 formed the nucleus for the 1951 and succeeding evaluations. Proper identification of the subjects and finding of up-to-date addresses for each member constituted a prodigious task.

OBJECTIVES

Re-evaluation of the living members of the group who had undergone cardiovascular examination in 1940 was the aim. A follow-up study of this large group of healthy young men after an interval of ten or more years was potentially a source of much valuable information. This project was designed to estimate the current physical status of those men with particular emphasis on the cardiovascular system, the morbidity and mortality rates, and the influence of aviation on these rates. Findings were analyzed absolutely and in comparison with the data accumulated in 1940-41.

SUBJECTS

In order to locate the original 1056 subjects the investigators availed themselves of the following sources of information: Surnames, initials, and flight class number were obtained from the data sheets used in analyzing electrocardiograms. Complete names and ages were found on the original class sheets in the files of the Pensacola Naval Air Station. File numbers of most of the instructors and cadets who had remained in flight training were then located in the appropriate Naval registers. File numbers could not be obtained locally for those men who had washed-out or for any of the enlisted men who had been examined during the studies. International Business Machine punch cards were then utilized by the Bureau of Naval Personnel to search their files for the current status of those whose file number and name were known. This resulted in an accurate but incomplete list of those on active duty, those in the Naval Reserve, those who were dead, and those who had been retired. The addresses of the men on active duty could be tabulated automatically by means of the punch cards as were the dates and causes of death of the deceased subjects. However, the addresses of the members of the Naval Reserve and of active and inactive officers and men of the United States Marine Corps had to be copied by hand from available files in Washington, D. C. The punch cards for all men whose addresses and file numbers were available were then sent to the Veterans Administration for use in searching their files. A number of additional addresses were obtained in this way. The remaining men had to be sought for laboriously in officer and enlisted files in the Bureau of Naval Personnel, in Headquarters, U. S. Marine Corps, the Bureau of Medicine and Surgery, and in the Naval Records Management Center, Garden City, Long Island. Over a two-year period it was possible to

obtain the addresses on all but 29 known survivors of the original group. Yet, a number of addresses were not currently correct, and it was necessary to contact known friends, alumni offices, chambers of commerce, city libraries, telephone directories, and families in order to trace a number of the subjects.

Information concerning the dates and causes of death of the deceased subjects had been compiled in files in the Veterans Administration, Headquarters, U. S. Marine Corps, and the following naval bureaus: Bureau of Naval Personnel, Bureau of Aeronautics, and Bureau of Medicine and Surgery. In many cases the death certificate was examined; in other cases surviving relatives and civilian hospital records supplied the necessary information. In only one case was it impossible to ascertain the date and cause of death.

Of the 1056 men studied in 1940–1941, 220 had died, 7 could not be located, and 829 survivors were located. Of the latter group 703 were examined and an additional 115 returned questionnaires but were not reevaluated otherwise (Table II.1).

Table II. 1

Status of Medical Evaluation (1940–51)

Evaluation Status		Number
Located		1049
Survivors	(829)	
Re-examined		703
Questionnaires only		115
No response		11
Died	(220)*	
Not located		7

* 213 men died in World War II.

TESTS AND PROCEDURES

As the subjects were located and identified, questionnaires were mailed to them requesting information as to their past and present military service, aviation activities, civilian occupation, and general health. The follow-up examinations in almost all cases were conducted by a team from the Naval School of Aviation Medicine traveling by plane or by converted carry-all to various locations within the United States. The mobile unit contained portable x-ray equipment, two electrocardiographs, and the requisite equipment for conducting a physical examination. Subjects were examined at their residence, place of business, in the truck, or wherever possible; subjects located overseas were examined by local medical facilities of the armed forces, and the

results forwarded to the School of Aviation Medicine. It was not possible to adhere to a formal schedule or test sequence either by the team from the School of Aviation Medicine or elsewhere because of the obvious limitations, but all results were recorded on Navy Standard Form 88. When completed, the pertinent data from the physical examination, the roentgenogram, and electrocardiogram were coded on punch cards together with similar measurements obtained during the original study in 1940.

INTERVIEW--PERSONAL AND MEDICAL HISTORY

Separate detailed forms were completed on 1) medical history, 2) occupation, and 3) military and flight status (Appendix B, pages B1-B6). Emphasis in the medical history was placed on the cardiovascular system and family history. The examining physician assisted the subject in answering all forms. A communication also asked of the participants that they volunteer to place a request in their personal effects, that, in the event of their untimely death, the School of Aviation Medicine be notified and a report of autopsy forwarded if available (Appendix B, page B7).

PHYSICAL EXAMINATION

The majority of the subjects were examined by either Doctor Packard or Doctor Graettinger; here, too, special attention was given the cardiovascular system. The examination included auscultation and percussion of heart and lungs, funduscopy, abdominal palpation, and measurements of the blood pressure and pulse in the supine and standing positions. A fifth phase diastolic end point was used for blood pressures. Subjects unavailable to these examiners were examined for this study by Armed Forces or Veterans Administration medical officers or by private physicians. If personal contact could not be made, routine military or civil aeronautics administration physical examinations for 1951 and 1952 were reviewed. Results were recorded on Navy Standard Form 88 (Appendix B, page B8).

CARDIOVASCULAR TESTS

Electrocardiography

The investigators used Sanborn Cardiettes for all electrocardiograms; photographic tracings were made. Many different makes of electrocardiographs were used by the other examiners. In all but a few cases the tracings at standard speed included the unipolar and bipolar limb leads and the usual six unipolar precordial leads. The rate, rhythm, and durations (PR, QRS, QT) were measured in standard fashion. Since a change in the relationship of the electrical field of the heart to the recording electrodes alters the amplitude and configuration of electrocardiographic deflections and since differences in electrocardiographic techniques also cause changes in electrocardiographic tracings, lead by lead comparisons of the amplitudes of the deflections were not made. Estimations of the positions of the mean electrical axes of QRS and T in the frontal plane were made in the electrocardiograms by the technique of Grant and Estes (22). In addition, changes in the amplitude or configuration of the deflections which could not be attributed to a shift in the electrical field of the heart were noted.

ANTHROPOMETRY

Standard heights and weights were the only measurements taken.

TELEOROENTGENOGRAMS

Standard posterior-anterior 14" x 17" views of the chest were taken. Portable x-ray units were employed by the team in the field only when "permanent" type units were not available.

Chapter III: 1957 Study

Principal Investigators: Captain Ashton Graybiel, Lieutenant William R. Harlan, Jr., and Lieutenant Robert K. Osborne

INTRODUCTION

Identification of important physiologic precursors of disease and investigation of the development of many disease states, particularly cardiovascular disease, require a study projected over many years. A large number of epidemiologic studies (23-26) in progress with these goals have been initiated in primarily middle age populations; hence, an important phase in the pathogenesis of the disease has necessarily been neglected, namely,subtle physiologic differences during young adult life. These early differences and their environmental interrelationships could not be appreciated in studies confined to older age groups. In addition, only from long-term studies of young, healthy individuals can normal standards be developed which would permit diagnosis of asymptomatic, sub-clinical disease. The results of serial examinations of this group have provided a unique opportunity to review alterations in blood pressure, electrocardiograms, and serum lipids in relation to age and other parameters.

Although aviation medicine had been thrust into the space age, many problems remained in the selection of physical standards for flying personnel and the relationship of flying to the development of disease. The longitudinal nature of these problems also made them inaccessible to the usual experimental approach. A prospective study could also clarify the physical and laboratory parameters of greatest value in selection and maintenance of the best physically qualified individuals.

OBJECTIVES

Major attention was placed on the following: 1) Diseases which have affected the group, with cardiovascular disease emphasized. 2) A study of the group still actively flying, both in service and without, with a comparison to the nonflyers. In particular, were aviators predisposed to certain diseases more than others? 3) A review of the changes that have occurred in the various measurements taken which seemed to be related to the aging process alone. 4) A search for clues which would have heralded the onset of significant disease, or any false premonitions. 5) Finally, the continued accumulation of data so that a continuing baseline was present for future reference for these and any other intervening problems.

SUBJECTS

Addresses of the subjects were obtained in a similar fashion as was described for the 1951 evaluation. A retail credit agency located a number of individuals who could not be found by the other means. Since 1952, 20 subjects had died; of the 816 survivors, 784 were re-examined; only three subjects could not be located (Table III.1).

For purposes of analysis the majority of the survivors were divided into those continuing as aviators, 432, and those never qualifying as aviators, 100, or flying less than five years, 264.

Table III.1

Status of Medical Evaluation (1951-57)

Evaluation Status		Numbers
Located		836
Survivors	(816)	
Re-examined		785
Questionnaires only		19
No response		12
Died	(20)	
Not located		3

TESTS AND PROCEDURES

This follow-up examination was conducted in much the same way as the previous evaluation in 1951. A team from Pensacola, Doctors Harlan and Osborne, traveled throughout the country to examine the subjects usually in available government medical facilities but if necessary in their homes.

Since examinations were conducted primarily in the "field," it was not always possible to adhere to a rigid time sequence, yet an attempt was made to record basal blood pressures and fasting blood specimens as described later.

In some instances geographical considerations made it necessary for other medical officers to carry out the examination according to instructions sent them. In addition to the studies of 1951 (medical and personal history, physical examination, chest film, and electrocardiogram) a "double" Master two-step was obtained on 455 subjects and blood was analyzed for lipids. The data for each individual subject for this examination as well as the previous ones were grouped, analyzed, and placed on punch cards for convenience and for a permanent record.

INTERVIEW--PERSONAL AND MEDICAL HISTORY

This included a complete medical and personal history with emphasis on detailed family history, physical activities, and dietary habits (Appendix C, C1-C4).

PHYSICAL EXAMINATION

A general physical examination was conducted with special attention directed to recording blood pressure (fifth phase diastolic was used) and examination of the retinal vascular pattern. Both examiners made an attempt to standardize blood pressure and retinal evaluations between themselves before carrying out any examinations in the field. Blood pressures were taken sitting and supine during the middle of the physical examination, a period which had been preceded by ten minutes of resting while the examiner auscultated the heart, examined the abdomen, et cetera (Appendix C, C3, C4).

CARDIOVASCULAR TESTS

Cold Pressor Tests

This procedure as described by Hines and Brown (27) was repeated in 27 men who could be studied under the same conditions as in 1940. The results were evaluated using each of the two criteria suggested by Hines and co-workers (28). The "old" criterion divided normals into hyperreactors who had a maximum increment greater than 20/15 mm Hg and hyporeactors who had a lesser response. The "new" criterion separated these two groups on the basis of an increase of diastolic pressure more than 15 mm Hg and a maximal diastolic blood pressure exceeding 90 mm Hg.

Electrocardiography

Resting 12-lead electrocardiograms were recorded on a Sanborn twin-beam electrocardiograph so that photographic tracings could be obtained. A "back-up" Sanborn machine with indirect writer was utilized if necessary. The electrocardiograms were modified by the equated lead selector (29) so that the unipolar leads were augmented, one mv equals 11.5 mm; and the polarity of AVR was reversed, complex typically upright. In 455 subjects a "double" Master two-step test was performed. (This refers to double the number of trips in double the period according to Master's table. The pace remains the same.) Besides the clinical interpretation of the routine and exercise tracings, a number of measurements were made (30): rate, PR interval, QRS and QT duration, mean frontal QRS and T vectors, initial and terminal 0.04 second QRS vectors, and the maximal rate achieved after the double Master two-step test. Records from previous examinations were also scored for these parameters if not previously available.

Ballistocardiograms

These were taken on an ultra-low frequency swing bed (31) on a limited number of individuals who were examined in Pensacola.

LABORATORY DETERMINATIONS

Whenever possible, blood was drawn either fasting or four hours after a light meal. Blood was analyzed for cholesterol by the method described by Abel et al. (32). Serum lipoproteins were determined by ultracentrifugation at the Institute of Medical Physics (33). Because of financial limitations at various times, lipids were not obtained on all subjects. (Appendix C, C-5, C-6).

ANTHROPOMETRY

Heights and weights were taken with available apparatus at the various examining stations. The circumference of the left arm was also measured to the nearest millimeter.

TELEOROENTGENOGRAMS

As in the previous evaluation 14" x 17" films were obtained both in the posterior-anterior and lateral views.

Chapter IV: 1963 Study

Principal Investigators: Captains Ashton Graybiel and Robert E. Mitchell, and Lieutenant Commander Albert Oberman

INTRODUCTION

The 1963 evaluation was designed to be the most comprehensive survey of the participants to date. These men had now reached an age when detection of latent disease was an extremely important consideration. With the interest and support generated by the previous evaluations it was possible to perform thorough examinations at the Naval School of Aviation Medicine, in contrast to the previous follow-up examinations which by necessity were conducted by a team of Navy physicians who traveled about the country in a mobile laboratory unit. The ability to bring the subjects to Pensacola enabled the investigators to carry out the more desirable detailed physiological appraisal not possible in the previous two examinations. The men were provided commercial air transportation to Pensacola for two days of extensive testing in which every significant physiological measurement included in the earlier examinations was repeated. In addition, certain tests either not always possible in the field or not previously available were carried out.

Also due to increasing interest in the program at this time the Thousand Aviator Study gained the support and assistance of the Heart Disease Control Program of the U. S. Public Health Service in the form of financial aid, equipment, and personnel. Plans were formulated to continue this study indefinitely at intervals of three to five years.

Preliminary questionnaires (Appendix D, pages D1-D5) were sent to 815 participants during the latter part of 1962, requesting information concerning their recent health, occupation, flying and military status. Actual testing began in January of 1963 and continued until the Spring of 1965. An attempt was made to standardize all procedures insofar as possible (34). When possible, all forms were prepared for ultimate computer analysis.

OBJECTIVES

Objectives of the study can be classified as 1) medically oriented and 2) flight oriented. Three questions needed to be answered: What happens to a group of healthy young men as a result of aging? What tests have prognostic value? What is the effect of flying on man?

Medically Oriented

1. Obtain normative and baseline data on healthy young men.
2. Follow changes in baseline measurements as a function of age.
3. Correlate 1 and 2 with the appearance of cardiovascular abnormalities.
4. Define, retrospectively, precursors of cardiovascular disease.
5. Point out preventive and therapeutic measures.

Flight Oriented

1. Contribution toward delineation of the optimal cardiovascular assessment of the flyer in terms of

a. Career
   1) Initial selection: Emphasis on physiological, metabolic, and psychological "indicators" of later appearance of disease and disorder.
   2) Periodic examination
      (a) Routine: Emphasis on diagnosis of underlying disease and short-range prediction of susceptibility to an acute cardiovascular incident.
      (b) Comprehensive: Supplement to routine examination at critical ages or important stages of careers.
b. Mission (assessment in terms of professional responsibilities)
   1) Stress tests.
   2) Prediction (likelihood) of an acute cardiovascular incident over the period of the mission.

2. Implications for prevention of acute incidents or chronic disease.
3. Evaluation of effects of flight stress by comparison with nonflying professional groups.

SUBJECTS

An extensive search was made to locate all survivors utilizing the previous schemes for locating subjects, including the retail credit agency. Information also was obtained from the Navy Finance Center, Cleveland, Ohio, and through an article in Navy Times. A considerable number of individuals were personally contacted by telephone through government lines. A review of the records showed that four subjects had died since 1958; of 815 survivors, 675 were re-examined; 769 members returned questionnaires (5 of whom have since died) and 4 could not be located (Table IV.1). With rare exception each examinee underwent the entire test battery.

Table IV. 1

Status of Medical Evaluation (1957-65)

Evaluation Status		Number
Located		811
Survivors	(794)	
Re-examined		675
Questionnaires only		89
No response		30
Died	(17)*	
Not Located		4

*5 members died after returning the questionnaires and had not been examined.

TESTS AND PROCEDURES

The experimental routine varied according to the patient load and availability of equipment, but the following general routine would apply (Table IV.II): On the morning of the first day, initial blood pressures and a fasting electrocardiogram were taken. Shortly after this the fasting subjects provided blood and urine specimens. The remainder of the morning was occupied with roentgenograms, vectorcardiogram, orthogonal lead electrocardiograms, double Master's test, and the ballistocardiograms. A second blood sample was obtained two hours following the initial one and after administration of 100 grams of glucose. Immediately after lunch the audiograms and electroencephalograms were obtained. Following these procedures, the modified Harvard step-test (three minutes at 20 steps per minute) and the anthropometric examination were completed. Magnetic tape recordings of the electrocardiogram and pulmonary function followed by the physical examination and the second blood pressures completed the first day. On the morning of the second day the routine pulmonary function tests (conventional and wedge spirometer) were accomplished. The second Harvard step-test (4 minutes at 20 steps per minute) and tonometry were also carried out during this morning. Retinal photographs were taken and questionnaires completed during breaks in the schedule, and questionnaires not reviewed during the physical examination were reviewed at this time with the participant. The Graybiel-Fregly ataxia test and plethysmograms of the peripheral pulses as well as any prior omissions or repetitions of the test procedures concluded the examination. Unless an unusual patient load was present in the cardiac clinic the entire examination was completed by late in the morning or early in the afternoon of the second day.

Table IV. II

Testing Schedule

First Day	
0800	Recumbent BP lying, sitting (right arm), two-man method
0830	Electrocardiogram (Basal)
	Venous blood - PBI
	Lipoproteins
	Cholesterol
	Triglycerides
	Uric acid
	Glucose Tolerance Test
	Hematocrit
	W.B.C., differential
	Urinalysis
	Ingestion of 100 grams of glucose
	X-rays, chest (cardiac series)
0930	Vectorcardiogram
	Electrocardiogram (Orthogonal lead system)
1030	Double Master's test
	Ballistocardiograms
	Two-hour blood sample (Glucose and Triglycerides)
	Urine
1200	Lunch

1300	Audiogram Electroencephalogram Harvard step-test (3' at 20 steps per min.) Anthropometrics Magnetic tape recording of ECG and pulmonary function Physical examination "Casual" BP, one man, recumbent and sitting (right arm) History

Second Day

0730	Pulmonary function tests (conventional & wedge spirometer) Harvard step-test (4' at 20 steps per min.) Tonometry Retinal photographs Graybiel-Fregly ataxia test Plethysmograms Complete questionnaires--review with physician.

INTERVIEW--PERSONAL AND MEDICAL HISTORY

Each participant completed a medical history form containg 225 questions (Appendix D, pages D6-D18). This provided a detailed review of systems and past history with special attention to respiratory and cardiovascular symptoms. The examining physician scored a review-of-systems summary sheet after discussing the replies with the subject (Appendix D, page D19). A family history of cardiovascular disease, diabetes, and cancer in parents, siblings, and children was also included (Appendix D, page D20). A pulmonary questionnaire* (Appendix D, pages D21-D27) included details of cardiopulmonary disease and exposure to pulmonary irritants. It was also used in another study apart from the Thousand Aviators, necessitating some repetition of questions. The personal history (Appendix D, pages D28-D33) covered such diverse topics as smoking; physical activity, both on and off the job; hours of sleep; diet; socioeconomic status (35); ethnic origin; and geographical residences. A separate questionnaire regarding flight status and previous flying experience was also available (Appendix D, pages D34-D38).

PHYSICAL EXAMINATION

A complete physical examination was performed and recorded on a standard form (Appendix D, pages D39-D42). Any questionable noncardiac findings on the physical examination were referred to the appropriate consultant at the Naval Hospital in Pensacola. In addition to routine "casual" supine and sitting blood pressures taken during the course of the physical examination,a "basal" blood pressure was taken in the following manner:

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*Available only on those subjects who had pulmonary curves recorded on magnetic tape.

Immediately after arrival at the laboratory the subject rested in a quiet room. Shortly thereafter the supine blood pressure was taken on the right arm with a Bauman sphygmomanometer from which the back had been cut out so that the column of mercury was visible from front and back. The examiner auscultated (fourth phase diastolic) viewing the mercury column from the unmarked side (Figure IV.1); at the appropriate time he signaled to another observer who recorded the reading. Three trials were used for the supine; then the procedure was repeated for the sitting blood pressures.

All clinical diagnoses on each subject were coded according to the World Health Organization's classification of diseases (36). It might also be mentioned that a complete summary of the findings on each participant was sent to him complete with recommendations, if any (Appendix D, pages D43,D44).

Special criteria (Appendix D, pages D45-D47) were set up for establishing the diagnosis of coronary heart disease for present, past, and future evaluations. These standards, agreed on by two observers, graded the diagnosis as indeterminate, possible, probable, and definite.

CARDIOVASCULAR TESTS

Electrocardiography

A basal 12-lead electrocardiogram modified by the equated lead selector (29) was taken at standard speed and deflection on a Sanborn 100 Viso Cardiette. Standardized measurements (30) of the amplitudes of P,Q,R,S, and T; of the durations of PR, QRS, and QT; and of the mean frontal QRS and T axis were made in selected leads. Also, values for the peak-to-peak QRS voltage and duration from the onset of the Q to the peak of the T wave were determined in the frontal plane. All resting tracings were also classified according to Blackburn's system (37) for population studies. The scheme was modified to include a lesser classification for T waves < 1.0 mm upright. A conventional 12-lead electrocardiogram at standard speed and amplitude was also recorded on a magnetic tape apparatus, Sanborn 211 (Figure IV, 2). These tapes were then analyzed by the Instrumentation Unit of the Heart Disease Control Program by conversion to a digital form suitable for their established electrocardiographic programs (38,39). Table IV.III represents a computer interpretation of a Thousand Aviator electrocardiogram. Machine results were under constant supervision by the Instrumentation Unit.

Exercise electrocardiograms were taken at opportune times during the testing schedule. Each participant underwent a graduated battery in the following sequence: double Master's, a Harvard step-test at 20 steps per minute for three minutes, and at 20 steps per minute for four minutes (Figure IV.3). Individuals with physical disabilities, recent coronary symptoms, or with acute electrocardiographic changes were excused from the complete sequence though some of these men did participate in the less rigorous exercise tests. Leads I, II, III, AVF, V2, V4, V5, and V6 were recorded simultaneously in two groups on a four-channel Sanborn 964 at standard speed and deflection. A timed sequence of tracings consisted of baseline, immediately after exercise, 1 minute, 2 minutes, 3 minutes, and 5 minutes after exercise. A number of parameters were measured in leads II, AVF, V4, V5, and V6: amplitudes-P,Q,R,S,T, and J point; durations--PR,QRS,QT, and QX. Special attention was given to the ST segment which is characterized as depicted in Figure IV.4. The procedure for locating the reference points on the ST segment

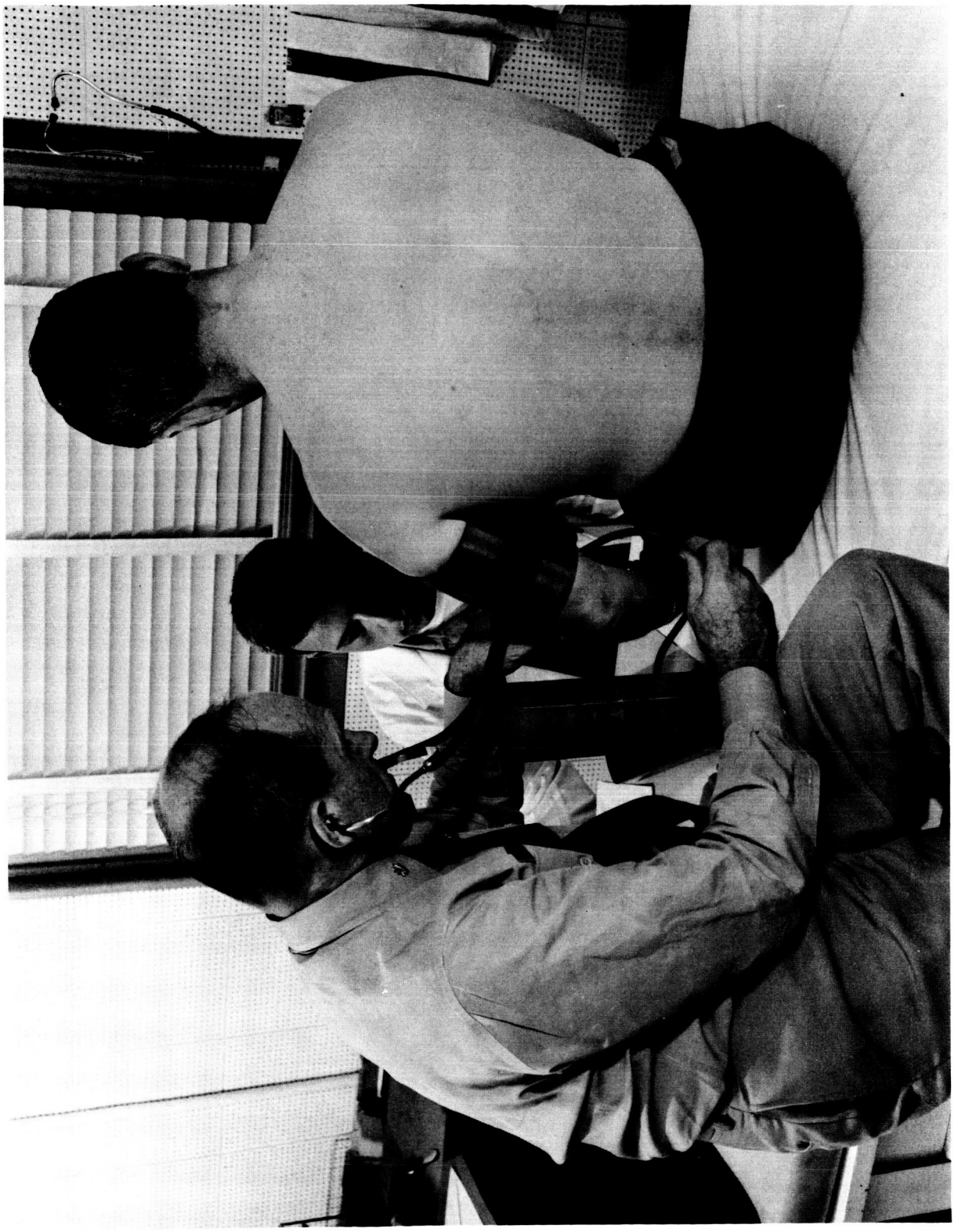

Figure IV.1

"Two-Man" Blood Pressure Recording

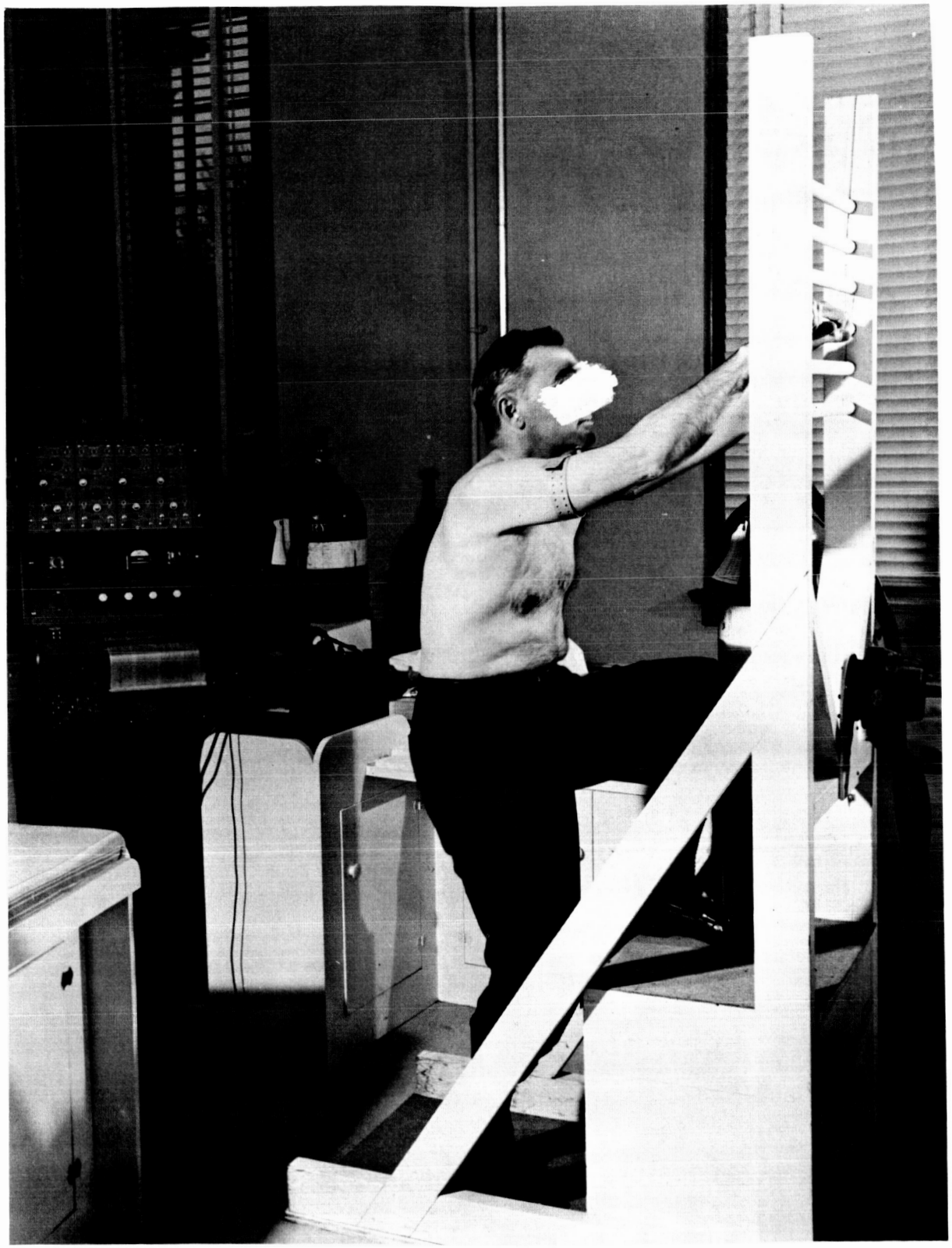

Figure IV.2
Sanborn 211 Magnetic Tape Recorder

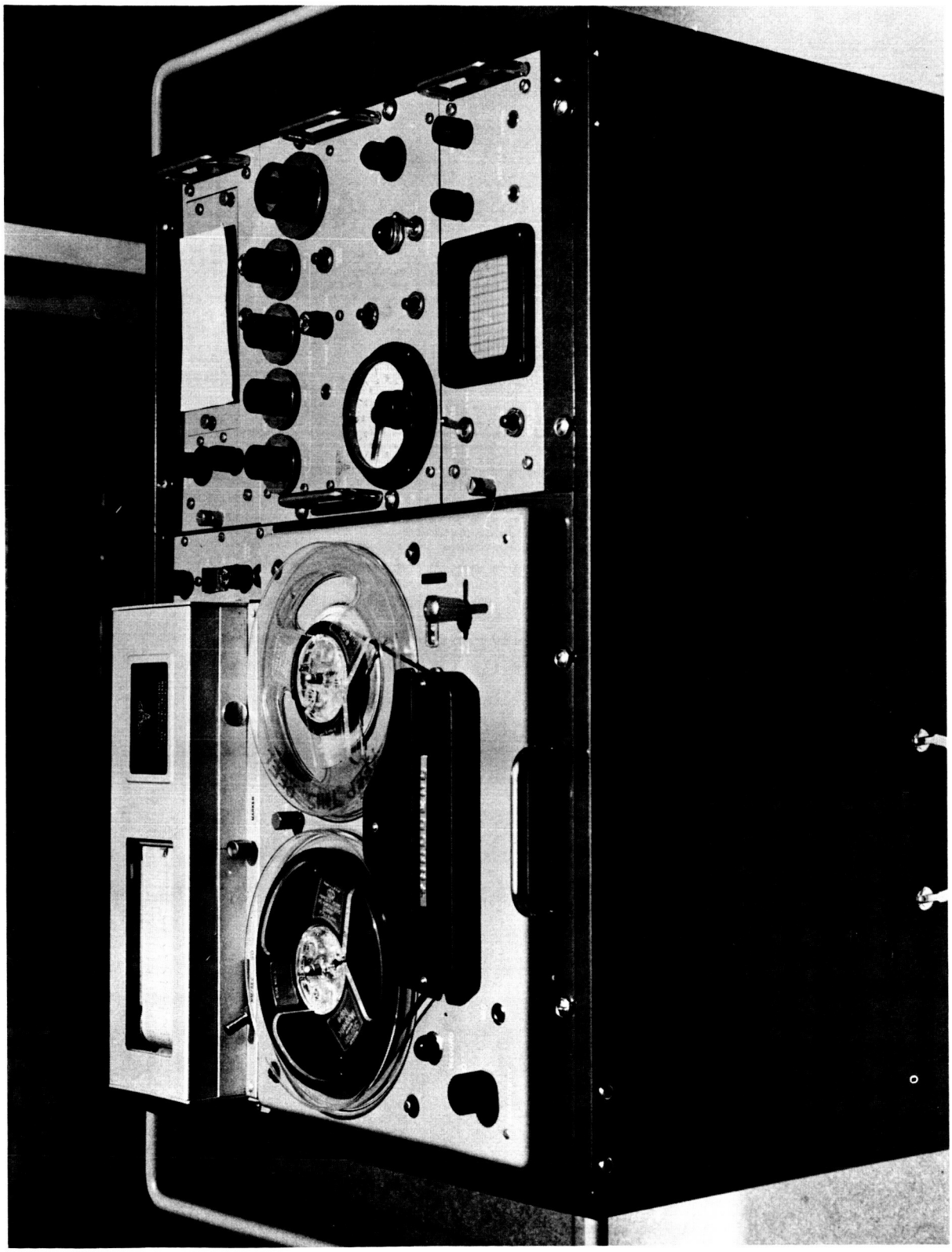

Figure IV. 3
Modified Harvard Step-Test

Table IV. III*

INSTRUMENTATION FIELD STATION --- HEART DISEASE CONTROL PROGRAM

COMPUTER PROCESSED ELECTROCARDIOGRAM

PROCESSING DATE 05-11-64 PENSACOLA, FLORIDA ECG NUMBER 0X83

	I	II	III	AVR	AVL	AVF	V1	V2	V3	V4	V5	V6	
PA	.00	.13	.13	-.07	-.05*	.13	.04	.05	.07	.06	.04	.05	PA
PD	.00	.10	.11	.10	.08	.11	.05	.07	.12	.11	.08	.10	PD
QA	.00	-.04	-.06	.00	.00	-.03	.00	.00	-.03	.00	.00	-.03	QA
QD	.00	.02	.03	.00	.00	.02	.00	.00	.04	.00	.00	.02	QD
RA	.21	.74	.60	.03	.06	.74	.10	.32	.36	.95	1.13	1.05	RA
RD	.04	.05	.07	.01	.04	.07	.01	.03	.05	.05	.05	.05	RD
SA	-.18	-.13	.00	-.50	-.26	.00	-.52	-.68	-.45	-.31	-.20	-.13	SA
SD	.05	.05	.00	.05	.07	.00	.04	.08	.06	.05	.04	.04	SD
R'A	.00	.00	.00	.11	.00	.00	.06	.00	.00	.00	.00	.00	R'A
R'D	.00	.00	.00	.06	.00	.00	.04	.00	.00	.00	.00	.00	R'D
ST	.12	.11	.12	.12	.12	.12	.12	.12	.12	.06	.07	.10	ST
STO	-.03	-.03	-.02	-.02	.01	-.02	.02	.09	.10	.06	-.01	.02	STO
STM	.02	.01	.01	-.06	.04	.05	.02	.22	.25	.13	.05	.07	STM
STE	.08	.08	.05	-.16	.04	.11	.03	.46	.53	.18*	.11	.15	STE
TA	.22	.29	.13	-.28	.09*	.26	.00*	.67	.77	.77	.56	.42	TA
TD		.20					.00			.26	.23	.18	TD
PR	.00	.12	.13	.14	.12	.13	.13	.13	.11*	.15	.12	.12	PR
QRS	.09	.12	.10	.12	.11	.09	.09	.11	.15	.10	.09	.11	QRS
QT	.38	.43	.41	.37	.36	.40	.00	.42	.44*	.42	.40	.40	QT
RR	.92	.96	.94	.97	.92	.96	.96	.95	.92	1.03	.94	1.04	RR
RATE	65	62	63	61	64	62	62	62	65	58	63	57	RATE
CODE				C				C	C				
CAL	195	195	195	195	195	195	195	195	195	195	195	195	CAL

AXIS IN DEGREES	P	QRS	T	Q	R	S	STO	ST-T	QRS-T	ANGLE IN DEGREES
	90	87	56	-70	79	194			31	

*The left-hand column represents PA, amplitude of P wave; PD, duration of P wave; QA, amplitude of Q wave, et cetera. The remaining notations are self explanatory.

Interpretation Date 05-11-54

Right Bundle Branch Block
Bradycardia present; Check mechanism
Vertical QRS AXIS

1131

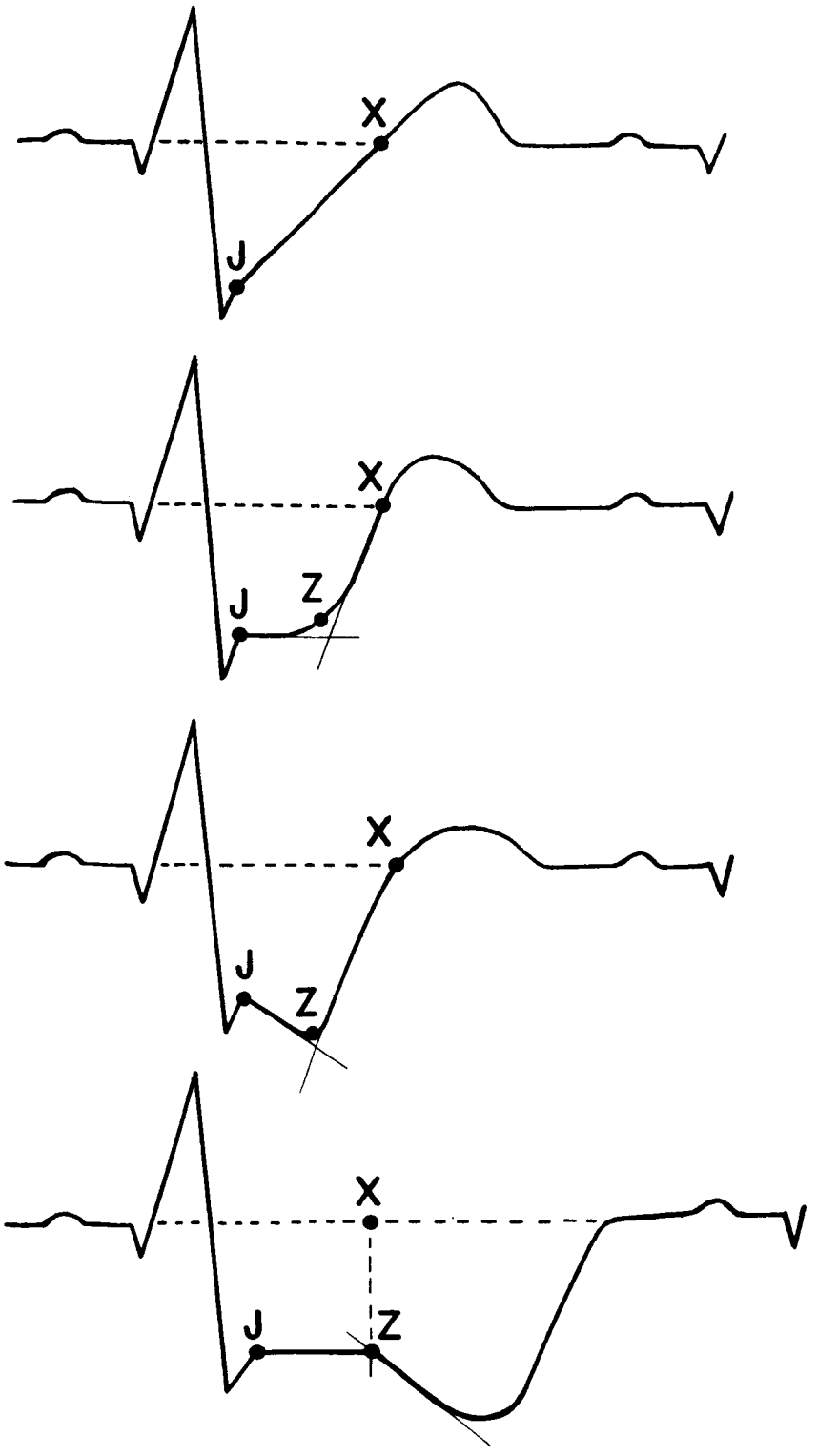

Figure IV. 4
Characterization of the ST Segment
A baseline was drawn from the PR segment immediately preceding the Q wave to the analogous point on the QRS complex following the ST segment to be measured. The J point and X point were defined; then a third point, the Z point, was established by the intersection of two straight lines, a straight line coincident with the initial part of the ST segment and another coincident with the proximal ascending limb of the T wave.

was as follows: A baseline was drawn from the PR segment immediately preceding the Q wave to the analogous point on the QRS complex following the ST segment to be measured. The J point and X point (where the ST segment crosses the isoelectric line (40)) were defined; then a third point, the Z point, was established by the intersection of two straight lines, a straight line coincident with the initial part of the ST segment and another coincident with the proximal ascending limb of the T wave. Although one or more of these points may be absent in a given situation, the ST segment can still be characterized by the remaining points in terms of slope or area. The geometrical method* for finding the area by means of similar triangles for all possibilities is demonstrated in the appendix (Appendix D, page D48).

Quantitative exercise electrocardiograms were recorded on a Sanborn 350 recorder, after work on a Lannoy bicycle ergometer, by means of a special purpose analog computer (41). The subject underwent two minutes of exercise (150 watts of work) after which orthogonal leads using the Frank lead system (42) were analyzed for spatial mean QRS vector, mean T vector, ventricular gradient, and ST parameters.

Plethysmography

For evaluation of peripheral pulses a mercury strain-gauge plethysmograph (Model 250, Parks Electronics Lab.) was used. This device was placed over the base of the fingernail (Figure IV. 5) to obtain a standard pulse wave for that particular individual since upper extremity pulses are rarely affected by peripheral vascular disease. This tracing was compared absolutely and then with those obtained from the toes with respect to amplitude, time required for the ascending limb of the curve, and contour of wave. A heat lamp was used to relieve any vasospasm brought on by emotion, temperature, et cetera. The administration and utility of the entire procedure have been described by Strandness (43).

Ballistocardiograms

These were taken on the Astro Space Air Suspension (Figure IV. 6) and the "Reeves" swing bed (Figure IV. 7), both ultra-low frequency ballistocardiographs, using the Sanborn 964 recorder. All tracings were taken simultaneously with lead II of the electrocardiogram, and the air suspension tracings also were recorded simultaneously with a carotid pulse wave. The majority of the participants had records taken on both machines. Using the trough of the G wave as the baseline, amplitudes of GF, GH, GI, GJ, GK, GL, GM, and GN were measured. The duration of Q-H, Q-I, Q-J, G-H, J-K, H-L, and P-Q were measured as was the time from the Q wave of the electrocardiogram to the upstroke and incisuria of the carotid pulse. Other values were derived from these basic parameters.

Vectorcardiograms

The vectorcardiogram was obtained from a Sanborn 350 apparatus with a three-plane scalar recorder (Figure IV. 8). Frontal, horizontal, and left sagittal loops were inscribed at intervals of two milliseconds employing the Frank lead system (42). Orthogonal tracings in the three planes using the same lead system were also taken. Detailed measurements on spatial vectors from these tracings have been made to date on the initial 200 subjects (Appendix D, pages D49, D50).

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*Calculations performed by Doctor Robert J. Wherry, Jr.

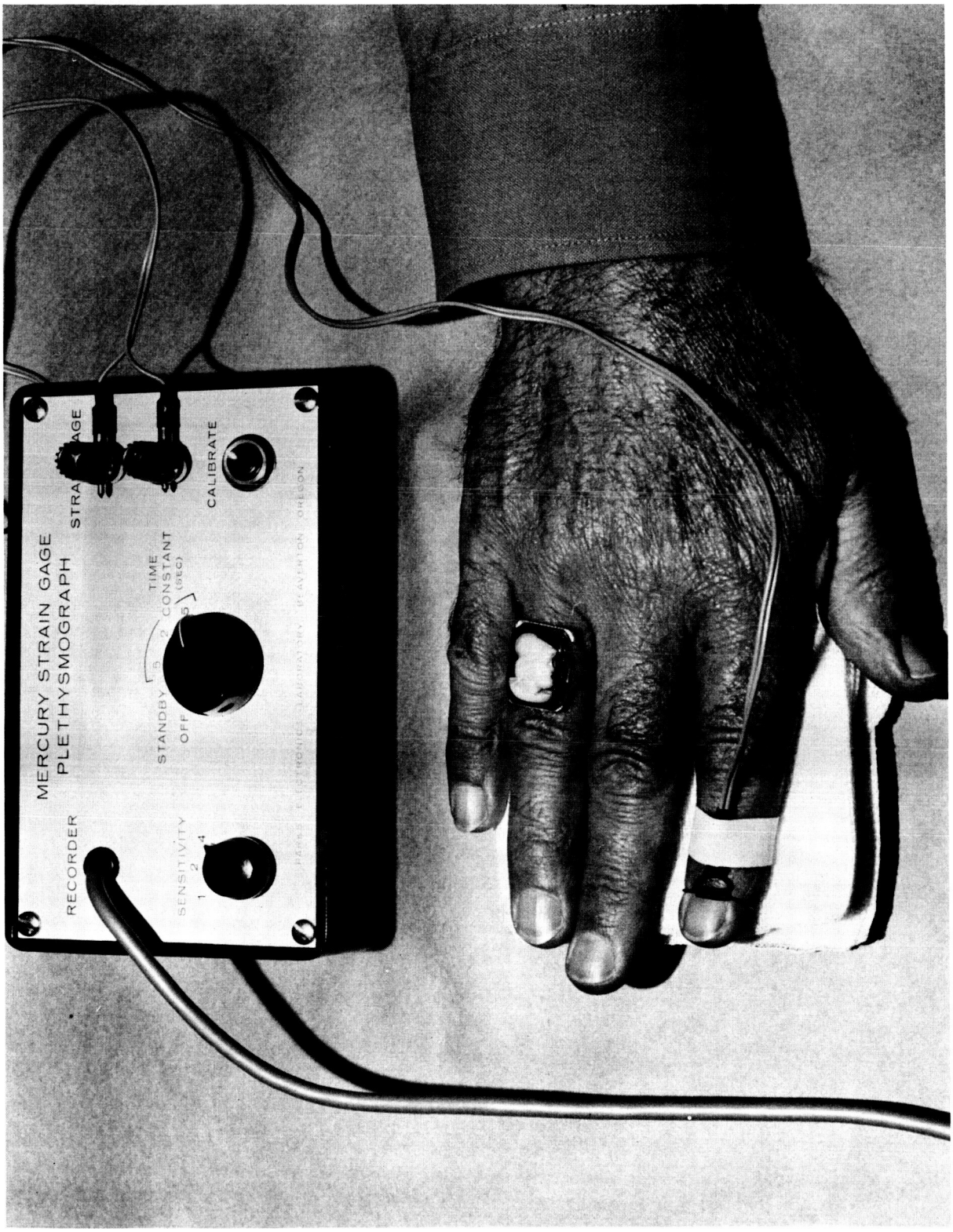


Figure IV. 5

Plethysmograph

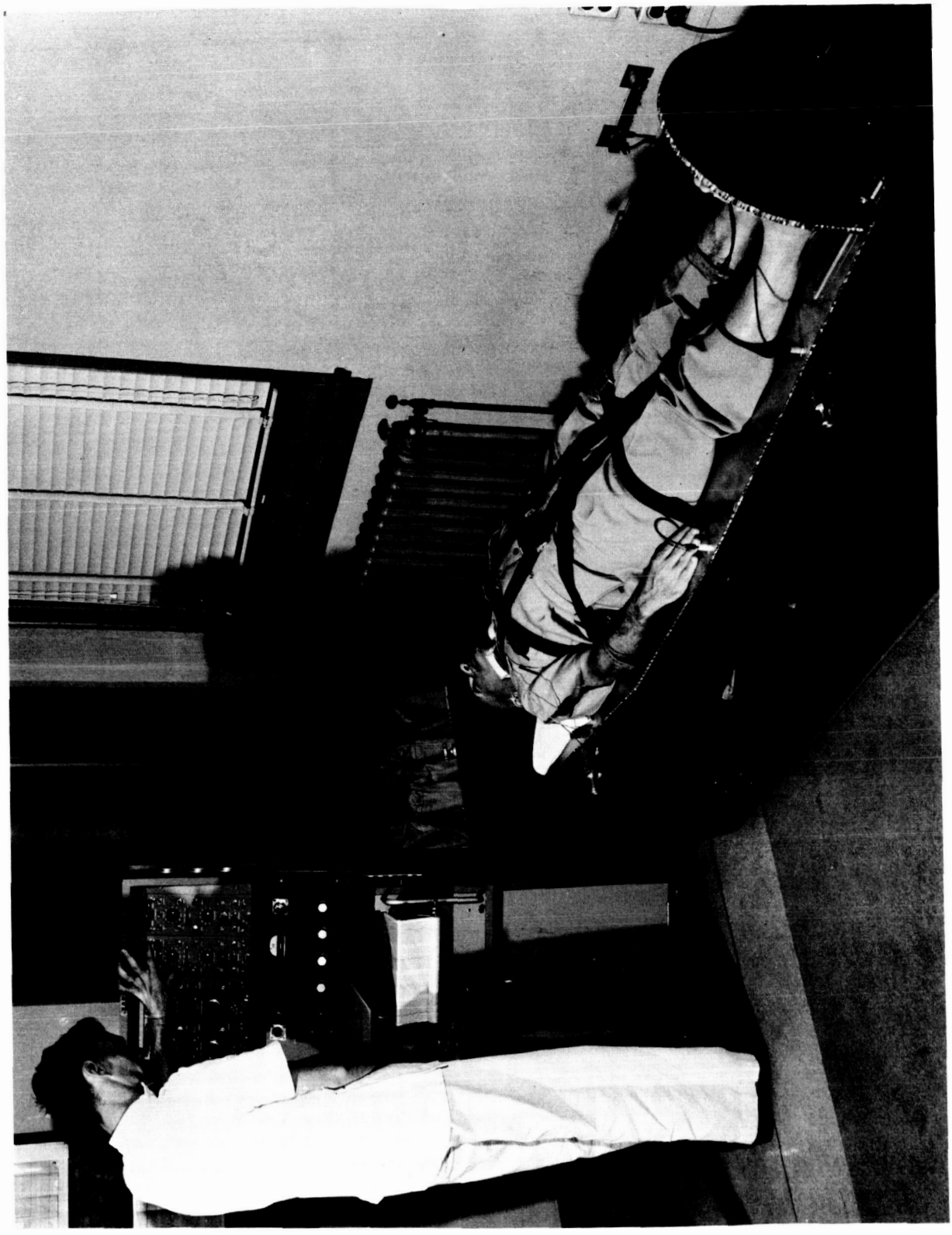


Figure IV. 6

Astro Space Air Suspension Ballistocardiograph

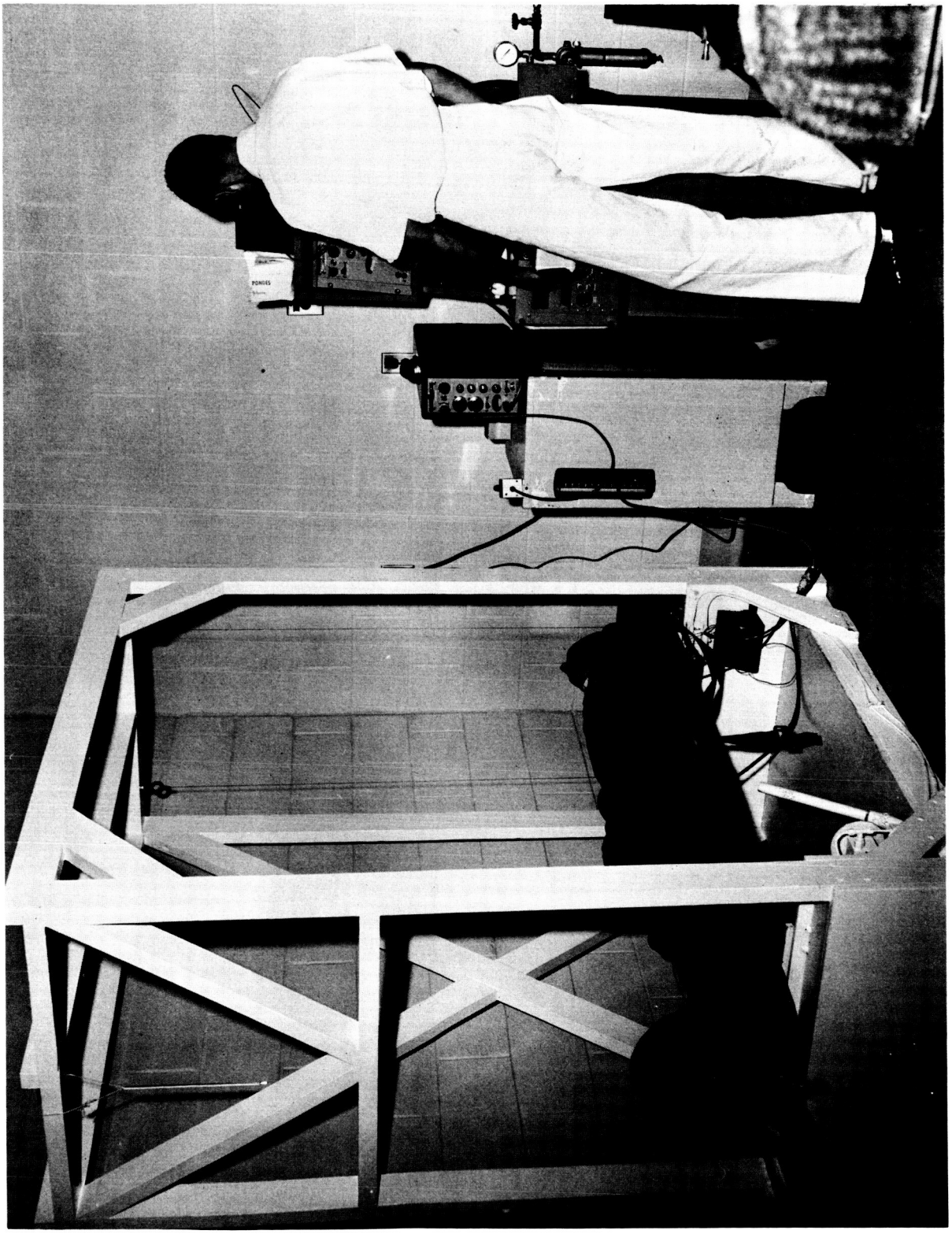


Figure IV. 7

"Reeves" Swing Bed Ballistocardiograph

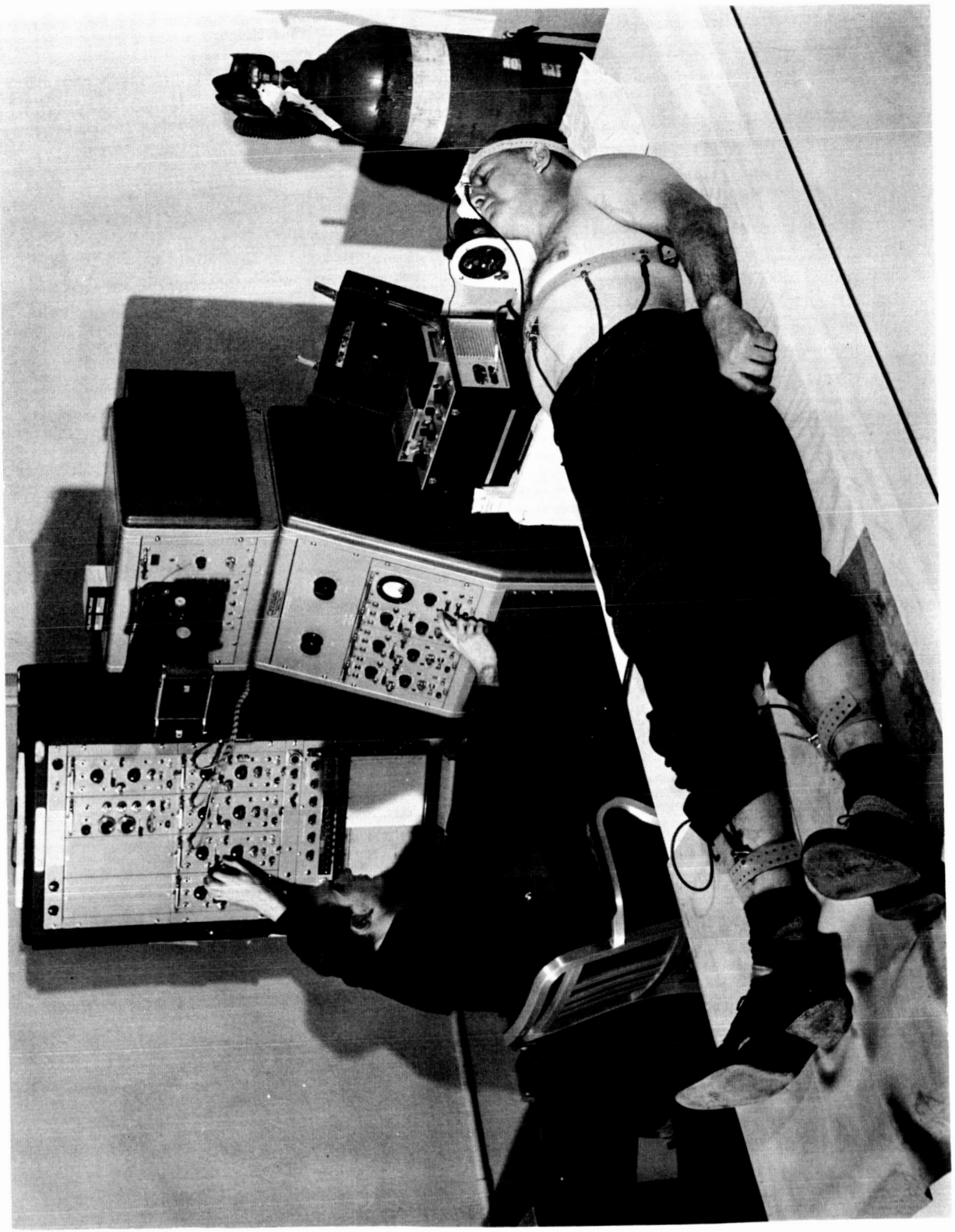


Figure IV. 8

Vectorcardiograph, Sanborn 350 Apparatus

LABORATORY DETERMINATIONS

Hematocrit, white blood cell count, and differential cell count were done in routine fashion from a finger "stick." The urine was microscopically analyzed and tested for albumin and sugar with "Uristix." Serum cholesterol was determined by the method of Abel et al. (32). Serum lipoproteins were determined by ultracentrifugation at the Institute of Medical Physics (33). Protein bound iodine (44) and uric acid (45) measurements were also carried out on the fasting blood. Triglyceride values were unsatisfactory for the initial 391 participants; the solvent in the initial method did not adequately eliminate the phospholipids. Determinations employing the method of Carlson (46) proved quite adequate for the remainder of the group. Cholesterol and the later triglyceride studies were standardized by the Heart Disease Control Program lipid laboratories in Atlanta, Georgia. Glucose values both fasting and two hours after a 100 gram carbohydrate load were analyzed by the method of Somogyi (47). Glucose determinations for the first 384 members of the study group ran approximately 12 milligrams per cent below later standards. This was corrected by improving preservation methods since the determinations were not carried out on the same day. All abnormally high glucose results were substantiated by a repeat complete glucose tolerance test, performed by the subject's own physician, if necessary. Triglyceride determinations two hours after the carbohydrate load were also available on a sample of 230 subjects.

PULMONARY FUNCTION AND METABOLIC STUDIES

Routine spirometry was done with a 13.5 L Collins apparatus. In a sitting position the subject performed the following maneuvers after runs of tidal breathing: maximal inspiration, maximal expiration, and finally a maximal expiration after a maximal inspiration (vital capacity). The readings were made at two speeds, 32 mm per minute and 160 mm per minute. A separate determination of these parameters was made on a Med-Science Wedge Spirometer 370 adopting the procedure of Bartlett (48). A velocity-volume loop was photographed with a polaroid camera from the oscilloscope. This loop was produced when the sitting subject after breathing normally into the spirometer then inhaled maximally and as rapidly as possible after which he exhaled in the same manner. All maneuvers were photographed superimposed on each other as depicted in Figure IV. 9. In addition to the measurements obtained from the routine spirometry, maximal inspiratory and expiratory velocity could be calculated by this method.

By means of the Sanborn 211 and the Med-Science Wedge Spirometer 370, expiratory and inspiratory curves were also recorded on magnetic tape for computer analysis (49, 50). While standing, the subject inhaled maximally from room air through a three-way valve, then exhaled with maximum force and speed into the spirometer (Figure IV. 10). He then inhaled as quickly and rapidly as possible from the spirometer, exhaling into the room air. A paper recording (Figure IV. 11) immediately demonstrated the validity of the curve. Final analysis of total volumes, forced expiratory and inspiratory volumes (one second, two seconds, and three seconds), and flow rates (maximal, 200-1200 ml, and 25%-75%) rested with the computer. The interpretation of a computer processed spirogram is illustrated in Table IV. IV.

ANTHROPOMETRY (51-53)

All weights and measurements were taken in the afternoon with the examinee completely disrobed. An average of two readings was taken for each parameter. All measurements of an extremity were made on the right side.

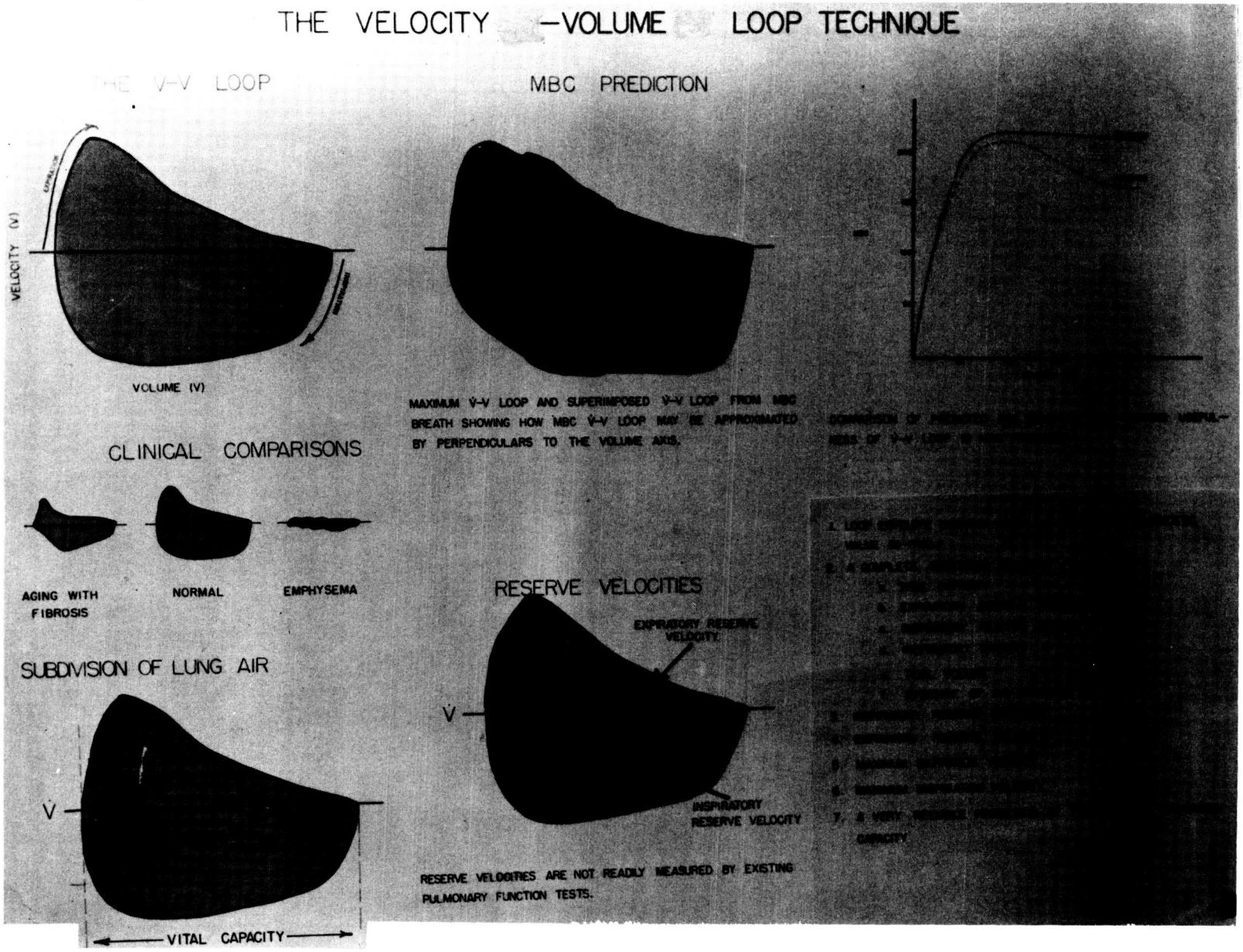

THE VELOCITY —VOLUME LOOP TECHNIQUE
THE V̇–V LOOP
VELOCITY (V̇)
VOLUME (V)
MBC PREDICTION
MAXIMUM V̇–V LOOP AND SUPERIMPOSED V̇–V LOOP FROM MBC BREATH SHOWING HOW MBC V̇–V LOOP MAY BE APPROXIMATED BY PERPENDICULARS TO THE VOLUME AXIS.
CLINICAL COMPARISONS
AGING WITH FIBROSIS
NORMAL
EMPHYSEMA
SUBDIVISION OF LUNG AIR
V̇
VITAL CAPACITY
RESERVE VELOCITIES
EXPIRATORY RESERVE VELOCITY
V̇
INSPIRATORY RESERVE VELOCITY
RESERVE VELOCITIES ARE NOT READILY MEASURED BY EXISTING PULMONARY FUNCTION TESTS.

Figure IV. 9

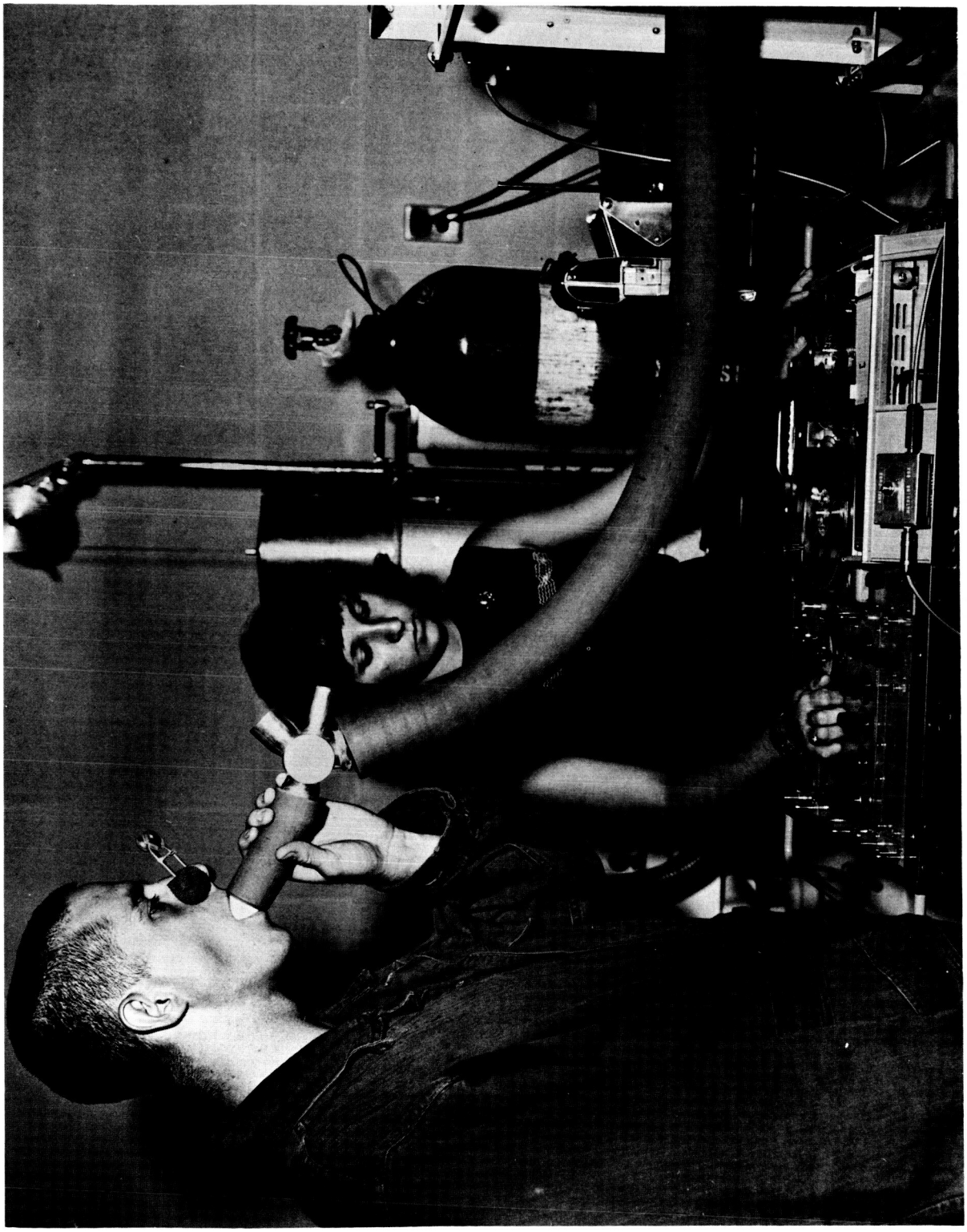
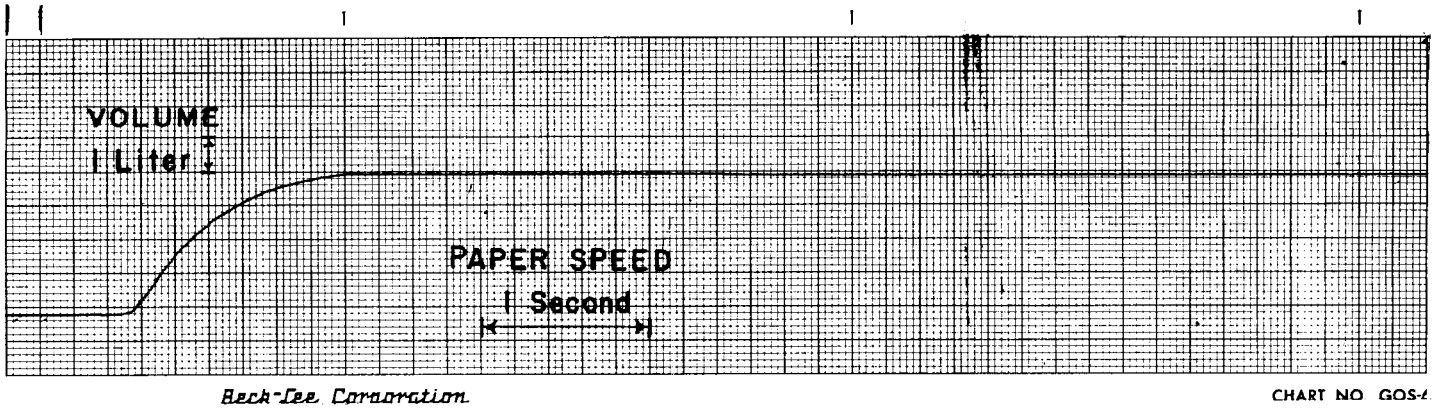
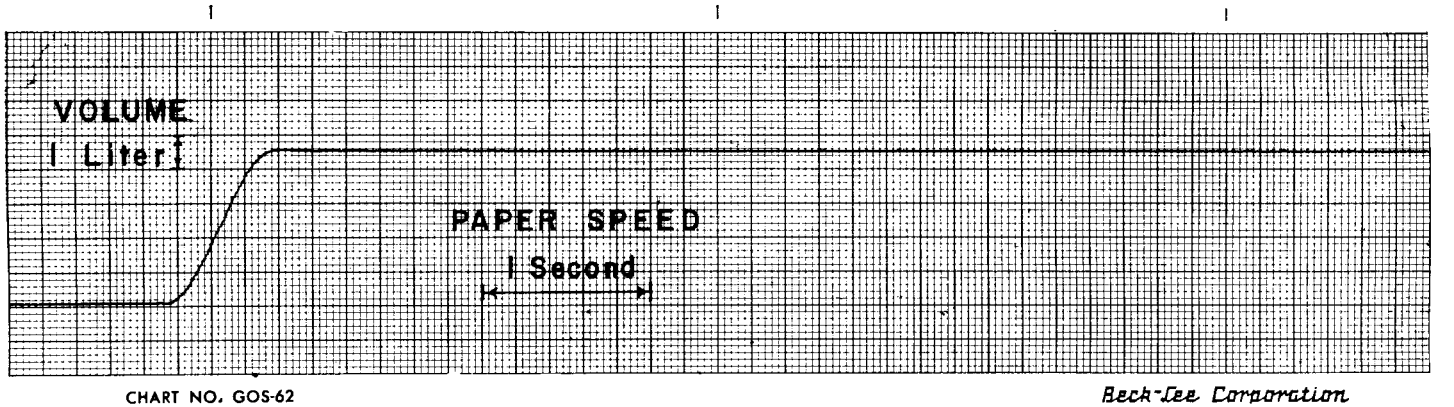


Figure IV. 10

Recording Pulmonary Curves on Magnetic Tape



A. FORCED EXPIRATORY SPIROGRAM



B. FORCED INSPIRATORY SPIROGRAM

Figure IV. 11

Table IV. IV

INSTRUMENTATION FIELD STATION ---- HEART DISEASE CONTROL PROGRAM

COMPUTER PROCESSED FORCED EXPIRATORY SPIROGRAM

PROCESSING DATE 08/06/65 CALIBRATION CONSTANT 1,083 ML

PATIENT NO. 0000-02 AGE 21 YRS SEX M HEIGHT 74 IN

PREDICTED VITAL CAPACITY 4,752 ML

	TRIAL 1	TRIAL 2	NORMAL
FORCED VITAL CAPACITY (ML)	5,230	5,448	
PERCENTAGE OF PREDICTED VC	110	114	≥ 80
TIME OF FVC (SECONDS)	1.96	2.60	
TIME OF MAX. INST. FLOW RATE	0.17	0.15	
FORCED EXPIRATORY VOLUMES (ML)			
ONE-HALF SECOND	3,205	3,269	
PERCENTAGE OF FVC	61	60	
THREE-FOURTH SECOND	4,076	4,089	
PERCENTAGE OF FVC	77	75	
ONE SECOND	4,666	4,679	
PERCENTAGE OF FVC	89	85	≥ 75
TWO SECONDS	5,217	5,410	
PERCENTAGE OF FVC	99	99	≥ 94
THREE SECONDS	5,217	5,435	
PERCENTAGE OF FVC	99	99	≥ 97
AT MAX. INST. FLOW	1,166	1,128	
PERCENTAGE OF FVC	22	20	
FLOW RATES (ML/SEC)			
200-1200 ML	7,735	9,025	≥ 7,000
25%-75% FVC	5,129	4,853	≥ 3,400
25%-50% FVC	6,884	6,795	
50%-75% FVC	4,087	3,775	
.5 - 1 SEC	2,922	2,820	
1 - 2 SEC	551	731	
2 - 3 SEC	0	25	
MAX. INSTANTANEOUS MID-EXHALATION	9,568 5,402	9,476 5,081	

INTERPRETATION -

ABOVE DATA WITHIN NORMAL LIMITS

Heights

A special device (Figure IV. 12) was used for measuring heights. With head oriented in the horizontal eye-ear (Frankfort) plane, and back flat against the support, the subject stretched to maximum height and inspired deeply. This procedure was used for both standing and sitting heights taken to the nearest tenth of an inch.

Weight

Was taken on a calibrated balance scale to the nearest pound.

Skinfolds

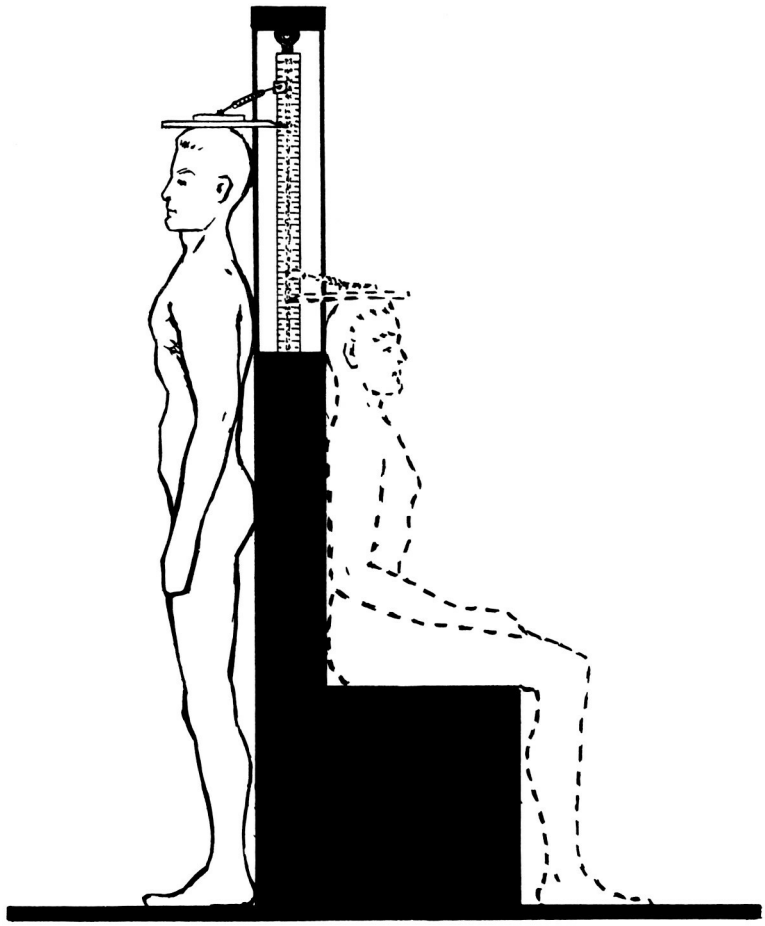
Four areas were measured: 1) midway between the right acromial process and the olecranon, 2) at the inferior tip of the sacpula, 3) the right mid-axillary line at the level of the xiphoid, and 4) right mid axillary line at the level of the umbilicus. A full thickness of skin was pinched up from the underlying tissue parallel to the natural folds of the area. Lange skinfold calipers were then applied to the fold about one cm below the fingers and halfway down the fold. Values were recorded after the indicator had settled (Figure IV. 13).

Circumferences

Keuffel and Esser Wyteface tape was applied with minimal pressure for these measurements. Chest circumferences were taken at the fourth intercostal space at mid-breath, maximal inspiration, and maximal expiration (Figure IV. 14). The relaxed abdomen was measured at the level of the umbilicus just superior to the "fat roll." The biceps was assessed at the mid-point of the arm between the right acromial process and olecranon, first with the arm and forearm relaxed at the side, and then with the arm perpendicular, but the forearm placed parallel to the floor while the fist was tightly clenched. The maximal circumference of the forearm was measured with the entire arm extended parallel to the floor, volar surface upward, and hand open. That portion of the wrist just distal to the styloid process of the ulna was measured with the arm in the same position. The maximal circumference of the calf was measured while the subject stood on a chair with his legs slightly apart.

Diameters

All diameters were evaluated with a Hrdlička anthropometer; the blades were pressed firmly against the bony prominences. For the biacromial diameter the subject stood with his head slightly bent forward and shoulders "slouched." Measurement was made from the most lateral aspects of the acromial processes (Figure IV. 15). Both breadth and anterior-posterior diameters of the chest were measured at the level of the nipples. The bi-iliac measurement was made just inferior to the anterior superior iliac spine in the horizontal plane, with the legs together. While the subject held this position the anthropometer was also placed on the trochanteric prominences. The diameter of the wrist was measured from the styloid process of the radius to that of the ulna with the arm hanging at the side, hand open and parallel to the sagital plane. Maximal diameter between the maleoli was measured with the subject standing on a chair dividing his weight equally between both feet. The anthropometer blades were 45 degrees to the horizontal plane for this measurement.



APPARATUS FOR MEASUREMENTS
OF SITTING AND STANDING HEIGHTS

Figure IV. 12

Figure IV. 13
Measurement of Subscapular Skin Fold

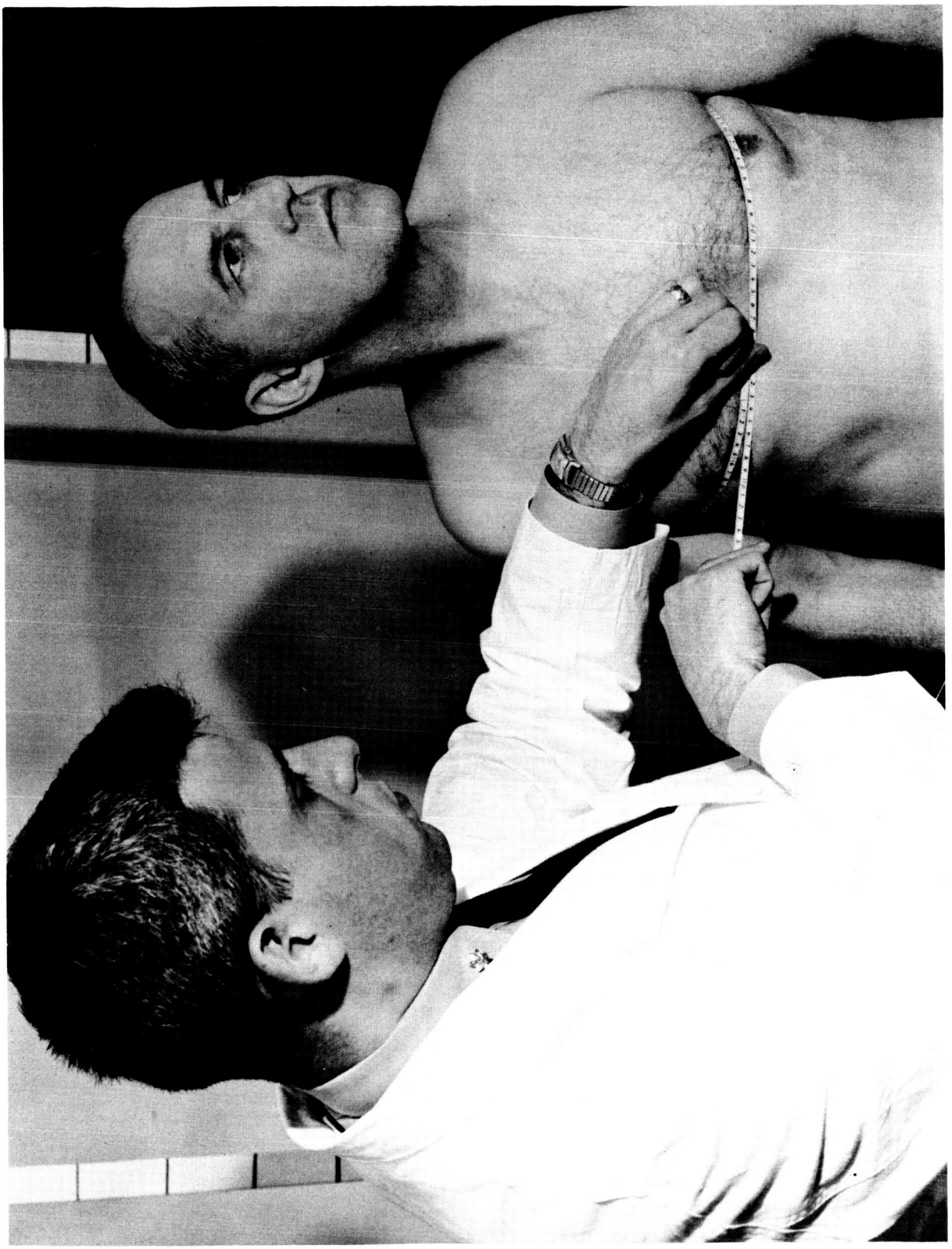


Figure IV. 14

Measurement of Chest Circumference

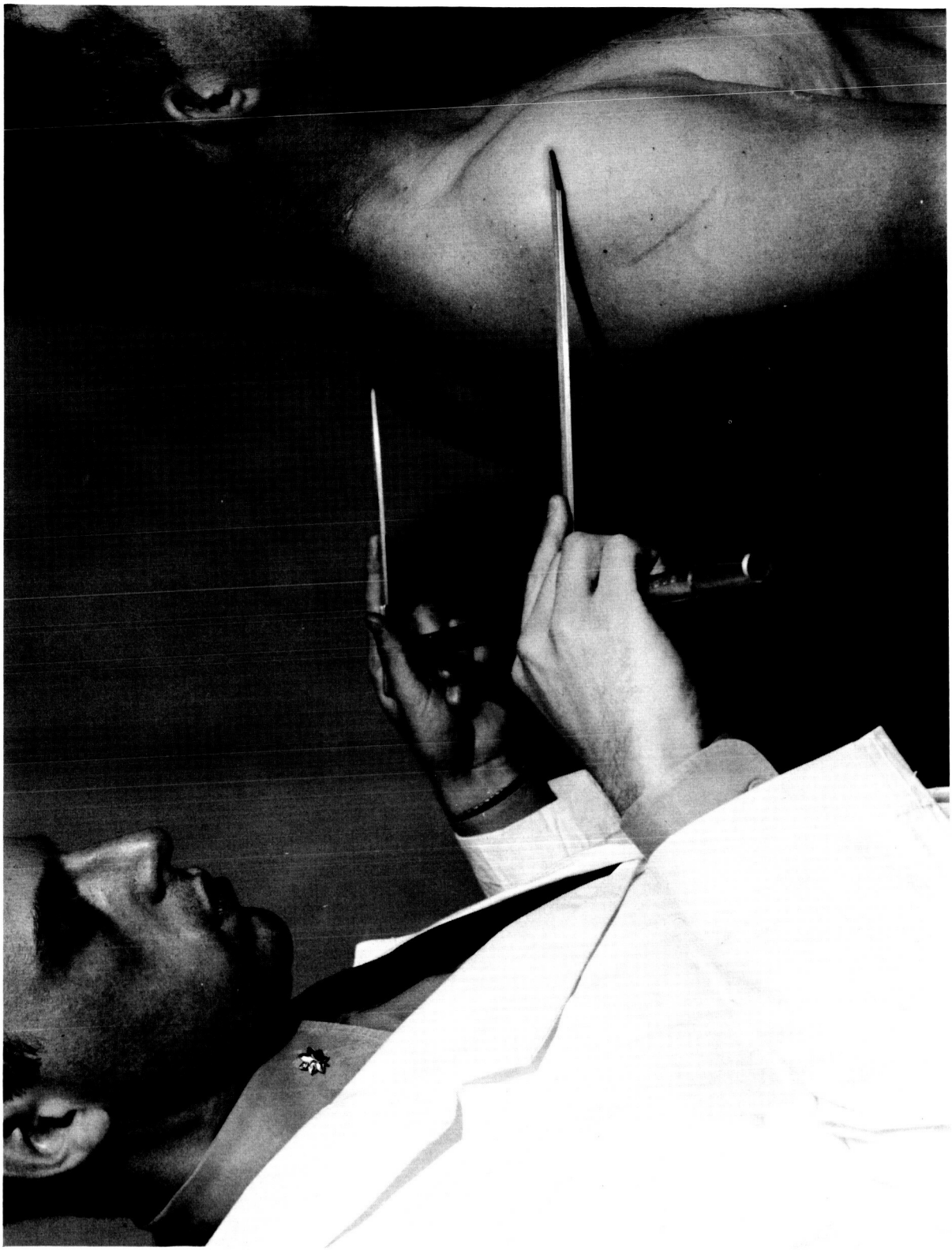


Figure IV.15
Measurement of Biacromial Diameter

Hand Grip

Strength was measured in both right and left hands with a dynamometer (Figure IV. 16) with the forearm parallel to the floor and at right angles to the arm. The maximal recording of two trials was used.

Somatotype (54)

Photographs (Figure IV. 17) were taken with the subject posed in three standard views by rotating a turntable 90 degrees. All pictures were made at a standard distance of 14 feet with a Rembrandt portrait camera (Model II) using a Tessar 6.3/210 lens. Scoring as described previously was on a 7-point scale for each of the components: endomorphy, mesomorphy, and ectomorphy (Figure IV. 18). Dysplasia (heterogenity of build) and gynandromorphy (femininity) were also evaluated. The somatotypes were rated by Doctor Albert Damon, Harvard University, who fortunately also scored the original somatotype in 1940.

TELEOROENTGENOGRAMS

Standard cardiac series consisting of posterior-anterior, left lateral, and right and left anterior oblique views were taken (Figure IV. 19). Other than the immediate clinical evaluation, measurements of the transverse, broad, and long diameters of the heart (Figure IV. 20) were made calculating frontal area and cardiothoracic ratios (55). Chest films available from 1952 and 1958 were also evaluated in this manner for comparison.

PSYCHOLOGICAL-PSYCHOMOTOR

Guilford Zimmerman Temperament Survey

This was a paper and pencil personality test in which the subject answered 300 questions about himself with a yes, no, or question mark reply. According to his response he was given a percentile ranking in the following categories: general activity, energy, restraint, seriousness, emotional stability, ascendance sociability, objectivity, friendliness, thoughtfulness, personal relations, and masculinity. Administration and interpretation of the test are discussed in an instruction manual (56).

Graybiel-Fregly Ataxia Test

The three distinct ataxia tests (57) consisted of: 1) walking a 3/4" wide rail with eyes open, 2) standing on a 3/4" wide rail with eyes open, and 3) standing on a $2\frac{1}{4}$" wide rail with eyes closed. The correct body position for all three tests is body erect, feet in heel-to-toe position, tandemly aligned, with the arms folded against the chest (Figure IV. 21). The subject first walked the 3/4" wide rail with his eyes open, then he stood on the same rail with his eyes open, and finally stood on a $2\frac{1}{4}$" wide rail with his eyes closed. The walking test is scored on the number of consecutively correct steps to a maximum of 5 steps per trial. The scores on the standing tests depend on the number of seconds a subject is able to maintain his position to a maximum of 60 seconds with eyes open and 180 seconds with the eyes closed.

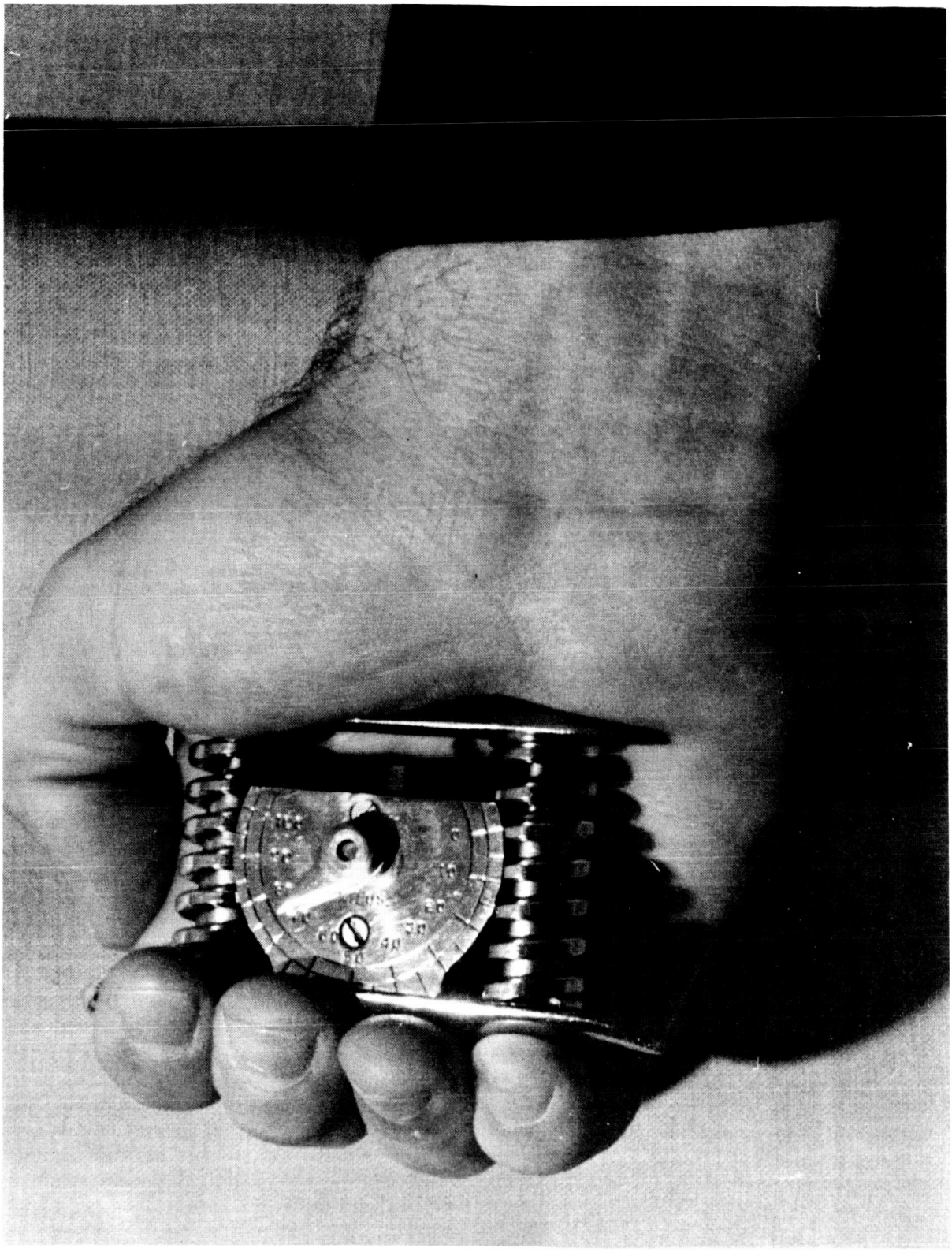


Figure IV. 16
Dynamometer

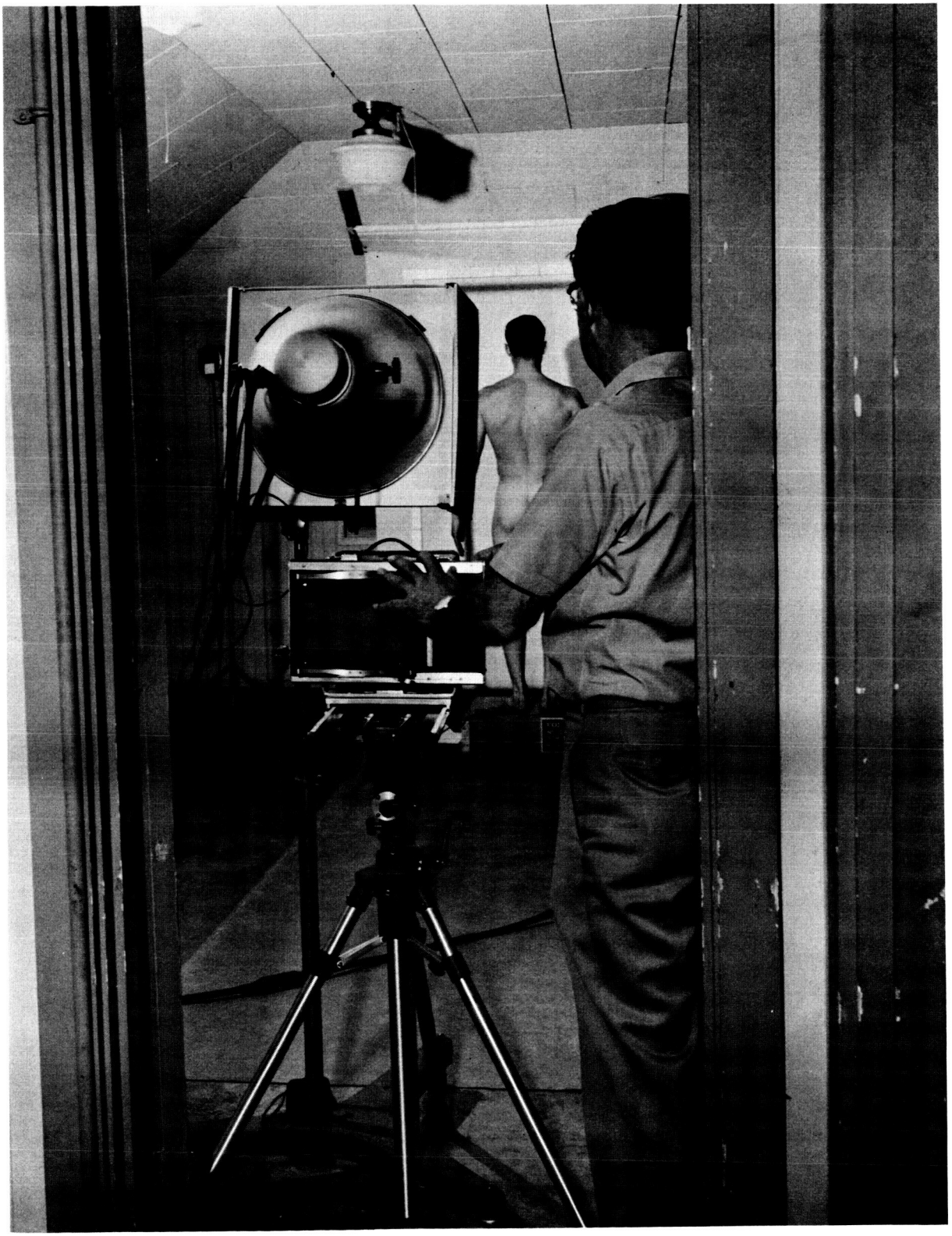


Figure IV. 17

Standardized Photograph Procedure for Somatotyping

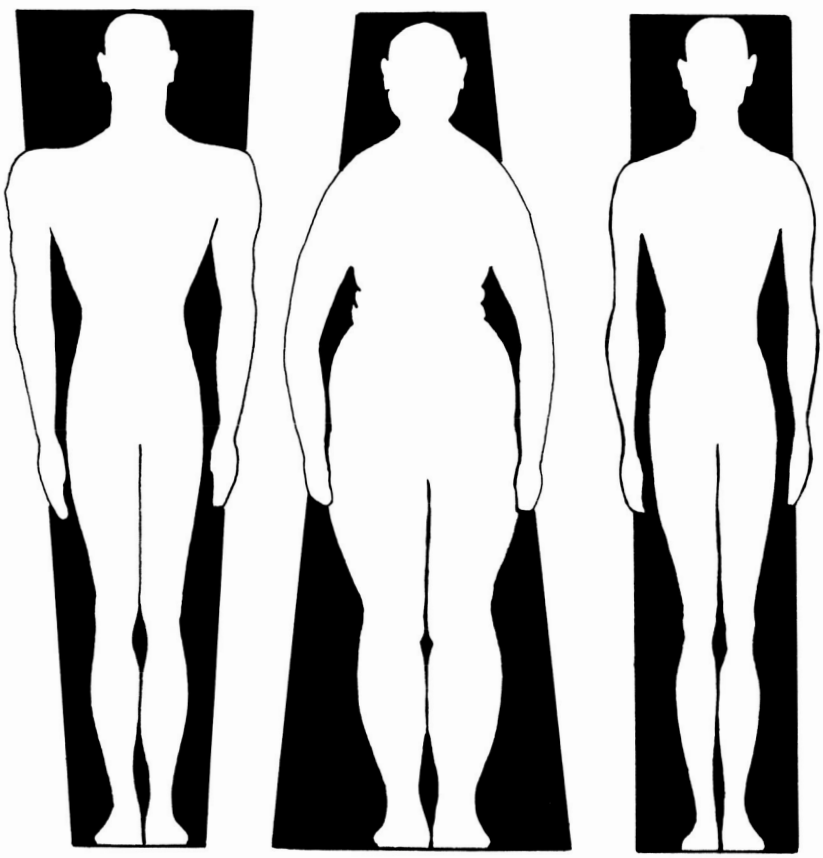


Figure IV. 18

Basic Somatotypes

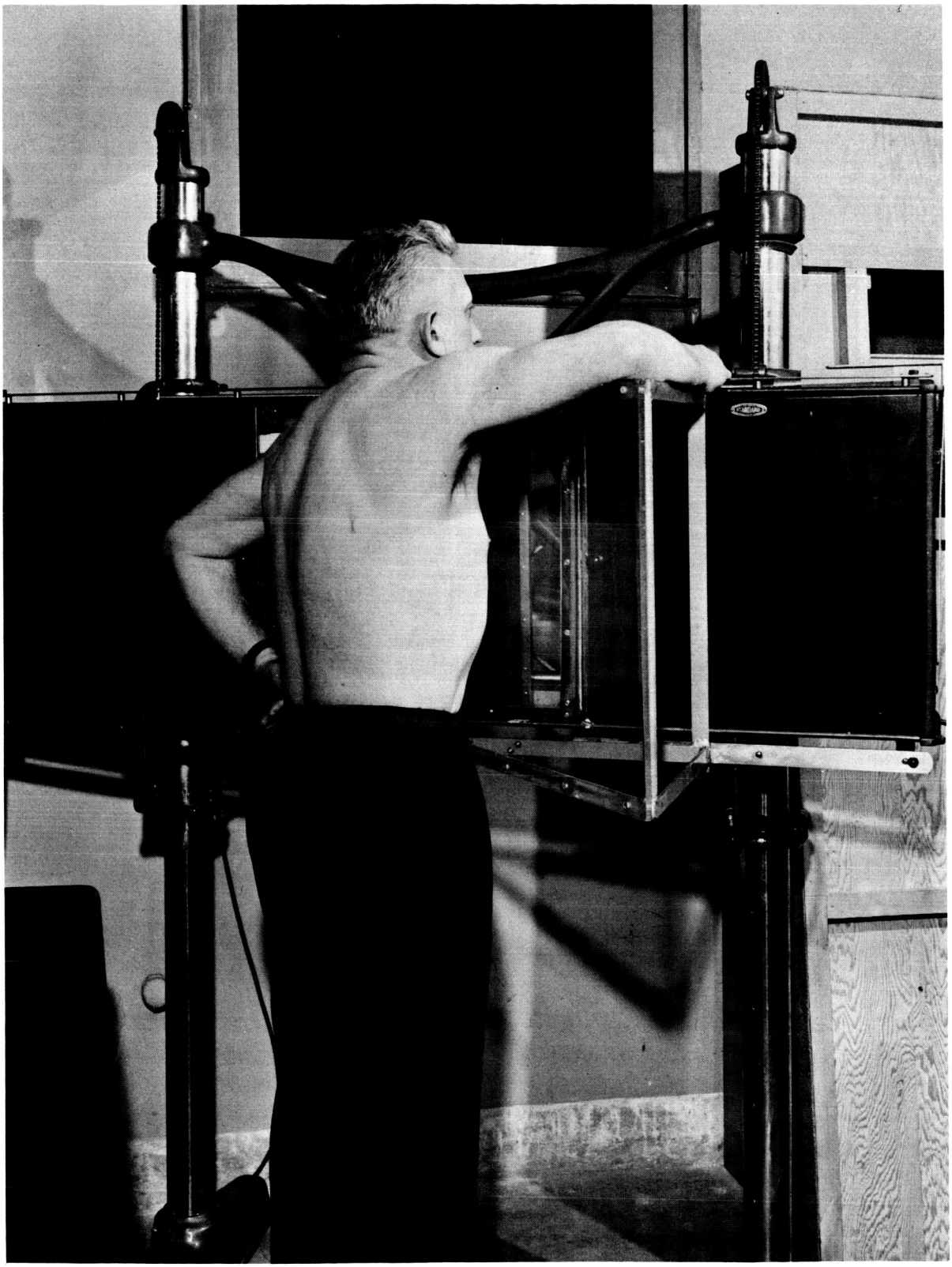
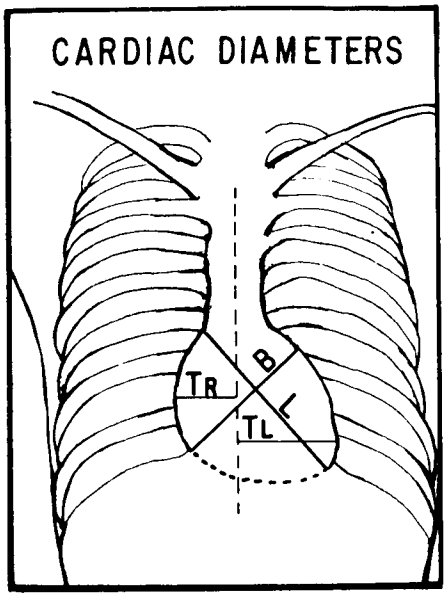


Figure IV. 19

Position of Subject for Teleorentgenogram



B = BROAD DIAMETER

L = LONG DIAMETER

TR+TL = TRANSVERSE DIAMETER

Figure IV. 20

Diagram for Measuring Cardiac Diameters

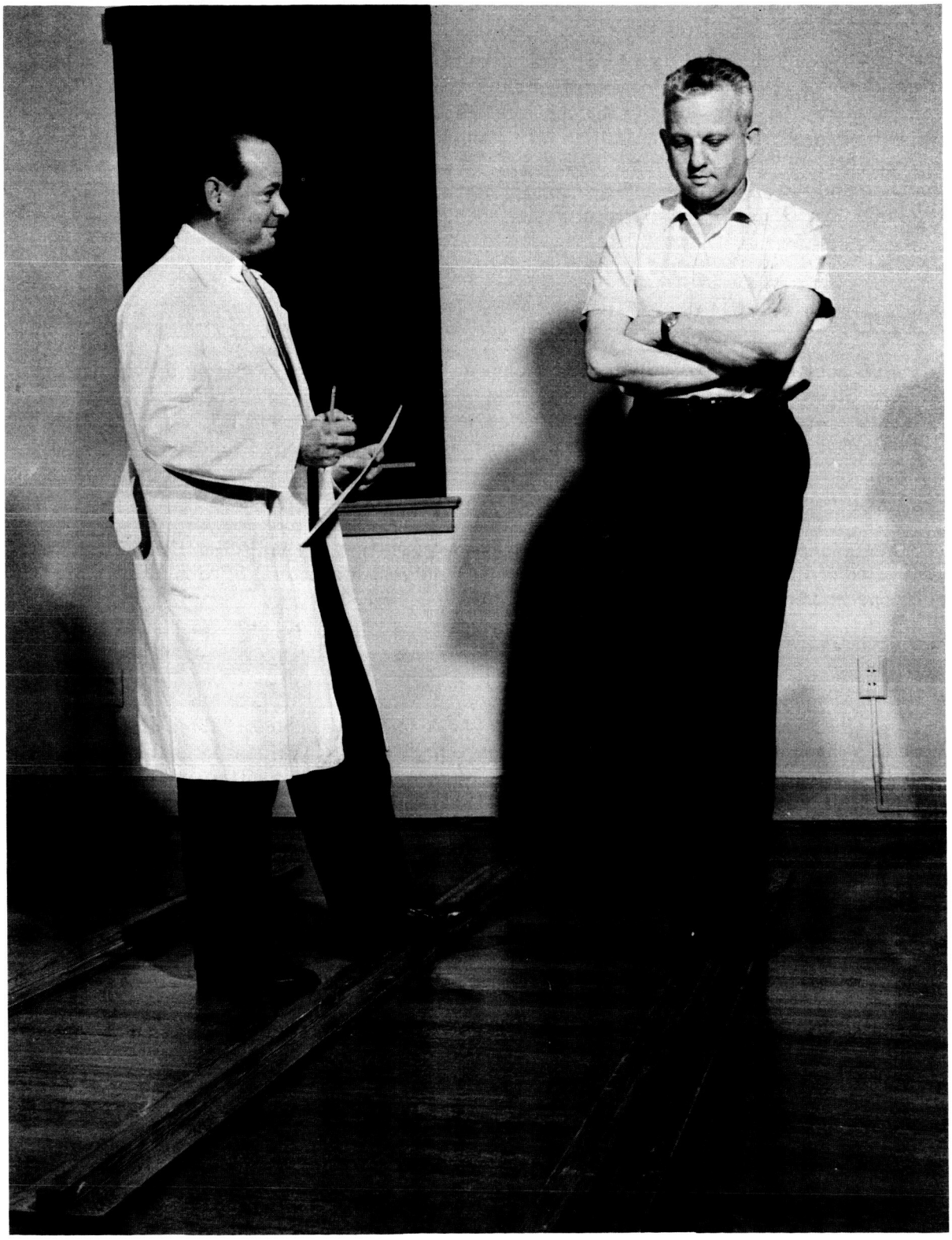


Figure IV. 21

Graybiel-Fregly Ataxia Test

Tilt Chair Test*

A special chair was used to determine the subject's ability to estimate the postural upright. It was designed to minimize proprioceptive clues when the subject was tilted with respect to the vertical plane. He was seated in the apparatus (Figure IV. 22) and asked to manipulate the chair by controls to a "true" vertical position. This setting was used as the "zero point." The subject was then blindfolded and the room darkened. The examiner at a separate control center tilted the chair and the subject attempted to correct his position to the vertical reference point. Deviations from this "zero point" were recorded for each trial and constituted the score.

VISION

Tonometry

A Schiotz tonometer with a 5.5 gm plunger load was used for measuring intraocular pressure (Figure IV. 23). This was usually done on the second morning, occasionally after the Harvard step-test. Readings were transferred from tonometer scale to mm Hg. All borderline and abnormal values were rechecked at the local Navy Ophthalmology Clinic.

Retinal Photographs (Figure IV. 24)

Photographs were taken with a Noyori Fundus Camera after pupil dilatation. The subject was seated and told to fix his gaze on a reference point. Two exposures of each fundus were made at an aperture of 2.4.

NEUROPHYSIOLOGIC

Electroencephalograms were taken either on a Grass Model III D or Model 6 (Figure IV.25). The lead placement is shown in Figure IV. 26 for both machines. Three runs were made in a standard fashion while the subject was resting; then a hyperventilation run was completed with three minutes of prehyperventilation, three minutes hyperventilation, and three minutes posthyperventilation. If the electroencephalogram appeared suspicious, photic-stimulation was carried out; there were twenty seconds of continuous stimulation at frequencies of 7, 10, 12, 15, 18, 21, 24, 27, and 30. A clinical interpretation was made for each record; no quantitation has been attempted to date.

AUDIOMETRY

Standard Threshold Audiogram

This test (58) was administered using the Rudmose ARJ-4 automatic audiometer. It measured threshold at 500, 1000, 2000, 3000, 4000, and 6000 cycles per second. A reversible electric motor drives an attenuator which controls the level of presentation of each test tone in succession. This motor is controlled by a switch held by the subject. As long as the subject does not press the switch, the tone gets progressively more intense. Holding the switch in the depressed position reverses the electric motor and causes the tone to become softer. A pen records the action of the motor-driven attenuator. Thus, by holding the switch down when he heard a tone and releasing it as long as he did not hear the tone, the subject caused the recording pen to swing from slightly below to slightly above his threshold, and recorded his own audiogram in this manner (Figure IV.27).

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*Testing was discontinued after 100 subjects.

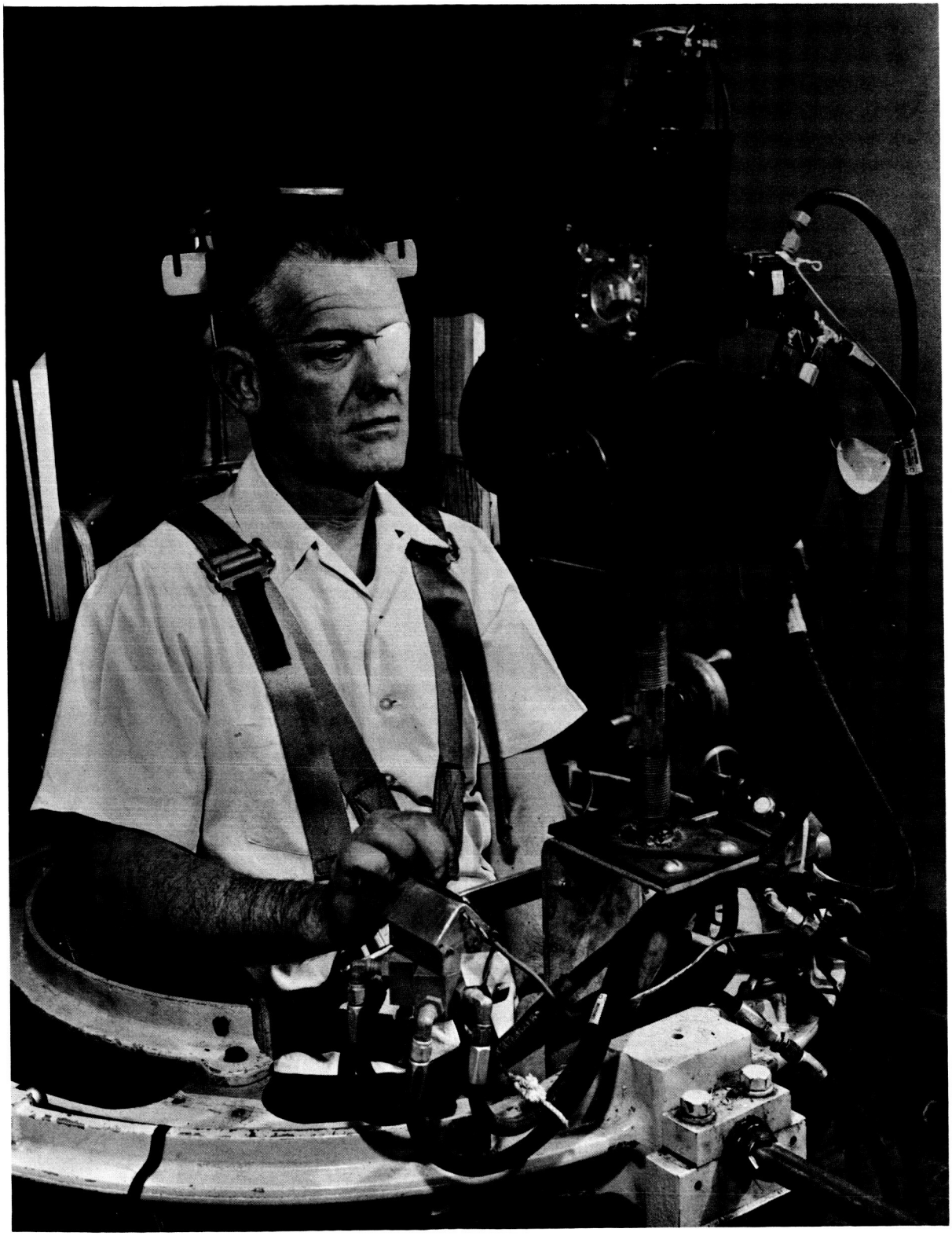


Figure IV. 22

Tilt Chair Apparatus

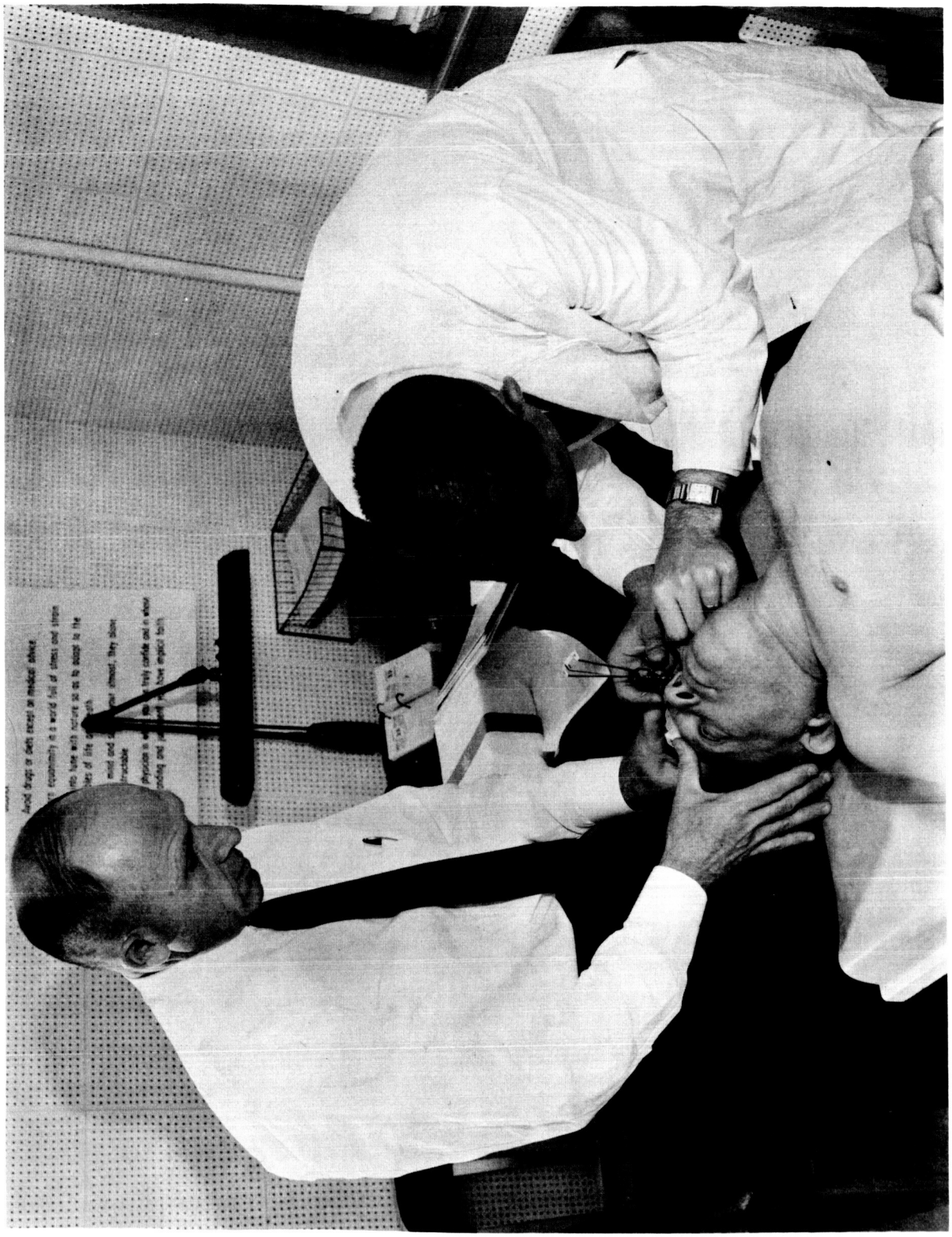


Figure IV. 23

Measurement of Intraocular Pressure with the Schiotz Tonometer

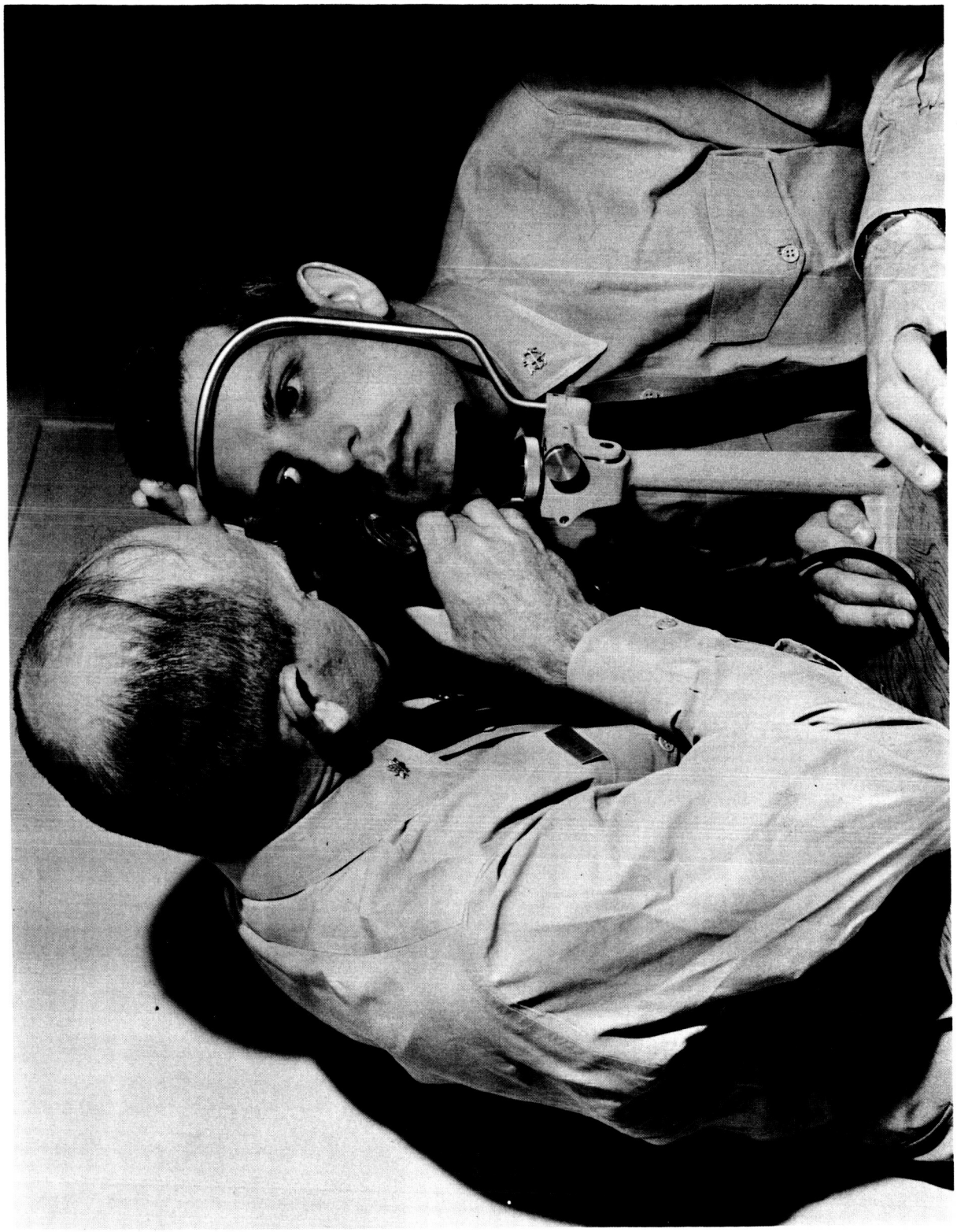
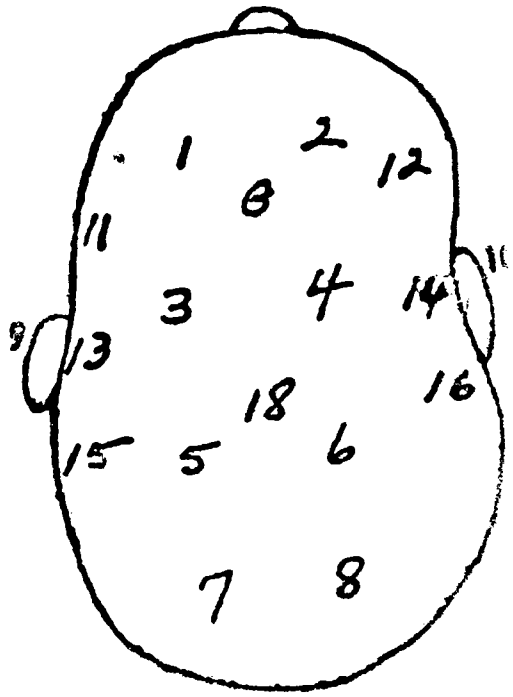


Figure IV. 24

Retinal Photograph with Nayori Fundus Camera

Figure IV. 25

Electroencephalograph



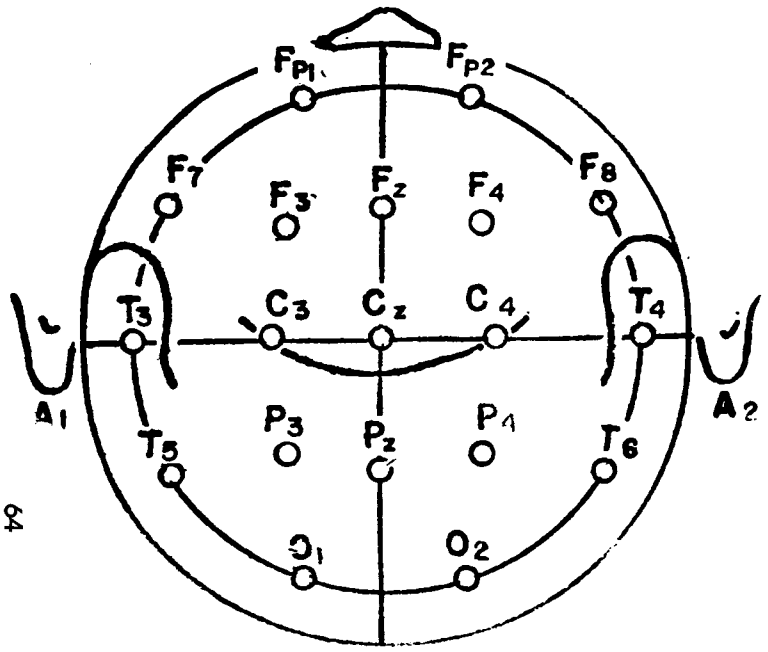
RUN 1	RUN 2	RUN 3	RUN 4
1 - 9	1 - 11	1 - 3	1 - 18
2-10	11 - 13	2 - 4	2 - 18
13-9	13 - 15	3 - 5	11 - 18
14-10	15 - 7	4 - 6	12 - 18
5 - 9	2 - 12	5 - 7	13 - 18
6-10	12 - 14	6 - 8	14 - 18
7 - 9	14 - 16	11 - 15	15 - 18
8-10	16 - 8	12 - 16	16 - 18

Figure IV. 26 A

Placement for EEG Leads With Grass Model III D

Run 4 was used for the hyperventilation run. There were 3 minutes of pre-HV, 3 minutes of HV, and 3 minutes of post-HV.

A photic stimulation was done; there were 20 seconds of continuous stimulation at each of the following frequencies: 7,10,12,15,18,21,24,27, and 30.



RUN 1	RUN 2	RUN 3	RUN 4
Fp1-A1	Fp1-F7	Fp1-F3	Fp1-Cz
Fp2-A2	F7-T3	Fp2-F4	Fp2-Cz
T3-A1	T3-T5	F3-P3	F7-Cz
T4-A2	T5-O1	F4-P4	F8-Cz
P3-A1	Fp2-F8	P3-O1	T3-Cz
P4-A2	F8-T4	P4-O2	T4-Cz
O1-A1	T4-T6	F7-T5	T5-Cz
O2-A2	T6-O2	F8-T6	T6-Cz

Figure IV. 26 B

Lead Placement for Grass Model 6

Run 4 was used for the hyperventilation run. There were 3 minutes of pre-HV, 3 minutes of HV, and 3 minutes of post-HV.

A photic stimulation was done; there were 20 seconds of continuous stimulation at each of the following frequencies: 7,10,12,15,18,21,24,27, and 30.

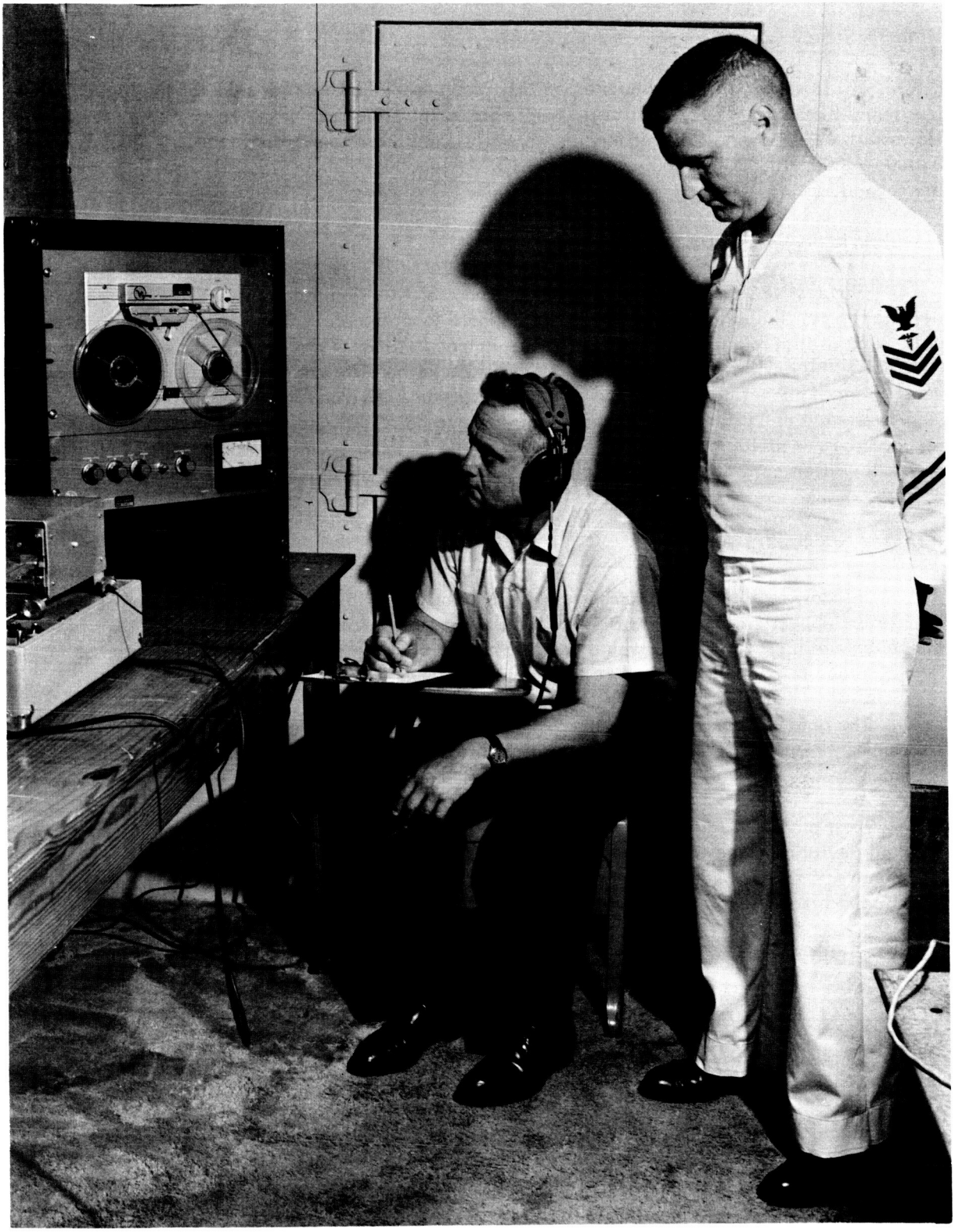


Figure IV. 27

Procedure for Recording Audiogram

High Frequency Audiogram

This test was one which was especially prepared by Rudmose for study of the high-frequency threshold in man. It was accomplished in the same manner as the preceding test. However, the following test frequencies were substituted for the standard tones: 4,000, 6,000, 8,000, 9,000, 10,000, 11,000, 12,000, 13,000, 14,000, 15,000, 16,000, and 18,000 cycles per second.

Naval Aviators Speech Discrimination Test

This test was developed at the Naval School of Aviation Medicine in 1962 (59). It was designed to test the aviator's ability to discriminate loud speech in the presence of high-intensity noise such as that found in the cockpit of an airplane. The test was presented through earphones from a specially modified tape recorder. Text material consisted of 100 single-syllable words constituting a phonetically balanced sample of common American speech sounds. The words were presented at 115 db in a background of airplane noise (Beechcraft SNB cockpit) which reached the ear at 100 db. The subject was required to write each test word, and the number of words written correctly represented his "NASDT Score," a measure of his discrimination in noise.

DATA PROCESSING

In addition to the case number assigned during the original study to each member a cumulative appearance number was given to each participant in this evaluation; for example, the seventeenth man examined would have an appearance number of 17. This enabled us to locate, process, and file the accumulated data more readily.

The data processing equipment available during the 1963 evaluation consisted of an IBM 1620 computer with disc drive and printer plus the implements required for electronic accounting machines.

Most programmed statistical procedures involved the common measures: range, means, standard deviations, skewness, and correlation coefficients. The formula of Wherry, Jr. (60) which corrects for shrinkage in the multiple correlation is perhaps the only nonstandardized statistical parameter used in this present evaluation.

MISCELLANEOUS

Special Autopsy Protocol

Permission was asked for the inclusion of a special cardiovascular autopsy protocol in the emergency data portfolio of those participants still on active military duty (Appendix D, pages D51-D54). If such information could be obtained from post-mortem studies, it would provide invaluable correlative data that might be missed during the routine performance of an autopsy.

Chapter V

CONCLUSIONS AND RECOMMENDATIONS

INTERVIEW--PERSONAL AND MEDICAL HISTORY

The history forms used in the evaluations to date have contained a number of trivial questions concerning diet, exercise levels, etc. Time would be more profitably spent perhaps by focusing in depth on uncharted areas of such a nature that recall information would be accurate and standardizable. These historical areas should provide correlative data for objective information already at hand. A detailed, structured interview concerning alcohol intake and amount of physical activity throughout the participant's life would appear to satisfy these requirements. There also have been some inherent problems with the smoking history. An average quantity of cigarettes over a period of years does not reveal the changes in smoking habits or rates from day to day. A method has been developed (61) for quantitating this important variable more precisely by plotting the yearly amount against each year and describing the area under the curve. This may be a suitable method to employ for developing relationships with smoking.

PHYSICAL EXAMINATION

In conjunction with the follow-up examinations it might be feasible to conduct the "annuals" at Pensacola on all members of the study still on active military duty. This would provide detailed information of these participants and circumvent some of the problems involved with locating and scheduling members for each evaluation , especially those active duty members serving outside the continental United States.

CARDIOVASCULAR TESTS

It is hoped that the magnetic tape facilities will be expanded so that all cardiovascular functions can be recorded in this manner. The ease of analyzing, comparing, and storing these data after recording on magnetic tape would greatly facilitate further large scale studies along these lines.

For optimal characterization of exercise electrocardiograms the tracings should be run at double speed and double amplitude. This would help define the ST segment to a great extent for objective measurement. Also it has been advocated by some (62) that unless electrocardiograms are taken during exercise, positive responses will be missed; this procedure also might prove of value.

Repetition of the cold pressor test and the Schneider Index on a large sample of the population would provide data for making a definitive evaluation of the utility of these procedures.

LABORATORY DETERMINATIONS

A procedure for storing quantities of blood obtained from the study participants should be worked out before any subsequent follow-up. Benefits from such serum banks would be manifold.

Genetic markers for the Thousand Aviators have never been utilized. Methods for characterizing populations by their gene pool have been discussed by Blumberg (63) who uses biochemical traits such as red blood cell antigens and serum proteins.

PULMONARY FUNCTION AND METABOLIC STUDIES

If the results of the BMR in 1940 are assumed to be valid, a repeat of this test would provide unique information not available elsewhere.

PSYCHOLOGICAL-PSYCHOMOTOR

Recent interest has been generated in the use of psychomotor tests as an index of physiological aging (64). Remeasurement of selected psychomotor parameters used in 1940 for comparison with cardiovascular and general physiologic aging would be highly desirable .

DATA PROCESSING

Compilation of previous data has taken many different forms. Special indices were computed from various formats tuned to the computer facilities available at the time of analysis. These factors have led to certain inherent data processing problems; for example, relative weights have been computed using different standards, 9's have been recorded for unknowns, and constants have been added to certain values to preclude zeros which at one time could not be handled by the computer.

The apparent solution to the data processing problems appears to be that of extracting from the studies all primary (nonderived) values. These should be placed in a "fixed point," standard format for storage on magnetic tape. These "raw" data would indeed provide a common basis for any future relationships, indices or calculations, and obviate the need for data conversion before analysis.

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APPENDIX A

Forms Used in 1940 Study (Chapter I)

PERSONAL AND MEDICAL HISTORY FORM

(1) NAME: _____ CLASS # _____
(Last) (First) (Middle)

Age: _____ Height: _____ Weight: _____

(2) FAMILY HISTORY

Maternal grandmother: Age____ Died at age____ Cause of death (if known)_____
Maternal grandfather: Age____ Died at age____ Cause of death (if known)_____
Paternal grandmother: Age____ Died at age____ Cause of death (if known)_____
Paternal grandfather: Age____ Died at age____ Cause of death (if known)_____

Brothers: Approx. ages: _____
Sisters: Approx. ages: _____
Wife: _____
Children: _____

Indicate relation of blood relatives who have had:
Cancer _____
Tuberculosis _____
Heart Trouble _____
Kidney Trouble _____
Insanity _____
Diabetes _____
Allergy (hay fever, asthma, hives, unusual reaction to certain foods) _____
_____
Nervous Breakdown _____
What other illnesses are frequent in your family? _____
_____
_____
Is any member of your family now in the hospital or sick at home? _____
If so, give details: _____
_____
_____

Father: Age: _____ Died at age: _____ Cause of death: _____
Serious illnesses _____
Education _____ Occupation _____
How successful? _____
Characteristics (for instance, is he phlegmatic or irritable? Strict or lenient? Genial or serious? Easy going or tense? Steady or emotional?) _____
_____
_____

Mother: Age: _____ Died at age: _____ Cause of death: _____
Serious illnesses _____
Education _____
Occupation _____
Is she well adjusted? _____ What civic and social activities does she participate in? _____
Characteristics _____

What is your family origin? (English, French, etc.)_____
Father's family_____
Mother's family_____
What religions are represented in your immediate family? (Protestant? Catholic? Jewish? Other? Indicate if more than one)_____
_____
State your family's (including your fiancee's) reaction to your present course
Approve or object?_____
Pleased, worried, or both?_____
Further explanation:_____
_____
_____
_____

(3) PERSONAL HISTORY

Have you ever fainted?_____If so, give date and details_____
_____
Have you ever been "knocked out?"_____If so, give date, details and length of time "out"_____
_____
Have you ever had a head injury?_____

Check any of the following diseases or conditions you have had and give age:

CONTAGIOUS DISEASES
- Scarlet Fever
- Diphtheria
- Typhoid Fever
- Malaria
- Sleeping Sickness
- Syphillis
- Gonorrhea

LUNGS
- Pain in chest
- Chronic cough and expectoration
- Bloody expectoration
- Hemorrhage from lungs
- Tuberculosis
- Pneumonia
- Asthma

HEART AND CIRCULATION
- Any heart disease?
- Rheumatic fever
- Rheumatism
- Leaky valves
- Growing pains (arms and legs)
- Undue shortness of breath on exertion
- Palpitation of heart
- Irregular pulse
- Dizziness upon rising or exercise
- Swollen ankles (other than sprain or accidents)
- Hemorrhage

GASTRO-INTESTINAL
- Appendicitis
- Nausea or vomiting associated with low abdominal pain
- Indigestion
- Constipation
- Food Poisoning
- Hemorrhages from mouth
- Hemorrhages from bowels
- Ulcers of stomach
- Ulcers of intestines
- Hernia (rupture)

GENITO-URINARY
- Frequent urination
- Painful urination
- Wakefulness at night to empty bladder
- Sores on genitals
- Infection of genitals with discharge of pus
- Discharge from genitals

NEURO-PSYCHIATRIC
- Headache-recurrent and severe
- Sleeplessness
- Neuralgia
- Sleepwalking episodes
- Disturbing nightmares
- Bedwetting (after 6 yrs. of age)
- Outbursts of irritability
- Sudden blank periods in memory

NEURO-PSYCHIATRIC (cont.)

- Nervousness (without apparent reason)
- Nail biting
- Speech defect
- Recurrent worries
- Moody ups and downs (What do you think causes them?)
- Have you ever been severely upset by the death of a friend, broken love affair, or disappointment at school, college, or elsewhere?

EAR, NOSE, AND THROAT

- Colds. How often?_____
- Persistent sore throat
- Severe sinus trouble
- Discharge from ears
- Mastoiditis
- Hay Fever
- Sores in mouth
- Sores in corner of mouth or lips

Discuss any of the above conditions that need further explanation:_____

_____

_____

_____

_____

Have you ever had any unusual laboratory tests or X-ray examinations made in your case?_____If so, give date and details_____

_____

_____

From a health conservation standpoint, is there any organ or region of your body to which you would like a physician to devote special and searching attention?____
What?_____

_____

_____

What are your most pressing worries at present?_____

_____

Do you ever have a feeling of tightness or pressure in your head? Or peculiar feelings elsewhere, such as numbness or difficulty in moving? Where and under what conditions?_____

_____

_____

Do you retain any of the usual fear associated with flying?_____If so, is it due to (1) dangers of learning to fly, (2) fear of combat, (3) uncertainty about passing flight checks (check which)
What worries you most about it?_____

_____

_____

Have you had any serious accidents, broken bones, dislocations, or surgical operations?_____Give dates and details_____

_____

_____

How much tobacco do you use daily?_____

_____

What drugs or medicines do you take regularly (if any)_____
How much alcohol do you use? Beer_____per week. Cocktails_____per week. Whiskey_____per week. How often?_____
Do you think you are more or less susceptible to alcohol than most people?_____

_____

How often do you consult your dentist?_____When last?_____

Eating Habits:

Do you skip meals?_____ Which ones?_____ How often?_____ Did you skip meals at college?_____ at home?_____ If so, explain why_____

Do any foods disagree with you?_____

Check whether you take the following foods, "usually," "occasionally," "never," if occasionally, say in the space below how many times a week.

	Usually	Occasionally	Never
Milk			
Cream			
Butter			
Meat			
Chicken			
Fish			
Cheese			
Eggs			

	Usually	Occasionally	Never
Oranges or juice			
Tomatoes or juice			
Fresh fruits			
Whole grain cereals			
Oatmeal			
Cold cereal (which)			
Coarse grain bread (other than white)			

	Usually	Occasionally	Never
Carrots			
Cabbage			
Cauliflower			
Beans			
Peas			
Potatoes			
Salads			
Greens			

How does the mess compare with your food in college? Check. Better_____ About same?_____ Worse?_____ If worse, describe in what way_____

What is your opinion as to the quality of the food? Check. Good_____ Average_____ Poor_____ What is your opinion as to the preparation of the food Check. Well prepared_____ Average_____ Poor_____ If "average," or "poor," write clearly and concisely your criticism and recommendation_____

(4) ENVIRONMENT

Reared by whom until college	Where	Population

Birth order:_____ child out of_____ children in family.

Economic conditions:_____

Discipline (harsh? mild? variable?)_____

Was there particular emphasis on certain principles?_____ What ones?_____

Home conflicts: Parents _____ Other members of family _____
Broken Home _____
Reaction to, or opinion of, home training (for instance, did parents try to run your life too much? Do you think it could have been better or was it O.K.?) _____

Religious Conflicts: Parents _____ Family _____

(5) EDUCATION

Grammar School, name and location _____
Years _____ Standing (1st, 2nd, 3rd, or 4th quarter of class) _____
Failures _____

High School, name and location _____
Years _____ Standing (1st, 2nd, 3rd, or 4th quarter of class) _____
Subjects in which you were good _____
Subjects in which you were weak _____
Failures _____
Extra curricular activities (athletics, class offices, publications, etc.) _____

U. S. Naval Academy: Year graduated _____ Class standing _____

Colleges: Name _____ Years _____
Name _____ Years _____
Name _____ Years _____
Class standing _____ Degree _____ Year _____ Age _____
What was your major in college? _____
What did you plan as a career when you entered college? _____

Did you change your major? If so, why? _____

Extra curricular activities _____

In what subjects were you especially good? _____

In what subjects were you especially weak? _____

What subjects did you fail? _____
Reasons _____
Approximately how much of your support in college did you contribute? _____

Training other than college _____
Have you any dependents now? _____
What jobs have you had in college, summers, and since college? Indicate ones you liked and disliked (why) and those you did well and poorly (why) _____

(6) VOCATIONAL

What professions have you seriously considered? When and for how long?_____

_____

_____

_____

What led you to make aviation your profession? (Give your own discussion below then check off appropriate comments below)_____

_____

_____

_____

_____

How long have you been considering it seriously?_____

Did you build model planes?_____What sorts of planes?_____

_____At what age?_____

How many of the following suggestions influenced your decision to take up aviation? Give the numbers in the spaces below and explain details further. Add additional explanations of your own.

1. Felt the emergency called for all possible pilots?
2. Since you'd probably be called to some type of military service, you would prefer to be in aviation?
3. Because you felt that you could make some particular contributions to aviation as instructor, pilot, specialist, or in some other function? Specify.
4. (a) Because of what you read in magazines or elsewhere?
   (b) Because of moving pictures?
5. Because you considered naval aviation the best training for later aeronautical work, as air line manager, test pilot, etc.?
6. Considered yourself especially qualified for military flying and hence likely to do well in it?
7. To prove to yourself or others that you could make good in flying?
8. Attracted by salary?
9. To develop valuable traits, such as initiative or judgement? What particular ones?
10. To get away from other concerns and worries? What were they?
11. Because, though undecided at first, you were persuaded or encouraged by others? Why doubtful at first? What persuaded you?
12. Fascinated by the sensations of flight from first experience?
13. Mainly for sport? Or adventure?
14. Just suddenly decided?
15. Drifted into it without thinking much about it?
16. Always figured on going into flying?
17. Had interests related to flying? Mechanical, engineering, medical, etc.; that led you into it? State interests.
18. Felt it was an important and promising professional field in itself?

_____

_____

_____

What hobbies have you had? (including reading and types of material read). Give ages of various interests_____

_____

_____

Previous flying experience, including Elimination Base, C.A.A., private and miscellaneous):

Location and Approx. Dates	Hours at Controls or Under Instruction	Type of Plane	Number in Class	Number Dropped from Training	Your Approximate standing

State roughly the amount of passenger time you have had:

Commercial airlines_____

Private planes_____

Military planes_____

At what age did you first go up in an airplane?_____ What flight maneuvers or routine proceedings have seemed easiest for you to learn?_____

_____

What ones have seemed particularly difficult?_____

_____

What have your instructors considered to be your strong points?_____

_____

Your weak points?_____

If you had your choice, what particular type of aviation would you prefer? (Check)

Fighting carrier_____ Military instructor_____

Patrol_____ Commercial instructor_____

Scouting and observation_____ Photography_____

Test piloting_____ Gunnery_____

Have you had any flying accidents?_____ Have you had any near accidents?_____

Describe these and state their effect upon you_____

_____

_____

_____

_____

_____

Signature_____

THORNDIKE-KELLEY ATHLETIC ACHIEVEMENT TEST

NAME IN FULL Date_____
Last Name First Name Middle Name School_____

_____

Answer the following questions:
(approximately)

1. How many yards can you swim?
2. How many yards (approximately) can you swim under water?
3. Can you sail a sailboat?
4. How many miles (approximately) have you sailed?
5. Can you run a motor boat?
6. How many miles (approximately) have you gone?
7. Can you ride a motor-cycle?
8. How many miles (approximately) have you ridden?
9. Can you drive a motor car?
10. How many miles (approximately)have you driven?
11. Can you ride a horse?
12. How many miles (approximately) have you ridden?
13. Can you play tennis?
14. How many hours (approximately) have you played?
15. Can you play any musical instrument? What is the instrument?
16. How many hours (approximately) have you played it?
17. Do you know any skilled trade? What is the trade?
18. How much were you earning at it per day?

Examine the list of games, occupations, and amusements printed below. Think which three you like best to do; mark them b. Think which three you like next best; mark then nb. Think which three you like least; mark them w. Think which three you like next to least; mark them n.w. If there are any that you don't know enough about to enable you to decide how well you like them, mark them with a cross (x).

19. Play billiards
20. Boxing
21. Run a motor boat
22. Sail a sailboat
23. Play cards
24. Play chess
25. Play baseball
26. See the movies
27. Dancing
28. Fishing
29. Play football
30. Play golf
31. Ride horseback
32. Ride a motorcycle
33. Drive a motor car
34. Play some musical instrument
35. Listen to music
36. Reading
37. Shooting
38. Swimming
39. Play tennis
40. Walk with friends
41. Go to the theatre
42. Wrestling

APPENDIX B

Forms Used in 1951 Study (Chapter II)

U. S. NAVAL SCHOOL OF AVIATION MEDICINE
U. S. NAVAL AIR STATION
PENSACOLA, FLORIDA

Research Department:

QUESTIONNAIRE FOR FOLLOW-UP OF 1,000 AVIATORS

Please write or print legibly. Use check marks where possible.

DATE: _____

1. Name _____ (Last), _____ (First), _____ (Middle) 2. File # _____

3. Present address: _____ Rank _____

4. Present Military Status: ☐ Active duty (permanent) ☐ USN ☐ USMC
☐ Active duty (temporary) ☐ USNR ☐ USMCR
☐ Inactive ☐ Other _____
☐ Separated ☐ Retired ☐ Resigned

5. Was flight training completed? ☐ Yes. ☐ No.

6. If flight training at Pensacola was NOT completed:

A. Did you join any other military service: ☐ Yes ☐ No
B. Was any other flight training (Army, Air Force, CAA, etc.) successfully completed?

☐ Yes ☐ No If so, what type. _____

7. If flight training was completed, how many years did you fly as a pilot? _____

8. What type planes were piloted? Estimate number of hours in each:

_____	_____
_____	_____
_____	_____
_____	_____

9. Are you still active as a pilot? ☐ Yes ☐ No In what capacity: _____

10. Number of hours flown last month: _____

11. If you are no longer flying, please list occupation(s) engaged in since last aviation duty: _____

12. If you have suffered any of the following in the past 10 years, please check:

- ☐ Pain in chest on exertion
- ☐ Shortness of breath on exertion
- ☐ Palpitations
- ☐ Swelling of both ankles
- ☐ Myocardial infarction (Heart attack)
- ☐ Scarlet Fever
- ☐ Rheumatic Fever
- ☐ Diphtheria
- ☐ Kidney disease
- ☐ Injury to Chest
- ☐ Chest Surgery

Details _____

13. Have you had a physical examination in the past two years? ☐ Yes ☐ No

14. If so, please check any of the following that were found:

- ☐ High Blood Pressure
- ☐ Rapid heart rate
- ☐ Murmur in heart
- ☐ Sugar in Urine
- ☐ Overweight
- ☐ Coronary heart disease
- ☐ Rheumatic heart disease
- ☐ No abnormalities
- ☐ Other Abnormalities (please specify)

_____

15. Do you consider your present physical fitness as: ☐ Poor ☐ Good ☐ Fair ☐ Exceptional

16. Remarks: _____

_____

_____

When completed, please enclose in the self-addressed, franked envelope and mail promptly.

NOTE: Please check to be sure date, rank/rate and present military status are filled in.

HISTORY FORM FOR FOLLOW-UP OF 1000 AVIATORS SERIES #

Name: _____ File # _____ Rank: _____

Address: _____

Family History:

	Age if Living	Condition of Health	Age at Death	Cause of Death
Father				
Mother				
Brothers				
Sisters				

Past History: List any serious illnesses, injuries, or operations. Specifically inquire for rheumatic fever, scarlet fever, diphtheria, kidney disease, and hypertension.

Present Symptoms: Check appropriate items and give details.

( ) Dyspnea on exertion
( ) Palpitation
( ) Pain in chest
( ) Edema
( ) Cough
( ) Loss or gain of weight in past 6 months
( ) Visual
( ) Loss of hearing
( ) Ear, nose, throat, or sinus complaints
( ) Respiratory symptoms
( ) Gastro-intestinal symptoms
( ) Genito-urinary "
( ) Skin "
( ) Neuro-muscular "
( ) Psychiatric "
( ) None of above.

Does the subject believe that flying caused or aggravated any of the diseases or symptoms listed above (excluding aviation accidents)? If so, give details:

In the past ten years has the subject been told he has a murmur, tachycardia, or high blood pressure? If so, give details:

Has the subject ever had to return on subsequent days in order to pass certain items of the flight physical examination? If so, give details:

Date _____ Place _____ Doctor's name _____

Date form filled out _____ Case number _____

Last name _____ First name _____ Middle initial _____

Service or File Number _____ Date of Birth _____

AVIATION HISTORY

1. Had you completed flight training before reporting to Pensacola?

   _____No _____Yes If yes, what year? _____

   _____Private

   _____Commercial

   _____ Other - Specify _____

2. If naval air training was completed, give date _____

3. If flight training was not completed at Pensacola in 1940-41, did you complete flight training as a pilot later?

   Date completed _____ _____No further pilot training

   _____Army

   _____RAF

   _____RCAF

   _____Private

   _____ Other - Specify _____

4. If pilot training was not completed, did you remain in aviation as:

   _____bombadier
   _____navigator
   _____gunner
   _____engineer
   _____other flight crew
   _____ground crew (no flying)
   _____aviation industry (no flying)
   _____no further connection with aviation

5. If you are no longer flying, why did you stop?

6. Please fill out carefully for each year. Use check marks in Columns 1-5 to indicate proper flight status.

Flying as:

Calendar Year	Not flying (1)	Military pilot (2)	Commercial pilot (3)	Private pilot (4)	Air crew (5)	Hours logged	Number of aviation accidents	Number of accidents involving major damage to plane (A or B)	Planes lost as result of enemy action	Injuries to yourself in aviation accidents
1934 or earlier*										
1935										
1936										
1937										
1938										
1939										
1940										
1 Jan 1941 to 7 Dec. 1941										
7 Dec. 1941 to 31 Dec. 1941										
1942										
1943										
1944										
1945 to VJ Day										
1945 after VJ Day										
1946										
1947										
1948										
1949										
1950										
1951										
1952										

*If in flight status prior to 1934, please give details on other side of this paper.

MILITARY HISTORY

_____ Year entered

Type of first service:
_____ ROTC
_____ U.S. Naval Academy
_____ Aviation Cadet
_____ Other - Specify _____

Military Status

	Inclusive dates	Active duty dates	Highest rate or rank	Service or File number
US Navy-Reserve				
US Navy-Regular				
US Marine Corps-Reserve				
US Marine Corps-Regular				
US Air Force-Reserve				
US Air Force-Regular				
US Army-Reserve				
US Army-Regular				
Other (specify)				

If Reserve now:
_____ Continuous active duty involving flying
_____ Continuous active duty, not flying
_____ Organized reserve (paid, military flying)
_____ Organized reserve (paid, not flying)
_____ Volunteer reserve (meetings and non-paid flying)
_____ Volunteer reserve (non-paid meetings; no flying)
_____ Inactive reserve (no meetings or military flying)

Medals and awards (do not list area ribbons):

Months of combat duty:
_____ C B I
_____ Pacific
_____ European
_____ Korean

If inactive, why? _____ Date released

If separated (no military status at present), why? _____ Date separated

If not on active duty, what is your present occupation?

FOR 1000 AVIATOR FOLLOW-UP PROJECT

In the event of my death, please supply the following information to:

Commanding Officer
School of Aviation Medicine
U. S. Naval Air Station
Pensacola, Florida

Date of death _____

Cause of death _____

In Flight status at time of death _____

Case Number _____

_____
Subject's signature

Standard Form 88
(Rev. June 1956)

REPORT OF MEDICAL EXAMINATION

1. LAST NAME—FIRST NAME—MIDDLE NAME			2. GRADE AND COMPONENT OR POSITION	3. IDENTIFICATION NO.
4. HOME ADDRESS (*Number, street or RFD, city or town, zone and State*)			5. PURPOSE OF EXAMINATION	6. DATE OF EXAMINATION
7. SEX	8. RACE	9. TOTAL YEARS GOVERNMENT SERVICE: MILITARY / CIVILIAN	10. AGENCY	11. ORGANIZATION UNIT
12. DATE OF BIRTH	13. PLACE OF BIRTH		14. NAME, RELATIONSHIP, AND ADDRESS OF NEXT OF KIN	
15. EXAMINING FACILITY OR EXAMINER, AND ADDRESS			16. OTHER INFORMATION	
17. RATING OR SPECIALTY			TIME IN THIS CAPACITY (*Total*)	LAST SIX MONTHS

CLINICAL EVALUATION

NORMAL	(*Check each item in appropriate column; enter "NE" if not evaluated.*)	ABNORMAL
	18. HEAD, FACE, NECK AND SCALP	
	19. NOSE	
	20. SINUSES	
	21. MOUTH AND THROAT	
	22. EARS—GENERAL (*Int. & ext. canals*) (*Auditory acuity under items 70 and 71*)	
	23. DRUMS (*Perforation*)	
	24. EYES—GENERAL (*Visual acuity and refraction under items 59, 60 and 62*)	
	25. OPHTHALMOSCOPIC	
	26. PUPILS (*Equality and reaction*)	
	27. OCULAR MOTILITY (*Associated parallel movements, nystagmus*)	
	28. LUNGS AND CHEST (*Include breasts*)	
	29. HEART (*Thrust, size, rhythm, sounds*)	
	30. VASCULAR SYSTEM (*Varicosities, etc.*)	
	31. ABDOMEN AND VISCERA (*Include hernia*)	
	32. ANUS AND RECTUM (*Hemorrhoids, fistulae*) (*Prostate, if indicated*)	
	33. ENDOCRINE SYSTEM	
	34. G-U SYSTEM	
	35. UPPER EXTREMITIES (*Strength, range of motion*)	
	36. FEET	
	37. LOWER EXTREMITIES (*Except feet*) (*Strength, range of motion*)	
	38. SPINE, OTHER MUSCULOSKELETAL	
	39. IDENTIFYING BODY MARKS, SCARS, TATTOOS	
	40. SKIN, LYMPHATICS	
	41. NEUROLOGIC (*Equilibrium tests under item 72*)	
	42. PSYCHIATRIC (*Specify any personality deviation*)	
	43. PELVIC (*Females only*) (*Check how done*) ☐ VAGINAL ☐ RECTAL	

NOTES. (*Describe every abnormality in detail. Enter pertinent item number before each comment. Continue in item 73 and use additional sheets if necessary.*)

(*Continue in item 73*)

44. DENTAL (*Place appropriate symbols above or below number of upper and lower teeth, respectively.*)

O—*Restorable teeth*
/—*Nonrestorable teeth*
X—*Missing teeth*
XXX—*Replaced by dentures*
(6 X 8)—*Fixed bridge, brackets to include abutments*

RIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	LEFT
	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	

REMARKS AND ADDITIONAL DENTAL DEFECTS AND DISEASES

LABORATORY FINDINGS

45. URINALYSIS: A. SPECIFIC GRAVITY		46. CHEST X-RAY (*Place, date, film number and result*)
B. ALBUMIN	D. MICROSCOPIC	
C. SUGAR		

47. SEROLOGY (*Specify test used and result*)	48. EKG	49. BLOOD TYPE AND RH FACTOR	50. OTHER TESTS

MEASUREMENTS AND OTHER FINDINGS

51. HEIGHT	52. WEIGHT	53. COLOR HAIR	54. COLOR EYES	55. BUILD: ☐ SLENDER ☐ MEDIUM ☐ HEAVY ☐ OBESE	56. TEMPERATURE

57. BLOOD PRESSURE (*Arm at heart level*)						58. PULSE (*Arm at heart level*)				
A. SITTING	SYS. / DIAS.	B. RECUMBENT	SYS. / DIAS.	C. STANDING (*5 min.*)	SYS. / DIAS.	A. SITTING	B. AFTER EXERCISE	C. 2 MIN. AFTER	D. RECUMBENT	E. AFTER STANDING 3 MIN.

59. DISTANT VISION		60. REFRACTION			61. NEAR VISION	
RIGHT 20/	CORR. TO 20/	BY	S.	OX	CORR. TO	BY
LEFT 20/	CORR. TO 20/	BY	S.	OX	CORR. TO	BY

62. HETEROPHORIA (*Specify distance*)

ES°	EX°	R. H.	L. H.	PRISM DIV.	PRISM CONV. CT	PC	PD

63. ACCOMMODATION		64. COLOR VISION (*Test used and result*)	65. DEPTH PERCEPTION (*Test used and score*)	UNCORRECTED
RIGHT	LEFT			CORRECTED
66. FIELD OF VISION		67. NIGHT VISION (*Test used and score*)	68. RED LENS TEST	69. INTRAOCULAR TENSION

70. HEARING

RIGHT WV /15 SV /15

LEFT WV /15 SV /15

71. AUDIOMETER

	250 *256*	500 *512*	1000 *1024*	2000 *2048*	3000 *2896*	4000 *4096*	6000 *6144*	8000 *8192*
RIGHT								
LEFT								

72. PSYCHOLOGICAL AND PSYCHOMOTOR (*Tests used and score*)

73. NOTES (*Continued*) AND SIGNIFICANT OR INTERVAL HISTORY

(*Use additional sheets if necessary*)

74 SUMMARY OF DEFECTS AND DIAGNOSES (*List diagnoses with item numbers*)

75. RECOMMENDATIONS—FURTHER SPECIALIST EXAMINATIONS INDICATED (*Specify*)

76. A. PHYSICAL PROFILE

P	U	L	H	E	S

77. EXAMINEE (*Check*)

A. ☐ IS QUALIFIED FOR
B. ☐ IS NOT QUALIFIED FOR

B. PHYSICAL CATEGORY

78. IF NOT QUALIFIED, LIST DISQUALIFYING DEFECTS BY ITEM NUMBER

A	B	C	E

79. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
80. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
81. TYPED OR PRINTED NAME OF DENTIST OR PHYSICIAN (*Indicate which*)	SIGNATURE	
82. TYPED OR PRINTED NAME OF REVIEWING OFFICER OR APPROVING AUTHORITY	SIGNATURE	NUMBER OF ATTACHED SHEETS

U. S. GOVERNMENT PRINTING OFFICE : 1957 O—432298

APPENDIX C

Forms Used in 1957 Study (Chapter III)

U. S. NAVAL SCHOOL OF AVIATION MEDICINE
U. S. NAVAL AIR STATION
PENSACOLA, FLORIDA

QUESTIONNAIRE FOR FOLLOW-UP OF 1000 AVIATORS (1956-1957)

_____
(Case Number)

NAME _____
(Last) (First) (Middle) (Service/File No.)

PRESENT ADDRESS: _____

PERMANENT ADDRESS (Or best means of establishing contact):

_____

NEXT OF KIN: _____ ADDRESS _____

PRESENT MILITARY STATUS:

_____ USN _____ USMC _____ Active Duty _____ Active Reserve
_____ USNR _____ USMCR _____ Inactive Reserve _____ Resigned
Other (Please specify) _____

The following interim history applies to the period subsequent to the last examination (the last 5 years, approximately):

FLIGHT STATUS: Yes No
Actively Flying? _____ _____ If yes, in what capacity? _____

_____
Approximate hours per year _____
If non-flying, why? _____

OCCUPATIONAL HISTORY:
Occupation during interval _____
Number of days (regular working days) absent from work _____.

SOCIAL HISTORY:
Exercise approximately _____ hours per week. Type of exercise _____
_____. Tobacco _____ packs per week for _____ years.
Alcohol _____ drinks per day (approximately).

How would you describe your general physical condition? _____

QUESTIONNAIRE FOR FOLLOW-UP OF 1000 AVIATORS (1956 - 1957)

_____
(Case Number)

MEDICAL HISTORY:

Number of visits to physician or dispensary_____.
Number of days ill from any cause_____.
Number of days in hospital _____.

	Yes	No	
Accidents?	_____	_____	
Operations?	_____	_____	If yes, type and diagnosis._____

Serious illness? _____Diagnosis_____
Chronic or Recurring?_____

Have you been examined for insurance in the past 5 years?_____.
If yes, was it:
Approved without qualification?_____.
Refused?_____.
Special premium rates invoked? _____.

Have the following been reported to you by a physician in the past 5 years?

Heart Disease_____	Kidney Disease _____
Diabetes (sugar in urine)_____	Anemia _____
Lung disease_____	Tuberculosis _____
Peptic ulcer _____	Psychiatric Illness_____
	Any other _____

Please describe any of the items checked above_____
_____

Have you had the following symptoms in the past 5 years?
Pain in the chest with exertion _____
Shortness of breath with exertion _____
on level walking_____ on climbing one flight of stairs _____
on climbing successive flights of stairs _____.

Easy fatigability_____	Difficulty with urination _____
Chronic cough _____	Loss of hearing _____
Arthritis (joint pains) _____	Jaundice _____
Pain in legs on walking_____	Stomach, liver, bowel disturbance _____
Emotional changes _____	
Recent weight gain or loss_____	Gain past 5 yrs_____Loss past 5 yrs._____

Name of government activity most convenient to you where a physical examination might be performed (such as a Veteran's Hospital: Army, Navy, Air Force Base Hospital: Large Recruiting Center) _____

Please use reverse side for additional or explanatory information.

_____
(Case Number)

CLINICAL EXAMINATION FORM

NAME _____
(Last) (First) (Middle) (Service/File Number)

Please question patient regarding the following symptoms or systems and describe important aspects in the space below:

WEIGHT: _____ BUILD: Slender ___ Medium _____ Heavy _____ Obese _____

BLOOD PRESSURE (Supine): _____ After 15 minutes relaxation _____

PULSE (resting): _____

(check the following only when present)
CHEST: _____ Emphysematous contour _____ Clear.

_____ Adventitious sounds. Specify, please _____

HEART: _____ Murmur present.

_____ Apical systolic
_____ Apical diastolic
_____ Systolic at base
_____ Diastolic at base
_____ Soft (grade I-II)
_____ Loud (grade III-IV)
_____ Disappears with inspiration

_____ A_2 greater than P_2

_____ P_2 greater than A_2

Other abnormalities (specify) _____

CLINICAL EXAMINATION FORM FOR FOLLOW-UP OF 1000 AVIATORS

_____
(Case Number)

ABDOMEN: _____ Liver palpable
_____ Other palpable masses. Specify _____

RECTAL: Prostate: ____ normal. _____ moderately enlarged. _____ slightly enlarged.
_____ rectal mass.

SERUM CHOLESTEROL: _____ SERUM LIPOPROTEINS: _____

X-RAY: _____ Normal. _____ Old scarring. _____ Calcified density.
_____ Tumor. _____ Unidentified density.
Cardiovascular silhouette: _____ Normal. _____ Cardiac enlargement.

ELECTROCARDIOGRAM:
Rate: _____ ST segment: _____
Rhythm: _____ T waves: _____
Conduction: _____

Infarction pattern: _____ anterior. _____ posterior.

BALLISTOCARDIOGRAM:
_____ Normal
_____ Borderline _____ After stimulus.
_____ Abnormal

MAXIMUM BREATHING CAPACITY: _____.

VITAL CAPACITY (average of 3 trials) _____.

SUMMARY OF PERTINENT FINDINGS:

EVALUATION OF FACTORS IMPORTANT
IN CORONARY ATHEROSCLEROSIS

Name _____ Affiliation

Address _____

Permanent Address _____

Age _____ Sex _____ Menopause? _____

Weight _____ Height _____ Body Build _____

% overweight _____ % underweight _____

Personality (Patient's description) _____

Work and Exercise _____

Tobacco _____ Duration _____

Family History: Mother _____

Father _____

Siblings _____

_____

_____

Aunts, Uncles _____

BP (Left arm sitting) _____

BCG (Resting) _____ Anoxia _____

EKG _____

Exercise Tolerance _____

Lipoproteins SF0-12 _____ (actual) _____ (mean) = _____ (deviation from mean)

SF 12-20 _____ (actual) _____ (mean) = _____ (deviation from mean)

SF 20-100 _____ (actual) _____ (mean) = _____ (deviation from mean)

SF 100-400 _____ (actual) _____ (mean) = _____ (deviation from mean)

Atherogenic Index _____ (actual) _____ (mean) = _____ (deviation from mean)

Cholesterol_____

Other Diseases Present_____

Metabolic Disease (i.e., Diabetes, Cushing's)_____

Evidence of peripheral artery disease_____

Dietary fat_____

Fat Tolerance test_____

SUMMARY

APPENDIX D

Forms Used in 1963 Study (Chapter IV)

Preliminary Questionnaire
Thousand Aviator Study (1963)

Case number: 1 2 3 4 5

(6-30) Name: _____ (last), _____ (first), _____ (middle)

(A31-A70) Present Address: _____ (street), _____ (city), _____ (state)

(B30-70) Permanent Address: _____ (street), _____ (city), _____ (state)
or
Alternate means of contacting you through parents, relatives, business, etc.

(A71-79) Social Security number _____

(B71-77) Occupation during last 5 years _____

(B78) Present military status:

1 civilian, resigned or discharged
2 active duty
3 reserve commission (no billet)
4 reserve billet - flying
5 reserve billet - non-flying
6 retired - medical
7 retired - 20 year or more service
8 other _____ (specify)

(C6-14) Flying status (past 5 years only)

		YES	NO
6	non-flying	____	____
7	military - career	____	____
8	military - reserve	____	____
9	private	____	____
10	commercial air line	____	____
11	FAA	____	____
12	test pilot	____	____
13	other commercial flying	____	____
14	other _____ (specify)	____	____

Preliminary Questionnaire

Case number (c): 1 2 3 4 5

(C15) Number of hours flying as pilot or co-pilot per year (past 5 years only)

1	non-flying	4	100-150 hours	7	400-800 hours
2	less than 25 hours	5	150-200 hours	8	over 800 hours
3	25-100 hours	6	200-400 hours	9	aircrew only

(C16) Tobacco

1	never smoked	4	cigarettes - less than 1 pack/day	7	cigarettes - over 2 packs/day
2	pipe only	5	cigarettes - 1 pack/day	8	stopped smoking in past 5 years
3	cigars only	6	cigarettes - 2 packs/day	9	other _____ specify

(C17) Alcohol

1	never drank	4	one drink/day	7	problem with alcohol
2	rarely drink	5	two-three/day	8	stopped drinking
3	once or twice each week	6	over three/day	9	other _____ specify

(C18) General statement of health past 5 years

1	excellent, no symptoms	4	fair, acute illness with minor sequelae	7	chronic illness, able to work part time
2	good, except for minor symptoms	5	poor, acute illness with major sequelae	8	chronic illness, unable to work
3	good, except acute illness with no sequelae	6	chronic illness, able to work full time	9	chronic illness, activity severely limited

Preliminary Questionnaire

Case number (c): 1 2 3 4 5

(C19) Hospitalization

1 no hospitalization
2 hospitalized less than 5 days
3 hospitalized 5-14 days
4 hospitalized 14-30 days
5 hospitalized over 30 days

(C20-28) Operations	YES	NO
20 no operations	____	____
21 minor surgery, no hospitalization	____	____
22 chest surgery	____	____
23 abdominal surgery (including hernia)	____	____
24 bone surgery	____	____
25 skin or plastic surgery	____	____
26 hemorrhoid surgery	____	____
27 vasectomy (male sterilization)	____	____
28 other _____ (specify)	____	____

(C29-37) Accidents and injuries (past 5 years)

29 none	____	____
30 aviation - major	____	____
31 aviation - minor	____	____
32 automobile - major	____	____
33 automobile - minor	____	____
34 sports - major	____	____
35 job connected - major	____	____
36 job connected - minor	____	____
37 other _____ (specify)	____	____

(C38-45) Examinations by physicians (since 1958)

38 none or routine (no abnormalities noted)
39 routine - abnormalities found
40 insurance exam - normal findings
41 insurance exam - abnormalities found
42 examination associated with minor illness
43 examination associated with serious illness
44 more than 5 visits to physicians
45 other _____ (specify)

Preliminary Questionnaire

Case number (c): 1 2 3 4 5

(C46-54) Medications (present)		YES	NO
46	none	____	____
47	vitamins	____	____
48	antihistamines	____	____
49	Alka Seltzer or similar acid neutralizing drugs	____	____
50	cough medicines	____	____
51	tranquilizers	____	____
52	antibiotics	____	____
53	cold preparations	____	____
54	other _____	____	____

May we contact your physician or hospital for more complete information relative to these hospitalizations or examinations? If so, please give physician's name and address: _____

Have any of the following findings been reported to you in the past 5 years (exclusive of our evaluation)?

		YES	NO
C55	diabetes	____	____
C56	abnormal chest X-ray	____	____
C57	abnormal electrocardiogram (at rest or after exercise)	____	____
C58	high blood pressure	____	____
C59	peptic ulcer diagnosed by X-ray or symptoms	____	____
C60	kidney or bladder disease (infections, nephritis)	____	____
C61	kidney stones	____	____
C62	anemia or disease of blood	____	____
C63	tuberculosis	____	____
C64	psychiatric illness or severe emotional symptoms	____	____
C65	heart attack or coronary thrombosis	____	____
C66	angina pectoris (chest pain due to heart disease)	____	____
C67	pericarditis (inflammation of covering of heart)	____	____
C68	liver or gall bladder disease (cirrhosis, gall stones, etc.)	____	____
C69	pancreatitis (disease of pancreas)	____	____
C70	disease of intestines or large bowel	____	____
C71	undiagnosed stomach pain	____	____
C72	lung disease (exclusive of tuberculosis)	____	____
C73	spinal disc disease	____	____
C74	disease of prostate	____	____
C75	disease of skin (including tumors)	____	____
C76	tumor or cancer of internal organs	____	____
C77	other _____ (specify)	____	____

Preliminary Questionnaire

Case number (d): 1 2 3 4 5

Have you had any of the following symptoms in the past five years?

		YES	NO
D6	chest pain with exertion	____	____
D7	unusual or arrhythmical heart beat	____	____
D8	undue shortness of breath with exertion	____	____
D9	easy fatiguability	____	____
D10	chronic cough or cough productive of blood	____	____
D11	arthritis or joint pains	____	____
D12	difficult or painful urination	____	____
D13	jaundice or liver disease	____	____
D14	stomach pain	____	____
D15	low back pain	____	____
D16	decrease in hearing	____	____
D17	bleeding from gastrointestinal tract (stomach, bowel, etc.)	____	____
D18	episodes of fainting or unconsciousness	____	____
D19	severe or recurrent headache	____	____
D20	transient or prolonged loss of motion of arms or legs	____	____
D21	transient or prolonged loss of vision or speech	____	____
D22	visual disturbances (double vision, blurring, etc.)	____	____
D23	unexplained difficulty in sleeping	____	____
D24	other _____ (specify)	____	____

The space below is for additional or explanatory information related to the above questions or to any aspect of this study.*

*If the answers to questions C20-77 and D6-24 are "yes," please give dates and pertinent explanatory information.

CARDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE

This present history pertains only to the period since your last School of Aviation Medicine examination.

Please answer the questionnaire as indicated:

"no," "now have," or "have had."

Your answers will be discussed with you by the examining physician.

NAVSCOLAVNMED 6500/19

CASE NUMBER [| | | | |] 1-5

DATE (not coded)_____

No code 1 Now have code 2 Have had code 3

Have you failed a vision or eye test?	[ ]	6
Have you had hemorrhages or bleeding in the whites of the eyes?	[ ]	7
Do you have burning, itching or pain of the eyes?	[ ]	8
Have you noticed a colored halo around lights at night?	[ ]	9
Do you have double vision?	[ ]	10
Have you had absence of one-half of your field of vision in one or both eyes?	[ ]	11
Have you had any bleeding or tender gums?	[ ]	12
Do you have partial or complete dental plates?	[ ]	13
Have you experienced dental pain at high altitude?	[ ]	14
Have you had persistent difficulty with swallowing?	[ ]	15
Have you had frequent severe sore throats?	[ ]	16
Have you had hoarseness except with cold?	[ ]	17
Have you had nosebleeds other than due to injury?	[ ]	18
Have you had a ruptured ear drum?	[ ]	19
Have you had, or been told that you had, a temporary or permanent hearing loss?	[ ]	20
Have you had, or been told that you had, tinnitus (ringing or buzzing in the ear)?	[ ]	21
Have you ever had a severe ear ache?	[ ]	22
Have you had aerotitis (pain in the ear associated with flight)?	[ ]	23
Have you been exposed to high intensity noise?	[ ]	24
Have you used protection devices against noise such as ear plugs or ear defenders?	[ ]	25

Have you had an ear infection or draining ear?		26
Do you have chronic sinusitis?		27
Do you have frequent head colds?		28
Have you had vertigo (dizziness or sensation of spinning)?		29
Are you allergic to any type of contact, plants, house pets, or animals, which results in increased nasal discharge?		30
Do you have hay fever?		31
Have you had any persistent enlargement of any of the glands of your neck?		32
Do you have a chronic or recurrent cough?		33
Have you coughed up blood?		34
Have you coughed up pus?		35
Have you had, or do you now have, frequent coughing spells?		36
Do you have pain in the right side of your chest?		37
Do you have pain in the left side of your chest?		38
Do you have pain along the breast bone or sternum?		39
Have you had, or do you now have, shortness of breath while lying down?		40
Have you had or do you now have shortness of breath that awakens you from sleep?		41
Have you had, or do you now have, difficulty breathing during or following exertion?		42
Have you ever had to sit up at night to get your breath?		43
Have you had, or do you now have, any difficulty with breathing?		44
Have you had, or do you now have, any chronic chest condition?		45
Have you had, or do you now have, bronchial asthma?		46
Have you had, or do you now have, pleurisy?		47
Have you been told that you had air sacs or cysts of the lungs?		48

Have you had contact with anyone having tuberculosis? [ ] 49

Have you had a collapsed lung? [ ] 50

Have you had pneumonia? [ ] 51

Have you had, or been told that you had, bronchiectasis? [ ] 52

Have you had, or do you now have, chronic bronchitis? [ ] 53

Have you ever been told that you had fluid on the lungs or in the chest? [ ] 54

Have you ever had fluid drawn off or removed from your chest cavity? [ ] 55

Do your lungs wheeze at times? [ ] 56

Have you had, or been told that you had, high blood pressure? [ ] 57
(If yes, indicate MILD____ MODERATE____SEVERE____DURATION____ YEARS)

Have you had, or been told that you had, low blood pressure? [ ] 58

Have you had, or been told that you had, coronary heart disease? [ ] 59

Have you had, or been told that you had, any other heart trouble? [ ] 60

Have you had, or been told that you had, a heart murmur? [ ] 61

Have you had, or been told that you had, trouble with your circulation? [ ] 62

Have you had, or been told that you had, enlargement of the heart? [ ] 63

Have you had, or been told that you had an abnormal electrocardiogram? [ ] 64

Have you had, or been told that you had, heart damage from an infection or other illness? [ ] 65

Have you been told that you had hardening of the arteries? [ ] 66

Have you taken medicine for your heart? [ ] 67

Have you had any chest injuries? [ ] 68

Have you had pounding headaches and flushing of the face? [ ] 69

Have you had marked racing of your heart while sitting or resting? [ ] 70

Have you ever had scarlet fever? 71

Have you ever had St. Vitus Dance or chorea? 72

Have you ever had rheumatic fever or a rheumatic heart? 73

CARD NUMBER 75

CASE NUMBER 76-80

CASE NUMBER ☐☐☐☐☐ 1-5

DATE (not coded)_____

NO code 1 Now have code 2 Have had code 3

Have you had any chest pain that awakened you from sleep?	☐ 6
Have you had chest pain or discomfort while doing physical exertion or following physical exertion?	☐ 7
Have you had chest pain or discomfort during or as a result of emotional stress (anger, fear, excitement)?	☐ 8
Do you have chest pain or discomfort during intercourse?	☐ 9
Have you noticed chest pain or discomfort while walking against a cold wind?	☐ 10
Have you noted chest pain related to smoking?	☐ 11
Have you had any other forms of chest pain, aching, or discomfort (constriction, burning)?	☐ 12
Have you had chest pain or discomfort associated with pain in the left arm?	☐ 13
Have you had chest pain or discomfort associated with pain in the right arm?	☐ 14
Have you had chest pain or discomfort associated with pain in the jaw or teeth?	☐ 15
Have you had sensations of pressure or fullness in your chest?	☐ 16
Have you had pain in the upper part of your abdomen?	☐ 17
Are you troubled with sensations of pressure or gaseous distention in the upper part of your abdomen?	☐ 18
Do you have discomfort in the upper portion of your abdomen after eating or after exercise?	☐ 19
If you have chest pain or discomfort, how often do you get it?	☐ 20

Daily code 1 Several times each year code 4
Weekly code 2 No pain code 9
Monthly code 3

If you have chest pain or discomfort what is the maximum duration? 21

momentary	code 1	as long as 5-10 minutes	code 4
less than a minute	code 2	more than 10 minutes	code 5
several minutes	code 3	no pain	code 9

If you have chest pain or discomfort is it relieved by: 22

rest	code 1	change of positions	code 3
medication	code 2	nothing	code 4

If you have chest pain or discomfort is it associated with:
(No code 1 Yes code 2)

sweating 23

shortness of breath 24

palpitations 25

nausea 26

light headedness 27

other_____ 28

Do you have, or have you been subject to, dizzy spells? 29

Do you tire easily with slight effort? 30

Do you seem to be unusually fatigued? 31

Have you been told that you have an abnormal amount of fat in your blood? 32

Have you had or been told that you had pericarditis (inflammation of the sac around the heart)? 33

Have you had intermittent or recurrent pain anywhere in your abdomen? (If so, indicate_____) 34

Is your appetite usually poor? 35

Do you frequently have nausea or upset stomach? 36

Are you awakened at night by discomfort in the stomach? 37

Do you have any stomach discomfort which is relieved by milk, food or baking soda? 38

Do you have indigestion? 39

Have you vomited any bloody material or coffee-ground-like material?		40
Have you had any episodes of vomiting of any type that did not appear to be associated with food poisoning?		41
Are there any foods that now give you trouble (fats, etc.)?		42
Do you suffer from any constant stomach difficulty?		43
Do you have recurrent or intermittent pain anywhere in your abdomen?		44
Do you have any pain in the chest which bothers you at night that is relieved by sitting upright?		45
Have you been told that you have a hernia through the diaphragm?		46
Have you had an x-ray of the stomach or intestines?		47
Have you been told that you had a peptic ulcer?		48
Have you been told that you had gallbladder disease or gallstones?		49
Have you been told that you had liver disease?		50
Have you been told that you had jaundice?		51
Have you been told that you had cirrhosis?		52
Have you been told that you had hepatitis?		53
Have you been told that you had disease of the pancreas?		54
Has anyone ever drawn or removed fluid from your abdomen?		55
Has there been any recent change in the number of times you move your bowels a day or type of bowel movement (liquid or solid)?		56
Do you have constant, intermittent or recurrent loose bowel movements or diarrhea?		57
Have you had any bright red blood on the toilet tissue after a bowel movement?		58
Have you had any bright red blood mixed in the stool with the bowel movement?		59
Have you had any dark bloody material mixed in the stool of a bowel movement?		60

Have you had any black or tarry bowel movements?	☐	61
Do you have or have you had hemorrhoids or piles?	☐	62
Do you have itching about the rectum?	☐	63
Have you been told that you had any parasites, bacteria, or form of infection of the bowels?	☐	64
Have you had a hernia?	☐	65
Do you seem to have an unusual amount of thirst?	☐	66
Do you pass unusually large amounts of urine?	☐	67
Have you had or been told that you had anemia?	☐	68
Have you been told that you had a blood abnormality?	☐	69
Have you had a blood transfusion?	☐	70
Do you bruise easily?	☐	71
Have you had a cancer or malignancy?	☐	72
CARD NUMBER	☐	75
CASE NUMBER	☐☐☐☐☐	76-80

CASE NUMBER [ ][ ][ ][ ][ ] 1-5

DATE (not coded)_____

No code 1 Now have code 2 Have had code 3

Have you been treated for syphilis?	6
Have you been told that you had a venereal disease?	7
Do you have difficulty in passing your urine?	8
Have you had to be catheterized in order to pass your urine or for any other reason?	9
To the best of your knowledge have you had pyelitis or infection of the kidney?	10
Have you been told that you had cystitis or an infection of the bladder?	11
Have you been cystoscoped (instrument examination of the bladder)?	12
Have x-rays been taken of your kidneys or bladder?	13
Have you had prostatitis or infection of your prostate gland?	14
Have you been told that your prostate gland was enlarged?	15
Have you been told that you had pus in the urine?	16
Have you been told that there was blood in your urine?	17
Have you been told that there was sugar in your urine?	18
Have you been told that you had albumin or protein in the urine?	19
Have you had a kidney stone?	20
Do you have to get up at night to pass water?	21
Do you seem to urinate more frequently than you think is common?	22
Do you have burning pain when you urinate?	23
Have you noticed blood in your urine or passed blood while urinating?	24
Have you had intermittent swelling of the face for reasons other than injury or localized infection?	25

Have you had pounding headaches and flushing of the face? 26

Have you been told that you have thyroid disease? 27

Do you have excessive sweating? 28

Have you noticed any difficulty or clumsiness on walking or climbing stairs? 29

Has your hair changed in texture (become fine and soft or coarse and stiff)? 30

Do you fall asleep for short periods of time even though you have had adequate sleep the night before? 31

Do you have unusual intolerance to hot weather? 32

Do you have unusual intolerance to cold weather? 33

Are you easily excited? 34

Do you worry or sleep poorly before flights? 35

Are you frequently tense and irritable? 36

Have you ever had a period of loss of memory (for example, associated with an accident)? 37

Have you had coma or been unconscious for any reason (accident, illness)? 38

Have you had a convulsion? 39

Have you fainted? 40

Have you had spinal fluid drawn off or a spinal tap performed? 41

Do you often feel unhappy and depressed? 42

Have you seriously considered committing suicide? 43

Do you have frequent severe headaches? 44

Do you sometimes have difficulty pronouncing words clearly? 45

Do you notice a tendency to be clumsy when using your hands and arms? 46

Have you had trouble with frequent or severe burning sensations in the fingers, toes or feet? 47

Have you had or been told that you had a slipped disc?		48
Do you have frequent back pain?		49
Have you had stiff or painful joints?		50
Have you had pain or changes in color of the fingers or toes?		51
Have you had a numbness or tingling in either arm or hand?		52
Do you have a tremor or shaking of your hands?		53
Have you had swelling of any joints?		54
Have you had or been told that you had arthritis?		55
Have you had loss of hair over the tops of your toes and feet?		56
Do you have difficulty in maintaining your balance?		57
Have you had any bone or joint difficulty of arms or legs (including fractures)?		58
Do you tend to have muscle cramps (arms or legs)?		59
Have you had any paralysis of any of the muscles in either arm, hand, hip, leg or foot?		60
Have you had severe or frequent numbness and tingling in the feet?		61
Do you have pain in the calf of your leg while walking?		62
Do you have unusual swelling or enlargement of the veins in your legs (varicose veins)?		63
Have you had sores or ulcers on your feet or legs?		64
Have you had any swelling of your ankles or feet?		65
Have you had or been told that you had thrombophlebitis?		66
CARD NUMBER		75
CASE NUMBER		76-80

CASE NUMBER ☐☐☐☐☐ 1-5

DATE (not coded)_____

During the past three years has your job assignment caused you to work closely with radar or microwave devices? ☐ 6

During the past three years has your job assignment caused you to work closely with solvents (including aircraft engine cleaners) or missile propellants? ☐ 7

Are you, or have you ever been engaged in aerial spraying or crop-dusting? ☐ 8

Have you had contact dermatitis (irritation of skin from chemicals, etc.)? ☐ 9

Are you sensitive or allergic to any drugs? ☐ 10

Have you had serum sickness? ☐ 11

Have you had giant hives? ☐ 12

Other than diagnostic x-rays, have you been exposed to x-radiation, radiation therapy, or radioactivity? ☐ 13

If so, was this followed by a period of nausea, vomiting, diarrhea, fever, unexplained bruise marks or sudden loss of hair? ☐ 14

Have you received radium treatment for any reason? ☐ 15

To the best of your knowledge, have you been exposed to lead, such as leaded fuel and lead base paints? ☐ 16

Have you traveled outside the United States during the past six months? ☐ 17

If so, did you experience any illnesses or develop any symptoms during or shortly after the trip? ☐ 18

Have you had carbon monoxide poisoning? ☐ 19

Have you been frequently exposed to increased quantities of carbon monoxide? ☐ 20

Has any of your work or hobbies required you to be exposed to carbon tetrachloride (carbon tetrachloride is contained in many solvents, cleaning materials and fire extinguishers; it is frequently used in dry cleaning and degreasing agents)? ☐ 21

To the best of your knowledge have you been exposed to Beryllium containing fumes or dust? ☐ 22

CARDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE
SUMMARY SHEET

CASE NUMBER ☐☐☐☐☐ 1-5

Review of Systems
Normal code 1 Slightly suspicious code 2 suspicious code 3
Very suspicious code 4 Abnormal code 5

Eyes ☐ 6

ENT ☐ 7

Cardiorespiratory
lungs ☐ 8

heart
general ☐ 9

angina ☐ 10

hypertension ☐ 11

Gastrointestinal
general ☐ 12

gall bladder ☐ 13

peptic ulcer ☐ 14

liver ☐ 15

Genitourinary
renal ☐ 16

bladder, prostate ☐ 17

other ☐ 18

Metabolic ☐ 19

Neurological ☐ 20

Musculo-skeletal ☐ 21

Peripheral vascular ☐ 22

Allergy ☐ 23

Hematological ☐ 24

Dermatological ☐ 25

CARD NUMBER ☐ 75

CASE NUMBER ☐☐☐☐☐ 76-80

FAMILY HISTORY

	(AGE AT ONSET)					
	Heart trouble	CVA (strokes) before age 60	High blood pressure	Diabetes	Cancer	High blood fat, high cholesterol
Father Age_____ Age at death_____ history significant code 1 not significant code 2 suspect code 3						
Mother Age_____ Age at death_____ history significant code 1 not significant code 2 suspect code 3						
Siblings Ages _____ _____ _____ _____ Brothers' ages at death _____ _____ _____ _____ Sisters' ages at death _____ _____ _____ _____ _____ history significant code 1 not significant code 2 suspect code 3						
Children Number _____ history significant code 1 not significant code 2 suspect code 3						


23


24

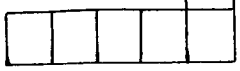

25


26

CARD NUMBER


75

CASE NUMBER


76-80

PULMONARY SURVEY

THE INFORMATION GIVEN IN THIS SURVEY IS STRICTLY CONFIDENTIAL AND WILL NOT BECOME PART OF YOUR INDIVIDUAL RECORD UNLESS YOU SO DESIRE.

Please note that some columns are to be filled in by the examiner. These are enclosed and carry the notation "DO NOT WRITE IN THESE BLOCKS."

In the section marked HISTORY and PAST HISTORY OF ILLNESS; do not bother to fill in subsequent items if leading question is answered by no; if leading question is yes, please answer all items pertaining to it.

Please fill boxes where indicated with correct numbers. If only one number, place it in far right hand box and precede with zeros. If two numbers, place in two right hand boxes, etc.

EXAMPLE:

NO code 1 YES code 2 DON'T KNOW code 9

Do you cough throughout the day?
(If you do, then code)

How many years have you had this cough?
(If 11 years, then code)

0	0	2
0	1	1

ON occasional items, fill in directly and do not code.

EXAMPLE:

020 Cigarettes daily for 008 years

000 Cigars daily for 000 years

005 Pipefuls daily for 003 years

NAME_____ GROUP_____ DATE_____
Please print-LAST NAME FIRST

SERVICE NUMBER

SOCIAL SECURITY NUMBER

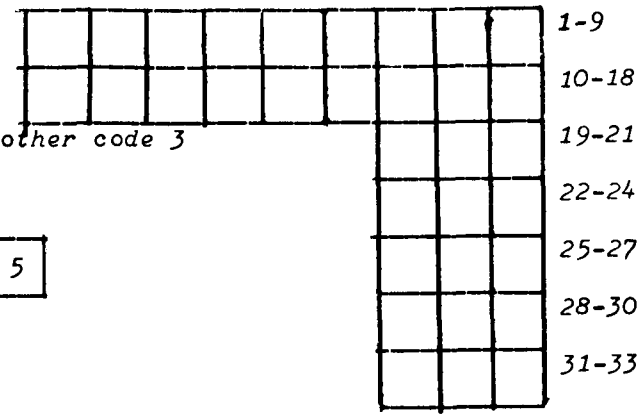
RACE: white code 1 negro code 2 other code 3

SEX: male code 1 female code 2

HEIGHT: EXAMPLE: 5'10½"= | 7 | 0 | 5 |

WEIGHT:

AGE: (LAST BIRTHDAY)



RESIDENCE (STATE) PAST TO PRESENT

_____FROM_____TO_____

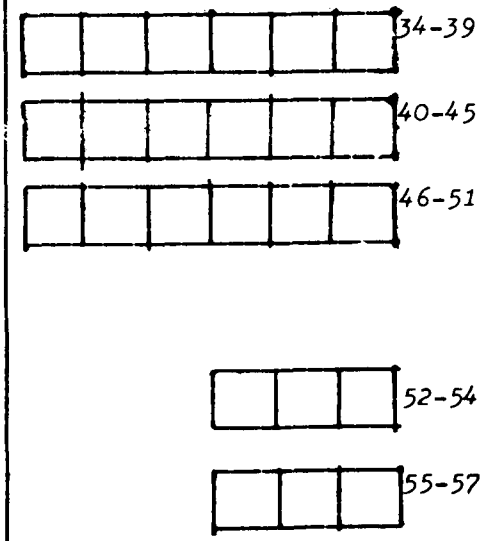
_____FROM_____TO_____

_____FROM_____TO_____

LABORATORY:
X-ray: normal code 1
abnormality lungs code 2
abnormality heart code 3
abnormality heart and lungs code 4

COUGH DURATION:

DO NOT WRITE IN THESE BLOCKS



PHYSICAL EXAMINATION:

CHEST: normal code 1
pectus excavatum code 2
kyphosis code 3
scoliosis code 4

CHEST Auscultation:
normal code 1
rales code 2
rhonchi code 3
wheezes code 4
any combination of above code 5

HEART: normal code 1
systolic murmur code 2
diastolic murmur code 3

BODY MEASUREMENTS:
sitting height

chest diameter (Breadth)

*(A-P_*

APPEARANCE NUMBER (DO NOT FILL IN THIS SPACE)

DO NOT WRITE IN THESE BLOCKS

58-60

61-63

64-66

67-69

70-72

73-75

76-80

DO NOT WRITE IN THESE BLOCKS

chest circumference (Inspiration)

(Expiration)

1-3

4-6

HISTORY: NO code 1 YES code 2 DON'T KNOW code 9

NASAL:

Do you frequently have a stuffy nose in winter? 7-9

Do you have this difficulty during the summer? 10-12

If yes to the above, how many years have you been troubled with this? 13-15

COUGH: NO code 1 YES code 2 DON'T KNOW code 9

Do you cough on awakening? 16-18

Do you cough throughout the day? 19-21

If yes to the above, how many months during the year do you cough like this? 22-24

How many years have you had this cough? 25-27

If yes, does it occur
NO code 1 SPRING code 2
SUMMER code 3 FALL code 4 WINTER code 5
ANY TIME OF YEAR CODE 6 DON'T KNOW code 9

Is cough productive of phlegm? 28-30

If yes, is amount generally:
Scant code 1
¼ cup code 2
½ cup code 3
more than ½ cup code 4 31-33

If yes, is color of phlegm:
clear or grayish code 1
occasionally yellow or green code 2 (At least in part)
usually yellow or green code 3
Don't know code 9 34-36

Have you ever coughed up blood? 37-39

If yes: flecks or streaks code 1
about 1 teaspoon code 2
more than teaspoon code 3
amount unknown code 9 40-42

If yes, was this during:
past six months code 1
1-2 years code 2
more than 2 years code 3
repeatedly, including past six months code 4
amount of time unknown code 9 43-45

SHORTNESS OF BREATH: NO code 1 YES code 2 DON'T KNOW code 9

Are you ever troubled with shortness of breath? 46-48

SHORTNESS OF BREATH (con't) NO code 1 YES code 2 DON'T KNOW code 9

If yes, does it occur:

after walking up a single flight of stairs		49-51
after walking at a moderate pace for 2-3 blocks		52-54
after eating a meal		55-57
when you get excited or angry		58-60
while resting or lying down		61-63
If yes, how many months have you been troubled with this?		64-66
Do you need pillows to breathe comfortably at night?		67-69
If yes, how many months have you been troubled with this?		70-72

WHEEZING: Does your chest ever sound wheezing or whistling? 73-75

DO NOT WRITE IN THESE BLOCKS

APPEARANCE NUMBER 76-80

WHEEZING (con't)

If so, do you get it with colds?		1-3
Do you get it apart from colds?		4-6
If yes, do you wheeze most at any time of year? No code 1 Spring code 2 Summer code 3 Fall code 4 Winter code 5 More than one code 6 Don't know code 9		7-9
How many months have you noticed wheeze?		10-12

CHEST PAIN: *NO code 1* *YES code 2* *DON'T KNOW code 9*

Have you ever been bothered by chest pain?
*If yes describe:*_____
_____ 13-15

If yes, how many months? 16-18

Have you ever noticed your ankles swelling? 19-21

If yes, how many months? 22-24

*During the past three years have you had any chest illness which has kept you off work, indoors, home in bed? Describe*_____
_____ 25-27

Have you ever had asthma? 28-30

If yes, age asthma started: 31-33

Age asthma stopped? 34-36

PAST HISTORY OF ILLNESS: *No code 1*
Yes code 2
Yes, recurrent code 3
Don't know code 9

Have you ever had bronchitis? 37-39

Have you ever had pneumonia? 40-42

Have you ever had pleurisy? 43-45

Have you ever had tuberculosis? 46-48

Have you ever had silicosis? 49-51

Have you ever had exposure to rock dust? (for long duration) 52-54

Have you ever had exposure to sand blasting? (for long duration) 55-57

Have you ever had exposure to coal mining, etc.? (for long duration) 58-60

Have you ever had broken ribs? 61-63

Have you ever had chest surgery or injury? 64-66

Have you ever had arthritis of the spine? 67-69

Have you ever had neuromuscular disorder? 70-72

Have you ever had a heart attack? 73-75

APPEARANCE NUMBER (DO NOT FILL IN) 76-80

NO code 1 YES code 2 RECURRENT code 3 DON'T KNOW code 9

PAST HISTORY OF ILLNESS (con't)

Have you ever had a heart murmur? 1-3

Have you ever had rheumatic fever? 4-6

Have you ever had congenital heart disease? 7-9

Have you ever had high blood pressure? 10-12

Have you ever had hay fever? 13-15

SMOKING TYPE: 16-18

none code 1
occasionally (less than one of each daily) (then code 2)
cigars only code 3
pipe only code 4
cigarettes only code 5
mixed, including cigarettes code 7

QUANITY: 19-21

if yes_ age started smoking

FILL IN QUANITY OF TOBACCO SMOKED:

DO NOT WRITE IN THESE BLOCKS

_____Cigarettes daily for_____years 22-27

_____Cigars daily for _____years 28-33

_____Pipefuls daily for _____years 34-39

METHOD: inhale code 1 40-42
do not inhale code 2

STATUS: smoke at present code 1 43-45

if stopped how many years ago 46-48

If stopped cigarettes, but now pipe or cigars (code 1) 49-51

How many years ago stopped cigarettes 52-54

DO NOT WRITE IN THESE BLOCKS

BLOOD PRESSURE:

SYSTOLIC 56-57

DIASTOLIC 58-60

APPEARANCE NUMBER: (LEAVE BLANK) 76-80

CARDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE

PERSONAL HISTORY

NAME _____

CASE NUMBER [ ][ ][ ][ ][ ] 1-5

Smoking [ ] 6

Type: none code 1 cigarettes only code 5
smoke occasionally code 2 pipe and cigars only code 6
cigars only code 3 mixed including cigarettes code 7
pipe only code 4

Quantity [ ] 7

fewer than 10 cigarettes daily	code 1
10-19 cigarettes daily	code 2
20-39 cigarettes daily	code 3
40 or more cigarettes daily	code 4
1-5 cigars or pipefuls	code 5
6 or more cigars or pipefuls	code 6
non-smoker	code 9

Method [ ] 8

Inhale code 1 do not inhale code 2 non-smoker code 9

Status [ ] 9

smoke at present	code 1
stopped 1 year ago	code 2
stopped 2 years ago	code 3
stopped 3-5 years ago	code 4
stopped 6-10 years ago	code 5
stopped over 10 years ago	code 6
previously smoked cigarettes but now only pipe or cigars past 1-5 years	code 7
5 years or more	code 8
non-smoker	code 9

Age started smoking _____ [ ][ ] 10-11

_____ cigarettes daily for _____ years

_____ cigars daily for _____ years

_____ pipefuls daily for _____ years

NAVSCOLAVNMED 6500/18

Weight [ ] 12

change since age 25

gained 0-5 lbs	code 1	lost 0-5 lbs	code 5
gained 6-14 lbs	code 2	lost 6-14 lbs	code 6
gained 15-25 lbs	code 3	lost 15-25 lbs	code 7
gained 25 or more lbs	code 4	lost 25 or more lbs	code 8

Maximum weight _____ at age _____

Weight 1940 _____ 1950 _____ 1960 _____

Physical Activity

Occupation [ ][ ] 13-14

light now, light 10 years ago	code 11
medium now, light 10 years ago	code 12
heavy now, light 10 years ago	code 13
light now, medium 10 years ago	code 14
medium now, medium 10 years ago	code 15
heavy now, medium 10 years ago	code 16
light now, heavy 10 years ago	code 17
medium now, heavy 10 years ago	code 18
heavy now, heavy 10 years ago	code 19
if not working	code 99

Describe job as to maximum effort, proportion of walking, proportion of standing, and proportion of strictly sedentary activity. _____

_____

_____

_____

work _____ days per week

vacation _____ days per year

sleep _____ hours per night

Do you have a planned physical fitness program? [ ] 15
Yes code 1 No code 2

Describe _____

_____

_____

Off Job - Usual evenings and weekends

		Nights (account for 7)	Weekend Days (account for 2 mornings and 2 afternoons)
0	TV	_____	_____
	Reading	_____	_____
	Sitting Around	_____	_____
1	Studying	_____	_____
	Bring home office work	_____	_____
2	Attend School	_____	_____
	Attend meetings	_____	_____
	Go visiting	_____	_____
	Entertaining	_____	_____
3	Out on the town (include shopping)	_____	_____
	Hobbies	_____	_____
	Driving (pleasure)	_____	_____
4	Home repairs	_____	_____
	Gardening	_____	_____
5	Heavy manual labor	_____	_____
	Extra job or overtime work	_____	_____
	Active sports	_____	_____
	Other_____	_____	_____
	TOTAL		

 16-17

Diet yes code 1 no code 2

Unrestricted ☐ 18

Restricted in calories ☐ 19

Restricted in salt ☐ 20

Restricted in fat content ☐ 21

Diabetic diet ☐ 22

Ulcer diet ☐ 23

Other_____ ☐ 24

If restricted, duration_____years

Do you consider your diet high, moderate, or low in fat content (dairy products, fat meats, or other fatty substances)? ☐ 25
High code 1 Moderate code 2 Low code 3

Do you consider your diet high, moderate, or low in carbohydrates (sugars, starches)? ☐ 26
High code 1 Moderate code 2 Low code 3

Has your type of diet changed within the past 5 years? ☐ 27
Yes code 1 No code 2

If yes, please indicate how and the reason for the change:

_____

Analysis of meals: ☐ 28

Meals	Frequent snacks	
3	no	code 1
3	yes	code 2
2	no	code 3
2	yes	code 4
more than 3	no	code 5
more than 3	yes	code 6

SOCIAL -ECONOMIC

Marital Status

Single	code 1	Widow	code 4
Married	code 2	Divorced	code 5
Separated	code 3		

29

Usual occupation _____ 30-31

Source of Income 32

Inherited savings provide basic income code 1

Earned wealth "new money" has provided "transferable" investment income code 2

Profits, fees, royalties includes executives who receive "share of profit" code 3

Salary, commissions, regular income on monthly or yearly basis code 4

Wages on hourly basis, piece work; weekly checks as distinguished from monthly code 5

Income from odd jobs or private relief; seasonal work only code 6

Public relief or charity code 7

Other _____ code 8

Education 33

Completed grade and high school

College years _____

Degrees _____

Religious affiliation _____ 34

Father

Occupation _____ 35-36

Birthplace _____ 37-38

Mother

Occupation_____ 39-40

Birthplace_____ 41-42

Where were you born - city and state?_____ 43-44

_____

Where have you lived most of your life?_____ 45-46

_____

Where have you lived most of the time since out of the service? 47-48

_____

for less than 1 year_____code 1 49

1-4 years _____code 2

5-9 years _____code 3

10-19 years _____code 4

20 years and over _____code 5

Social Index Score

_____x5 + _____x4 + _____x3 = 50-51

CARD NUMBER 75

CASE NUMBER 76-80

AUDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE
Pensacola, Florida

Date_____ Age[ ][ ] (1 2) Ser.No.[ ][ ][ ][ ][ ][ ][ ] (3-9)

Name_____ Service Group_____

Address_____

_____

PLEASE ANSWER ALL QUESTIONS AS ACCURATELY AS POSSIBLE
YOUR ANSWERS ARE CONFIDENTIAL

Number of years served as pilot or flight crew member [ ][ ] (10 11)

Total Flight time, including passenger and crew
Military and civilian [ ][ ][ ][ ][ ] (12 13 14)

Aircraft types flown. Time in each:
Military and civilian

Single Engine Prop (F6F, TBM, T28, etc.) [ ][ ][ ][ ][ ] (15 16 17)

Multi-Engine Prop (R5D, PBM, R4y, etc.) [ ][ ][ ][ ][ ] (18 19 20)

Single Place Jet (F9F, A4D, F8U, etc.) [ ][ ][ ][ ][ ] (21 22 23)

Multi-Place Jet (A3D, DC-8, etc.) [ ][ ][ ][ ][ ] (24 25 26)

NAVSCOLAVNMED 6500/22

Other Noise Exposure. Give number of years actively engaged:

Catapult [ ][ ] (27 28)

Gunnery [ ][ ] (29 30)

Flight Deck [ ][ ] (31 32)

Flight Line [ ][ ] (33 34)

Shop Work (specify type)_____ [ ][ ] (35 36)

Other (blasting, grinding,etc.)_____ [ ][ ] (37 38)

Have you worn ear protection on above jobs?

1. Always
2. Usually
3. Often
4. Seldom
5. Never

[ ] (39)

What type? (Specify kind most often used)

1. Ear plugs
2. Ear muffs
3. Cotton
4. Combination muffs & plugs
5. Other _____

[ ] (40)

Have you been around gunfire?

1. None
2. Very little
3. Much
4. Very much

[ ] (41)

Types of guns: (place 1 in block if yes; 2 in block if no)

.22 Cal. ☐ 42

.45 Cal. ☐ 43

.30 Cal. ☐ 44

Shotgun ☐ 45

Artillery, Mortar, etc. ☐ 46

Have you worn ear protection when around gunfire?

1. Always
2. Usually
3. Often
4. Seldom
5. Never

☐ 47

What type? (Specify kind most often used)

1. Ear plugs
2. Ear muffs
3. Cotton
4. Combination muffs & plugs
5. Other_____

☐ 48

Do you experience difficulty in following conversations under the following circumstances?
Place 1 in block if yes; 2 in block if no.

In groups (Parties, football games, etc.) [ ] 49

When talking with one person in quiet room [ ] 50

At meetings (Church, Business, etc.) [ ] 51

Radio news commentator [ ] 52

Television [ ] 53

Aircraft radio (Clearances, etc.) [ ] 54

Crew in aircraft (not on intercom.) [ ] 55

If you have a hearing loss place 1 in block, if no place 2. [ ] 56

Describe the loss below. Tell cause, if known.

_____

_____

_____

_____

_____

Rate each type aircraft in which you have experience according to the difficulty which you have had in communicating by Radio or Intercom. Insert the appropriate number in each square.

1. No difficulty encountered
2. Some difficulty
3. Moderate difficulty
4. Fairly serious difficulty
5. Quite serious difficulty

Single Engine Prop 
57

Single Place Jet 
58

Multi Engine Prop 
59

Multi Place Jet 
60

Rate the same aircraft according to the difficulty you have had in conversing with other occupants without using intercom:

Single Engine Prop 
61

Multi Engine Prop 
62

Multi Place Jet 
63

CASE NUMBER 
64-68

CARDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE

PHYSICAL EXAMINATION

CASE NUMBER 1-5

Date of Examination 6-11

Age last birthday 12-13

Blood pressure, lying (initial) 14-19

Blood pressure, sitting (initial) 20-25

Blood pressure, lying (second) 26-31

Blood pressure, sitting (second) 32-37

Pulse 38-40

General Appearance (describe obvious defects)_____ 41

_____

poor code 1 good code 3
fair code 2 excellent code 4

Teeth 42
poor code 1 good code 3
fair code 2 dentures code 4

Eyes (eye missing code 9 or 99)

Tonometry 43-44

Arcus senilis yes code 1 no code 2 45

Xanthelasma yes code 1 no code 2 46

Pupils normal code 1 abnormal code 2 47

Specify_____

Fundi (describe)_____ 48

Normal code 1 Keith Wagner: Grade 1 code 2 Grade 3 code 4
Grade 2 code 3 Grade 4 code 5

Unable to visualize code 6

NAVSCOLAVNMED 6500/17

Ears normal code 1 abnormal code 2 [ ] 49

Nose normal code 1 abnormal code 2 [ ] 50

Mouth and pharynx normal code 1 abnormal code 2 [ ] 51

Neck (veins, carotid pulsations) normal code 1 abnormal code 2 [ ] 52

Thyroid (describe)_____ [ ] 53
not palpable code 1 palpable code 2 surgically absent code 3

Lymph nodes not palpable code 1 palpable code 2 [ ] 54

Chest [ ] 55

normal code	1	kyphosis code	4
emphysematous code	2	scoliosis code	5
pectus excavatum code	3	other code	6

Chest auscultation

breath sounds: normal code 1 abnormal code 2 [ ] 56
Describe_____

rales code 1 rales and rhonchi code 3 [ ] 57
rhonchi code 2 wheeze code 5

Heart

thrill none code 1 systolic code 2 diastolic code 3 [ ] 58

Specify location_____

significant murmurs [ ] 59
systolic: none code 1 pulmonic code 3
aortic code 2 apical code 4
combinations code 5

Describe_____

_____

diastolic: none code 1 pulmonic code 3 [ ] 60
aortic code 2 apical code 4
combinations code 5

Describe_____

_____

non-significant murmurs
none code 1 pulmonic code 3
apical code 2 other code 5

Describe _____

_____

61

Abdomen

liver not palpable code 1 palpable and tender code 3
palpable code 2

62

Describe _____

other abnormalities (hernia, masses, etc.)
no code 1 yes code 2

63

Describe _____

Rectal
normal (prostate normal, no masses) code 1
prostate abnormal code 2 mass code 3

64

Extremities

color
normal code 1 rubor code 3
pallor code 2 cyanosis code 4

65

clubbing no code 1 definite code 2 suggestive code 3

66

palmar erythema no code 1 yes code 2

67

pulsations normal code 1 diminished or absent code 2

68

varicosities none code 1 minimal code 2 moderate code 3
marked code 4

69

edema
no code 1 1+ code 2 2+ code 3 3+ code 4 4+ code 5

70

describe all changes _____

arthritic changes no code 1 yes code 2

71

describe _____

Neurologic normal code 1 abnormal code 2 ☐ 72

describe _____

Skin normal code 1 abnormal code 2 Xanthoma code 3 ☐ 73

describe _____

Card Number ☐ 74

Case Number ☐☐☐☐☐ 76-80

Comments: _____

_____

_____

_____

_____

CARDIOLOGY BRANCH
SCHOOL OF AVIATION MEDICINE
THOUSAND AVIATOR PROJECT

DATE OF EXAMINATION_____ AGE_____

NAME_____

ADDRESS_____

_____

HISTORY:

PHYSICAL EXAMINATION: Blood pressure (recumbent) / . (sitting) / .

ANTHROPOMETRY: Height_____ Weight_____ Physique_____Body fat_____

X-RAYS (P.A., lateral, obliques):

LABORATORY: Hematocrit_____ W.b.c.:_____differential: _____N, _____L, _____M, _____B, _____E. Urine: albumin_____, sugar_____, micro_____. Cholesterol (Abel)_____mg %. Protein bound iodine_____micrograms %. Lipoproteins (centrifuge) S_f 0-12_____mg %, 12-20 _____, 20-100_____, 100-400_____; atherogenic index _____. Triglycerides _____mg %. Uric acid _____mg %. Fasting blood sugar _____mg %. Two hour post 100 grams glucose_____mg %.

TONOMETRY: OD_____ OS_____.

BALLISTOCARDIOGRAM:

VECTORCARDIOGRAM:

PULMONARY STUDIES: Vital capacity _____ liters

Expiratory reserve volume _____ liters

Inspiratory capacity _____ liters

Expiratory mid-volume velocity _____ liters/minute

NORMAL ABNORMAL

ELECTROCARDIOGRAMS: Routine:

Exercise:

ELECTROENCEPHALOGRAM:

AUDIOLOGY:

SUMMARY:

RECOMMENDATIONS:

R. E. MITCHELL
CDR MC USN

Diagnosis of Coronary Heart Disease

Definite

1. Unequivocal myocardial infarction by electrocardiogram. Criteria which must represent a change from previous tracing are as below:

CODE	Category	Leads	Impression
301	a. QS deflection	(V2 thru V5) (any 2 leads)	Anterior myocardial infarction
302	b. Q wave $\geq .04$ sec. or $\geq \frac{1}{4}$ of R wave.	"	"
303	c. R wave in lead V1, decrease in R waves without their disappearance as electrode moved to the left. Smallest R wave ≥ 1.5 mm.	"	"
304	d. Q wave $\geq .04$ sec. and/or $\geq \frac{1}{4}$ R wave.	I, V5, and V6	Anterolateral myocardial infarction
305	e. Q wave $\geq .04$ sec. and/or $\geq \frac{1}{4}$ R wave.	III, AVF	
	With Q wave $\geq .03$ sec. and/or $\geq \frac{1}{4}$ R wave	II	Diaphragmatic myocardial infarction
306	f. Q $\geq .05$ sec. and R $\geq$ +3mm.	AVF	
307	g. Q wave $\geq .04$ sec. and/or $\geq \frac{1}{4}$ R wave	AVF, III, V6	Diaphragmatic lateral myocardial infarction
308	h. R wave $\geq .04$ sec. and R/S ratio ≥ 1 (not present on previous tracing; RVH excluded)	V1	Posterior myocardial infarction
309	i. R wave V1, as in posterior infarction with Q wave $\geq .04$ sec. and/or $\geq \frac{1}{4}$ R wave.	V6	Posterolateral myocardial infarction

CODE

312 2. Classic symptomatology of a myocardial infarction without QRS change but with evolutionary ST and T wave changes of discordant type provided pericarditis can be excluded.

313 3. Documented history of myocardial infarction based on typical symptoms and confirmatory laboratory findings of muscle necrosis.

314 4. Definite intermediate coronary syndrome or angina pectoris with any work ECG showing > 0.5 mm of non-junctional ST depression, or grade II ballistocardiogram.

315 5. Appearance of LBBB (QRS $\geq$ .12 sec., R peak $\geq$ .06 sec. in V5 and/or V6), and T negative in leads with upright R (AVL, I, V5 or V6) and a clinical history compatible with coronary heart disease.

316 6. Post-mortem evidence of myocardial infarction due to underlying coronary atherosclerosis.

Probable

201 1. Intermediate coronary syndrome or angina pectoris in absence of a work ECG, or a negative work ECG (either $\leq$ 0.5 mm of non-junctional ST depression or junctional depression) if taken.

202 2. Any work ECG demonstrating $\geq$ 1.0 mm non-junctional ST depression.

203 3. Appearance of LBBB without supporting evidence of CHD.

204 4. Appearance of RBBB (QRS $\geq$ .12 seconds, R' present V1 and V2, S $\geq$ .04 sec in I or AVL).

205 5. Borderline work ECG changes (non-junctional ST depression 0.5 - 1.0 mm.) or a grade II to III BCG with a suggestive history of CHD.

206 6. Instantaneous unexplained death in an individual with a previous history compatible with CHD.

Possible

CODE

101 1. Appearance of RBBB without supporting evidence of CHD.

102 2. Borderline work ECG changes (non-junctional ST depression of 0.5-1.0 mm) or a grade III BCG without suggestive history of CHD.

103 3. Instantaneous unexplained death.

Appearance of nondiagnostic resting ECG changes which represent a change from previous tracings. These alterations must occur in an individual with a suggestive history of myocardial infarction, intermediate coronary syndrome, or angina pectoris; other etiologies, e.g., atrial fibrillation in a hyperthyroid individual, must be excluded:

104 4. T amplitude less than 0.05 mm in any 2 leads except III, AVR and V1.

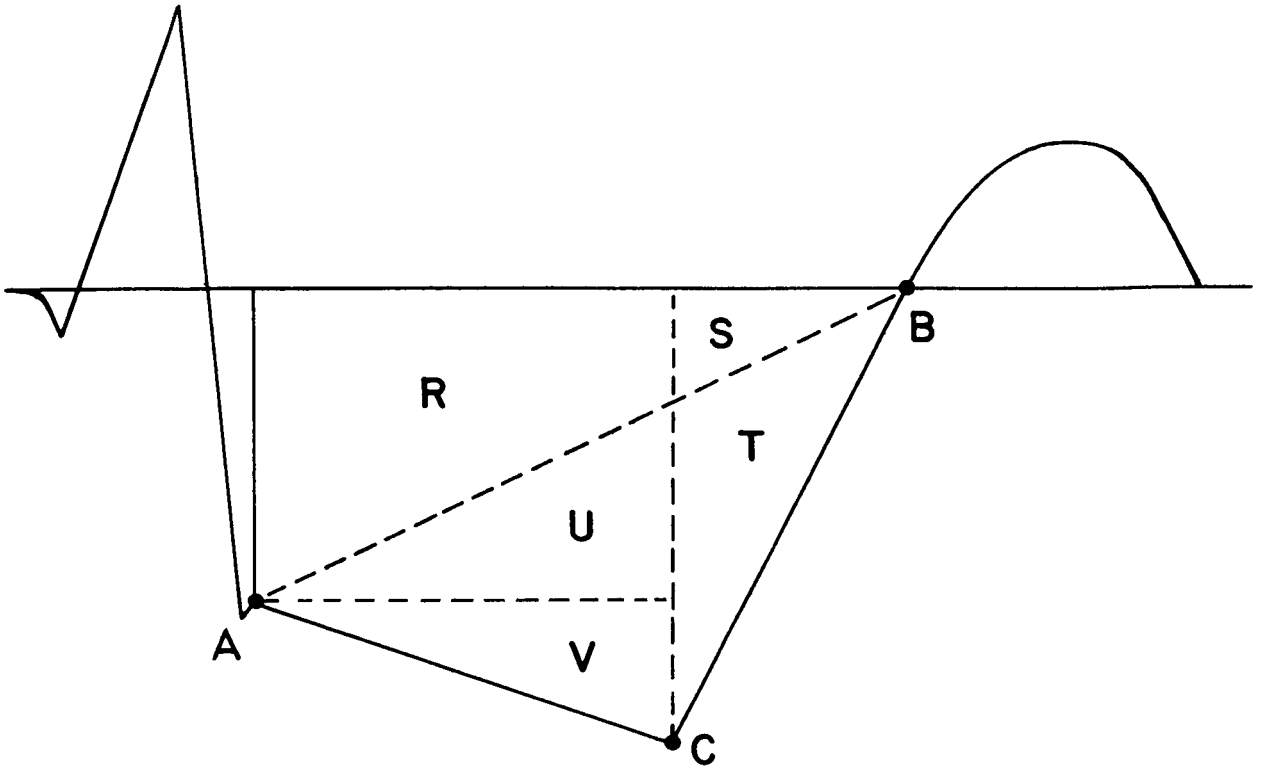
105 5. ST depression≥0.75 mm in any two leads.

106 6. Left axis deviation (<-30°).

Indeterminate

001 1. Equivocal history of intermediate coronary syndrome or angina pectoris.

002 2. Equivocal electrocardiogram.



Geometrical Determination of Area of ST Depression

These five triangles in simple combinations represent the various possibilities of ST depression. By summing the appropriate triangles one may determine the area of ST depression. The calculations for the individual triangles are presented below:

$$S = \frac{B_t - C_t}{2} \cdot A_m$$

$$T = \frac{B_t - C_t}{2} C_m - S$$

$$R = \frac{(B_t - A_t) A_m}{2} - S$$

$$U = A_m - (C_t - A_t) - R$$

$$V = \frac{(C_t - A_t)(C_m - A_m)}{2}$$

where

A_m = amplitude of A

A_t = time of A

B_m = amplitude of B

B_t = time of B

C_m = amplitude of C

C_t = time of C

CARD 11

FRANK
ECG ANALYSIS
for
F.C.C.

Field Identif	Factor Description	Value	+ -	IBM Col.
11-1 11-2	Series & Pt. # (male +, female -)			1-6
11-3	T H1 Amp. in m.m.			7-9
11-4	T H6 Amp. in m.m.			10-12
11-5	Q S1 Dur. in m.s.			13-15
11-6	Q S2 Dur. in m.s.			16-18
11-7	Q S3 Dur. in m.s.			19-21
11-8	Q S4 Dur. in m.s.			22-24
11-9	Q F1 Amp. in m.m.			25-27
11-10	R F1 Amp. in m.m.			28-30
11-11	S F1 Amp. in m.m.			31-33
11-12	P z Amp. in m.m.			34-36
11-13	P x Amp. in m.m.			37-39
11-14	P y Amp. in m.m.			40-42
11-15	T x Amp. in m.m.			43-45
11-16	T y Amp. in m.m.			46-48
11-17	T z Amp. in m.m.			49-51
11-18	R S2 Amp. in m.m.			52-54
11-19	Q S2 Amp. in m.m.			55-57
11-20	S S2 Amp. in m.m.			58-60
11-21				61-63
11-22				64-66
11-23				67-69
11-24				70-72
11-25				73-75

NAVSCOLAVNMED 6470/4C

FRANK
ECG ANALYSIS
for
F.C.C.

CARD 12

Field Identif	Factor Description	Value	+ -	IBM Col.
12-1 12-2	Series & Pt. # (male +, female -)			1-6
12-3	R F2 Amp. in m.m.			7-9
12-4	Q F2 Amp. in m.m.			10-12
12-5	S F2 Amp. in m.m.			13-15
12-6	S F2 Dur. in m.s.			16-18
12-7	S F4 Amp. in m.m.			19-21
12-8	S F4 Dur. in m.s.			22-24
12-9	R F5 Amp. in m.m.			25-27
12-10	Q F5 Amp. in m.m.			28-30
12-11	Q F5 Dur. in m.s.			31-33
12-12	S F5 Amp. in m.m.			34-36
12-13	R F6 Amp. in m.m.			37-39
12-14	Q F6 Amp. in m.m.			40-42
12-15	Q F6 Dur. in m.s.			43-45
12-16	S F6 Amp. in m.m.			46-48
12-17	S F6 Dur. in m.s.			49-51
12-18	R H1 Amp. in m.m.			52-54
12-19	S H1 Amp. in m.m.			55-57
12-20	R'H1 Amp. in m.m.			58-60
12-21	T H1 Amp. in m.m.			61-63
12-22	R F2 Amp. in m.m.			64-66
12-23	Q F2 Amp. in m.m.			67-69
12-24	S F2 Amp. in m.m.			70-72
12-25	T F2 (Tx) Amp. in m.m.			73-75

NAVSCOLAVNMED 6470/4D

CARDIOLOGY BRANCH
U. S. NAVAL SCHOOL OF AVIATION MEDICINE
PROTOCOL FOR POST MORTEM EXAMINATION

This gentleman is a member of the "Thousand Aviators", a group of cohorts who have participated in a longitudinal study, primarily cardiovascular, since 1940. It is of the utmost importance in this epidemiological study that a post mortem examination with special attention to the cardiovascular system be carried out on all participants. If at all possible, completion of the following protocol would be greatly appreciated. This standard data on the heart and vessels will be of inestimable value in our program. If routine autopsy facilities are unavailable, the heart and aorta (fixed in formalin) should be shipped to the address below. Any inquiries or suggestions regarding the protocol or study addressed to the Cardiology Branch, School of Aviation Medicine, U. S. Naval Medical Center, Pensacola, Florida will be immediately answered.

CASE NUMBER (leave blank) [| | | | |] 1-5

AGE [| |] 6-7

PATIENT'S NAME _____

PLACE OF DEATH _____
(Hospital, Institution, address)

AUTOPSY NUMBER _____

NAME OF PATHOLOGIST _____

SOURCE NECROPSY INFORMATION

Coroner's office	code 1	Service, VA Hospital	code 3	[ ] 8
Private hospital	code 2	Other	code 4	

TYPE OF EXAMINATION

Gross	code 1	Gross and micro	code 3	[ ] 9
Micro	code 2	Not known	code 9	

POST MORTEM BODY WEIGHT IN POUNDS [| |] 10-12

HEART WEIGHT IN GRAMS [| |] 13-15
(Please weigh after emptying chambers of all blood clots)

THICKNESS ANTERIOR ABDOMEN FAT IN MILLIMETERS [| |] 16-18
(Please measure mid-way between xyphoid process and the umbilicus from the skin surface to the anterior portion of the rectus sheath)

After sectioning the heart please record location and extent of the following lesions on schematic diagram (page 4)

PLEASE SCORE THE FOLLOWING STATEMENTS AS:
Absent 0; Slight 1; Moderate 2; Severe 3 where applicable.
If not record as: Absent 0; Present 5:

CORONARY ATHEROSCLEROSIS (with stenosis)			19
CORONARY OCCLUSION (Thrombus____;Sclerosis____)			20
RECENT INFARCT			21
HEALED (OLD) MYOCARDIAL INFARCT			22
MYOCARDIAL FIBROSIS (FOCAL)			23
VENTRICULAR DILATATION (If aneurysmal score as 4)	Left		24
	Right		25
EVIDENT SOURCE OF ARTERIAL EMBOLI, SUCH AS LEFT ATRIAL MURAL THROMBOSIS AND/OR VERRUCAL ENDOCARDITIS Please specify_____			26
CONGENITAL HEART OR GREAT VESSEL ANOMALY Please specify_____			27
OTHER ABNORMALITY INCLUDING PERICARDIUM Please specify _____			28

VESSELS

ATHEROSCLEROSIS OF ABDOMINAL AORTA AND/OR ILIAC ARTERY		29
ABDOMINAL AORTIC ANEURYSM WITH THROMBOSIS		30
THROMBOSIS OF FEMORAL ARTERY(S) WITH ASSOCIATED ATHEROSCLEROSIS		31

RECORD FOLLOWING IN MILLIMETERS

LEFT VENTRICULAR HYPERTROPHY (thickness at insertion anterior papillary muscle)			32-34
RIGHT VENTRICULAR HYPERTROPHY			35-37
VALVULAR DIMENSIONS	Aortic		38-40
	Pulmonic		41-43
	Mitral		44-46
	Tricuspid		47-49

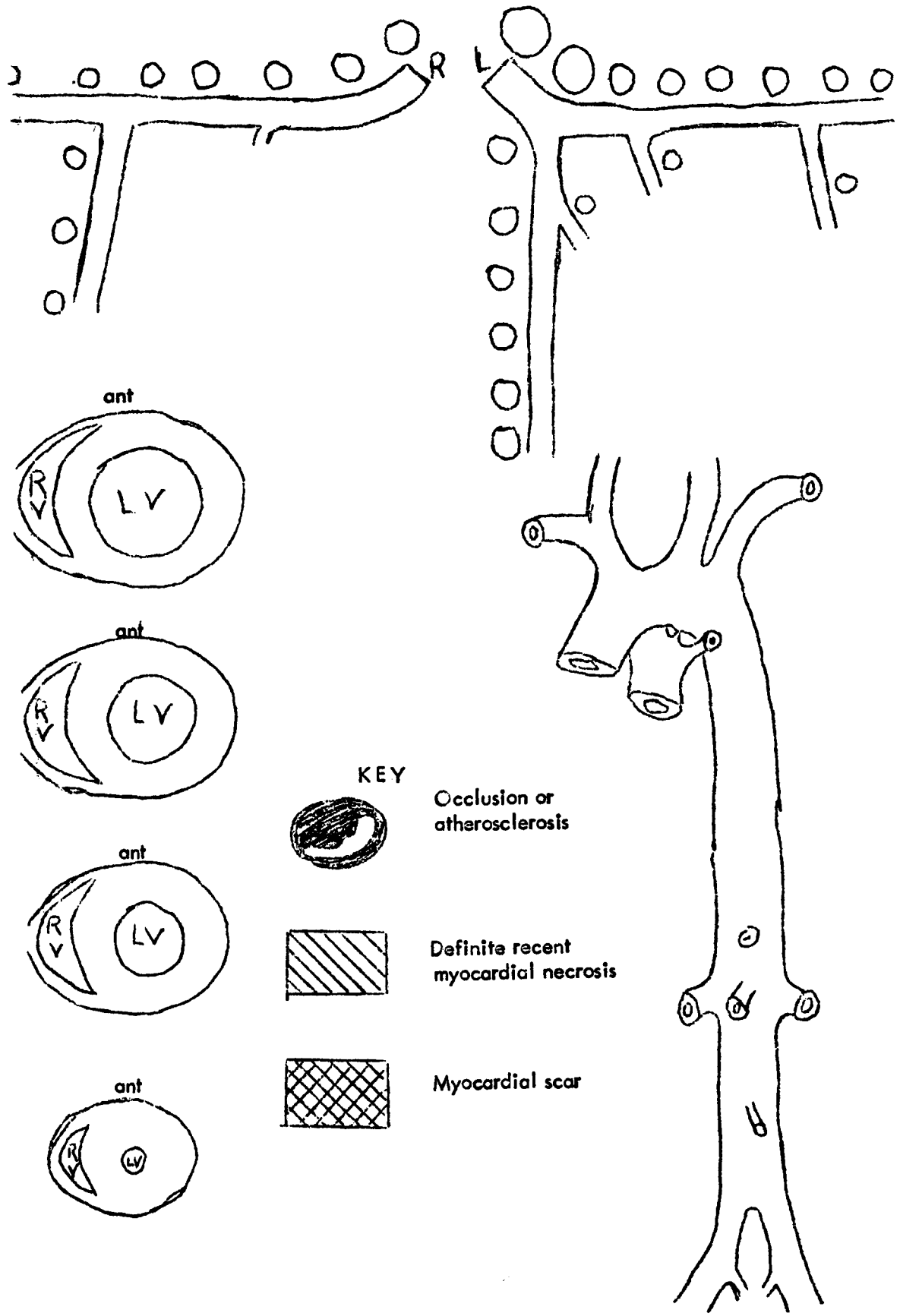
DISEASE OR CONDITION DIRECTLY CAUSING DEATH:

ANTECEDENT CAUSES (MORBID CONDITIONS) GIVING RISE TO ABOVE CAUSE:

OTHER SIGNIFICANT CONDITIONS:

COMMENTS REGARDING PROTOCOL:

PATHOLOGIST


R
L
ant
RV
LV
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RV
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ant
RV
LV
KEY
Occlusion or atherosclerosis
Definite recent myocardial necrosis
Myocardial scar

APPENDIX E

Summary of Tests for all Examinations

Summary of Tests+

Tests	Study 1940	1951	1957	1963
Interview--Personal and Medical Histories	*	*	*	*
Physical Examination	‡	*	*	*
Cardiovascular				
Routine electrocardiogram	*	*	*	*
Startle electrocardiogram	*			
Computer processed electrocardiogram				*
Exercise electrocardiogram			*	*
Ballistocardiogram			++	*
Vectorcardiogram				*
Plethysmogram				*
Cold Pressor Test	*		++	
Other	*			*
Laboratory Determinations			*	*
Pulmonary and Metabolic				
Spirometry	*			*
Basal metabolic rate	*			
Other	*			*
Anthropometry				
Somatotype	*			*
Measurements (in addition to height and weight)			#	*
Teleoroentgenograms		*	*	*

Summary of Tests - Continued

Tests	Study 1940	1951	1957	1963
Psychologic-Psychomotor				
Guilford-Zimmerman Temperament Survey				*
Ataxia test	*			*
Tilt Chair	*			*
Other	*			*
Vision	*			*
Neurophysiologic				
Electroencephalogram	*			*
Skin resistance	*			
Audiometry				*

+Completion of the tests is noted by an asterisk; if a procedure was not performed during an evaluation, the appropriate column is blank.

‡Only blood pressures were recorded because each subject had qualified medically before inclusion in the study.

++Examinations performed on less than 25 per cent of the study group.

Arm circumference only.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

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U. S. Naval Aviation Medical Center
Pensacola, Florida

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13. ABSTRACT

The Pensacola study of Naval Aviators, commonly termed the "Thousand Aviator Study," began in July 1940 as a survey to validate techniques for pre-selecting pilot trainees in order to reduce the large attrition rate in the flight training program at that time. From this original exploratory study of pilot selection evolved a longitudinal study which has provided continuous physiologic information on a group of healthy males from youth to senescence. Re-examinations have been made on survivors of the group in 1951, 1957, and 1963.

This Monograph purports to accomplish the following aims: 1) Present and unify the procedures and methods of all the examinations carried out on the group, 2) offer standard material for cooperative studies, 3) serve as a guide for future evaluations, 4) display the methodology employed in a fashion which lends itself to perusal by critical reviewers, 5) suggest by retrospection necessary modifications, and 6) provide a basis for scrutinizing the material in search of new avenues of investigation.

The material falls into the natural division of the four different examinations carried out to date, each chapter containing data regarding procedures and tests of a particular study. No findings of any of the evaluations are presented; for these the reader is referred to the Thousand Aviator Study Bibliography.

DD FORM 1 JAN 64 1473

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Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Aviation medicine Cardiology Laboratory procedures Pulmonary tests Anthropometry Psychology Vision Neurophysiology Audiometry Test procedures						

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