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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

12 December 1945

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From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Aero, Surface, and Submarine Medicine and Research in the Japanese Navy.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target M-06 and Supplementary Questionaires "A" and "B" of Fascicle M-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Comdr. P.B. Ayres,(MC), USNR, assisted by Lt. (jg) R.M. Hendrickson, USNR, and Lt.(jg) F.J. Gilbert, USNR, and Pfc. W. Costello, USMCR.

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M-06

AERO, SURFACE, AND SUBMARINE MEDICINE AND RESEARCH IN THE JAPANESE NAVY

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE M-1, TARGET M-06,

SUPPLEMENTARY QUESTIONNAIRES "A" AND "B"

DECEMBER 1945

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

MEDICAL TARGETS

AERO, SURFACE, AND SUBMARINE MEDICINE AND RESEARCH
IN THE JAPANESE NAVY

The results of the exploitation of this target have shown that the Japanese Navy Medical Corps made more progress in the field of aviation medicine than in any other. Studies on aviation medicine were undertaken by several civilian universities, and a relatively large volume of reports and reprints of their work has been surveyed and abstracted by other U.S. investigating committees.

Japanese naval aviation medicine was sharply divided into clinical and research activities, with relatively little inter-relation. This was also true of submarine medicine. "Surface" research was not organized as such, and suffered in comparison with the progress made in the other two fields.

This report supplements the investigations carried out by the other U.S. committees in the field of aviation medicine, and should be read with them.

LIST OF ILLUSTRATIONS

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LIST OF ENCLOSURES

REFERENCES

A. Japanese Personnel Who Assisted in Gathering or Locating Equipment and Documents:

1. Comdr. C. YAMAZAKI, (MC) IJN, Director, Research Section, Aero-Medical Division, First Naval Technical Research Institute, Yokosuka Navy Yard, YOKOSUKA, Japan.

2. Lieut. I. ABE, (MC) IJN, Tsuchiura Naval Air Station, Ibaraki Prefecture, Japan.

3. Lieut. Comdr. I. KIMURA, (MC) IJN, Director, Low Pressure Low Temperature Laboratory, Aero-Medical Division, First Naval Technical Research Institute, Yokosuka Navy Yard, YOKOSUKA, Japan.

B. Japanese Personnel Interrogated:

1. Those listed in Reference A, above.

2. Vice Admiral E. MOTOBAYASHI, (MC) IJN, Director, Aero-Medical Division, Yokosuka Navy Yard, YOKOSUKA, Japan.

3. Vice Admiral N. FUKUI, (MC) IJN, District Medical Officer, Second Naval District, Commanding Officer, Beppu Naval Hospital, BEPPU, Kyushu, Japan.

4. Vice Admiral Y. SHIMOBAYASHI, (MC) IJN, Commanding Officer, Kure Naval Hospital, KURE, Japan.

5. Personnel as listed and described in the report.

INTRODUCTION

The struggle between opposing nations to win air supremacy was marked by a succession of new mechanical developments, adaptations and designs and the utilization of new materials to produce planes of increasingly superior performance. This increased performance made new demands on the operating personnel, whose bodies could not be redesigned to meet the newly imposed conditions of high speed, high altitude, increased gravitational effects, and the many other factors involved.

The solution of these problems fell to those working in aviation physiology and aviation medical research, and demanded close cooperation between the researchers, those who flew, those who prepared them for flight, mentally and physically, and those who supplied them. The medical personnel were required to keep pace with the developments which modified or increased the effects that the human body experienced while in the air, and the Japanese Naval Medical Corps was charged with this responsibility, although there did not exist any separate division in the corps known as Flight or Aviation Medicine.

In submarine warfare as well, new and distressing problems arose due to the great distances frequently involved, and the extremes of heat and cold experienced in arctic and tropical zones. Surface ships, although operating in the same waters, did not share quite the difficulties arising in either of the former branches of the service.

Hence it was natural to expect that, in keeping with the expansion and performance of the Japanese Air Corps, their research activities would have outstripped the efforts expended on submarine and surface research.

THE REPORT

PART I - AVIATION MEDICINE AND RESEARCH

A. GENERAL

1. Improvement of Night Vision

a. Army Practice (quoted from General I. MIYAZAKI, (MC) IJA)

There are two methods of improving dark vision:

(1) By taking a preparation named migozai

(2) By training of indirect vision

The chief ingredients of migozai are cod liver oil (each tablet containing 5000 i.u.) and crucuron powder. (This is crude crucumin which promotes the secretion of the bile.) Licithin (a stabilizer of Vitamin "A") and phosphate of lime are added to this and made into sugar-coated tablets.

The action is: Crucuron promotes the secretion of bile and absorbs a large amount of Vitamin "A" necessary for the retina of the eye. This hint was obtained from the fact that most cases of night-blindness have liver trouble and the secretion of bile in not normal.

The effect: A great decrease can be seen in the threshold stimulus of light in about a day after taking migozai. The brightness of a lighted surface that can be barely seen with a 10 degree visual angle is:

The normal person: 1.0 - 10x6 micromilli-lamberts.

The person who has taken migozai: 0.3 - 1.0 micromilli - lamberts.

The vision of dark-adapted eye when taking this preparation improves from 1½ - 2 times. This means, looking at the same object, the eye can see it from twice the distance.

Dose: 3 tablets at one time, 3 times a day, to be taken from the day before night practice.

Indirect vision means that when looking at an object one should not look at it directly, but look at the top or side of the object so that the image of the object falls on the circumference of the retina. This is because the foveal part of the retina of the dark-adapted eye is not very sensitive.

The vision of the dark-adapted eye improves two to three times by this training. The direction of the eye should have a five to 10 degree visual angle with the line connecting the eye and object. The top, bottom, left or right side of the object can be looked at, but it is best to look at the top. One week of training improves the eye a great deal. By this training the eyesight of the regular soldier was improved more than two times.

b. Navy Practice

The Navy apparently placed great faith in its pituitary extract "melanophore hormone", (See NavTechJap Report, "Pharmacology and Malariology in Japan - Civilian and Naval", Index No. M-12). This was administered by hypodermic injection and increased the night vision of flight personnel greatly. (See Reports of the Aero-Medical Section, Air Technical Intelligence Group, ADVON, Far Eastern Air Forces.) 1cc of the extract (posterior lobe) was equivalent to 200 i.u. of pituitary extract. The dose was given about two or three hours before the target area was due to be reached, as the maximum effect was reached in 3½ hours, declining to zero in six to seven hours. The Navy seems to have used vitamin "A" when there was any question of deficiency, but not routinely as was done in the Army.

"Indirect Vision" training, and "dark adaptation" training were given to lookouts, spotters, gun pointers and trainers. Peripheral vision was explained and demonstrated. Silhouettes of United States ships were moved across the end of a dark room, with varying intensities of illumination. Pilots and crews of planes on night flying duty were dark-adapted by wearing red glasses for at least 15 minutes prior to take-off. The red glasses were worn until the crew was in the plane.

2. Test of Personnel for Night Vision

Japanese naval personnel were tested for night vision. Those who had especially good visual acuity were assigned to duty in the fleet or air corps, where their special qualifications would be best utilized. There was no special "ranking" of these personnel as to their degree of night vision.

3. Requirements for Visual Acuity and Color Perception

Aviator's physical examination requirements for visual acuity are shown in Table I.

4. Sunglasses

Japanese troops received no regular issue of sunglasses. They were allowed to buy and wear any commercial variety and shade: green, brown, yellow, grey, or blue. These usually were made of plain glass.

Officers and flight personnel received "issue" goggles. Various types were in use: the earlier sunglasses were made of plain grey tinted glass; later "neophen" glass was produced, a sample having been obtained from Germany and analyzed, so that the glass could be compounded in Japan. (A sample of this glass was forwarded to N.M.R.I., Bethesda, Md.)

5. Psychological Screening for Aviation Personnel

The psychological screening used in the selection of aviators was more psychometric than psychological. No selection tests existed comparable to those in the United States. (See Table I)

A "word-selection" test was in course of selection, construction, and standardization at the Naval Technical Research Station, Psychological Division, in Meguro-Ku, TOKYO. The investigation had no clear idea as to whether this could be used as an index to character or temperament. (See NavTechJap Report, "Organization, Administration, and Facilities of the IJN Medical Corps", Index No. M-AA).

The Suicide pilots were not selected by psychological screening. Men selected were those known to be the best pilots, those whose physical endurance had been demonstrated, those who were skilled in navigation or who were clever in evasive tactics, such as hiding in clouds, etc. The Kamikaze corps had more volunteers than planes; hence the selection of these pilots was made by the superior officers on the above-stated basis.

Benzedrine, administered when there was danger from fatigue and sleepiness, was the only drug given suicide pilots; on occasion caffeine was substituted for benzedrine.

The "training" given the suicide pilot consisted of brief refresher courses in navigation, target recognition, use of cloud cover, and evasive tactics. The necessity or advisability of mental conditioning was denied.

6. Use of Oxygen

The minimum altitude at which oxygen use was required of Japanese naval aviators was given as 3200 to 3500 meters. Lectures in use, need, and techniques of using oxygen equipment were given by the squadron medical officer to the fliers in pre-flight school. The flight instructors in the basic training schools continued practical instruction of cadets. The instructors were all "experienced pilots". They demonstrated the uses of the mask and supervised the cadets on the ground and during flight when oxygen mask training was carried on.

7. Acceleration Effects

The harmful effects of high acceleration in aircraft were countered by the following measures:

a. The aviators were taught to crouch and yell when "pulling out" of a dive.

b. An abdominal belt was supplied for the use of aviators who found them helpful.

c. A "pressure suit" was devised, particularly for use with the new rocket plane SHUSUI.

The suit consisted of a pair of knee-length, inflatable pants, extending to the costal margins. A half-inch rubber tube connected the trousers to an air cushion of 2500cc air capacity, on which the pilot sat. When "pulling out" it was expected that the "g" forces driving the pilot into the seat would cause the air to flow automatically into the pressure pants, thus compensating for the effect. By using this device the pilots were able to endure eight "g" for one-half second, instead of the seven "g" which was the usual maximum.

"Red out" was never a problem, as pilots seldom went into dives from speeds higher than 300 m.p.h.

8. Drugs for Altitude Flight

Oxygen, if used in time, and in adequate amounts, was the only drug required to counteract the effect of high altitude. There were some proposals that desoxycortex hormone be tried, but this was not done.

9. Vibration Effects

The studies of Sueda on the physiological effects of vibration were unknown to the Japanese Naval Air Corps. They had the following problems

on vibration under investigation at the Medical Section of the First Naval Technical Research Institute at YOKOSUKA, Japan.

a. Vibration induced eye fatigue.

b. Vibration induced general fatigue.

In an effort to solve the first problem, vibration effects were studied. It was discovered that on the small vibration testing machine (giving 7mm excursion at 500 RPM, to 0.25mm at 2500 RPM) visual defects began at 0.5 mm, excursion at 1500 to 2000 RPM. These findings were standard while using an anti-vibration cushion. If no cushion was used, the visual acuity decreased 50%. It was planned to construct binoculars or goggles of "pin-hole" type and a contained stroboscope, which would counter the vibration and increase visual acuity by 50%. Such equipment was still in the experimental stage.

10. Low Cockpit Temperatures

The lowest cockpit temperatures commonly encountered in Japanese aircraft were said to have been between minus 30 to 40° C in the HOKKAIDO area, and while flying at 8000 meters altitude.

11. Electrically Heated Flying Suits

Electrically heated flying suits were recently made available. They consisted of undergarments and socks to be worn under the regulation jacket, trousers, and shoes.

12. Survival Equipment

The Naval Air Corps denied that survival equipment was standard equipment on naval planes. A first aid kit of iodine, bandage, scissors, etc., was carried. On long flights bomber crews had emergency rations, sufficient for one or two days, consisting of biscuits, dried fish, chocolate, etc. No water or drinking fluid of any kind was carried. Life jackets usually were of kapok, sometimes of cork.

13. Use of Chemical Oxygen Generation in Airplanes

The use of chemical oxygen generators was confined almost entirely to the Army, which installed them in interceptors, fighters, and planes on distant bases. The chemical generator was designed and produced for the following reasons:

a. There was not sufficient carbon-steel for the manufacture of the required number of compressed oxygen cylinders.

b. Compressed oxygen cylinders were too heavy and weight considerations were of the greatest importance.

c. Such cylinders explode when penetrated by bullets.

d. The chemical generator was light, easy to construct, cheaper, and could be produced abroad, as in NAHA, Okinawa.

14. Rations for Life Rafts

Since the Navy did not equip its planes with rafts, no rations were designed with a view to raft-ration nutrition.

B. AVIATION MEDICINE

1. Personnel Selection Tests

a. General

Aviation Personnel Selection Tests are given below, and on pages 411-413 of NavTechJap Document No. ND10-7501.4, Medical Regulations.

Table I

AVIATION (PILOT) PHYSICAL EXAMINATION

(Minimum Requirements)

	AGE				
	Over 17	17	16	15	14
Height (cm)	154	152	149	145	141
Weight (kg)	46	43	40	37	34
Chest Measure (cm)	76	75	72	69	67
Expansion Chest (cm)	5.5	5.0	5.0	4.5	4.0
Vital Capacity Spirometric Meas.-(cc's)	2,900	2,800	2,600	2,500	2,300
Hand Grip Dynamometer (kg)	24	23	22	20	18
Vision	Each eye 1.0 if one eye is no worse than 1.2 and both eyes give a 1.2 result.				

Table II

DISQUALIFYING CONDITIONS

	AGE				
	Over 17	17	16	15	14
Forced Expiration Test (Sec.)	A column of Hg 20cm to be supported for time given plus any increase of pulse rate over 12 per sec. or irregularity. 35 sec.	35	30	30	25
Blood Pressure*	Any "extremely unusual or abnormal blood pressure." No fixed requirements.				

Heterophoria	(1) Exophoria or esophoria over 4^{o} (2) Hypophoria or hyperphoria over 1^{o}
Auditory Power	Minimum $\frac{150}{200}$ meter - (Watch tick).
Eustachian Tube	Any stricture as revealed by Valsalva's test.
10 Rev. per 20 Sec. Spinning	If the "reaction" continues over 15 sec. or the pilot exhibits signs of over sensitivity such as nausea.
Pulse**	Any extremely unusual characteristic of the rate or rhythm.
Visual Power**	Hypermetropia over two diopters, or any other unusual findings.
Light Perception	Randolt's Test - Under 0.5.
Accommodation**	Visual near point farther than 15cm. or asthenopia.
Visual Field*	Any field defect, scotoma or contraction of the field.
Stereoscopic Vision	The center rod on a sliding mount is to be displaced forward or backward, and then re-aligned with the two fixed rods 10 times. A total of 40mm added error of all trials disqualifies eye four meters from rods.
Tuning Fork Test*	Extremely unusual defect - (a "C" fork is used at 4 meters)
(Blindfolded) Linear Hop Test	Serpentine course, or deviation of 2 meters to one side. (The examinee is blindfolded, after being shown a 2" white line painted along the floor and is stationed at one end. He is required to hop on 1 foot along the line 20 feet.)
Balance	Under 28^{o}, or if extremely unbalanced.
Nystagmus	Cessation of nystagmus under 15 sec. or duration over 45 sec. after being spun in a chair 1 min. at 1 rev. per 2 sec.

* Indicates requirements for pilots only.
** Indicates tests not required during the war.

b. Disqualifying Points in History of Applicants

(1) Neurasthenia, neuralgia, rheumatism , beri-beri, except those who are completely cured.

(2) Mental diseases, psychoses, hysterias, epilepsy, chronic headaches, dizziness and giddiness.

(3) Chest - chronic bronchitis, apecal infection, pleurisy, asthma.

(4) All heart disease (history alone) is disqualifying.

(5) Chronic disease of the digestive organs, and genito-urinary tract.

(6) Abnormal metabolism (as in Basedow's).

(7) Positive Wasserman.

c. Psychological Tests

(1) Mental Test - Mass examination of candidates with five to 12 problems to solve.

(2) Kraepelin's Test - The addition of columns of figures for 15 minutes, a five minute rest period and 10 minutes further addition.

(3) Aptitude Tests

(a) "Motion control tester."

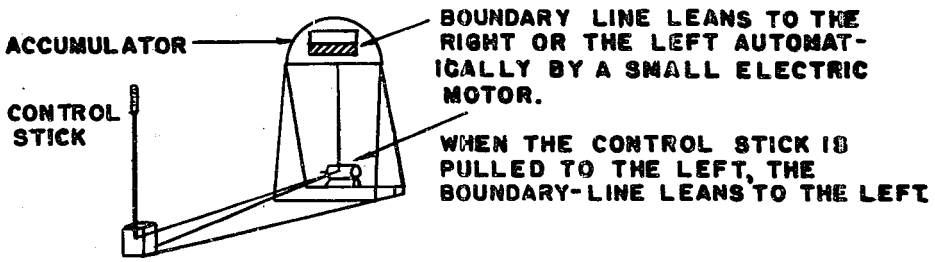


Diagram 1

MOTION CONTROL TESTER

Test: To control the stick in order to hold the boundary line horizontal.

Scoring: Test duration two minutes with 30 minutes rest period and then repeated for two minutes. Attached chronometer records the number of seconds of maintenance of the boundary line in the horizontal position. A cumulative recorder registers the sum of the deviations from the horizontal in degrees for the duration of the test. Scoring was rated as 0, 1, 2, 3, 4.

Conversion Table

Chronometer recordings of:	0 to 19 sec. scored:	0.0
	20 to 23 sec.	1.0
	40 to 59 sec.	2.0
	60 to 79 sec.	3.0
	80 to 120 sec.	4.0

Cumulative error recorder scores of:

360°	and above	equal	0.0
270°	and above	equal	1.0
180°	and above	equal	2.0
90°	and above	equal	3.0
0°	and above	equal	4.0

The raw score was the sum of the results scored for both types of error converted as above. This converted sum was further converted by the following table to a final score as follows:

Sum		Total
0 to 1	equal	0
2 to 3	equal	1
4 to 5	equal	2
6 to 7	equal	3
8	equal	4

A score of 2 on the horizontal recorder and a score of 3 on the deviation recorder equals 2 plus 3 equals 5 for the test. Converted on the final table 5 gives 2 as a final score for the test.

The first conversion table was altered from time to time as the result proved the standard too high or too low. This test was discontinued in 1944 as being relatively useless.

d. Coordination Test

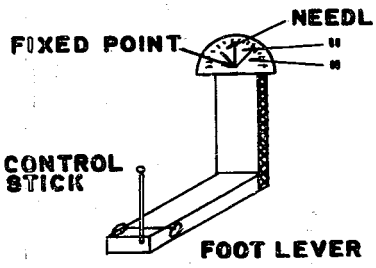


Diagram 2
COORDINATION TESTER

Test: To control so as to make the three needles coincide.

The time taken to line them up is recorded by electric chronometer.

Scoring: Test duration two minutes with 30 minutes rest period and then repeated for two minutes. A chronometer recorded the time taken by the applicant to achieve coincidence of the needles.

Time required to achieve coincidence and resultant score:

Time	Score
1 to 19 sec.	4.0
20 to 39 sec.	3.0
40 to 59 sec.	2.0
60 to 79 sec.	1.0
80 to 100 sec.	0.0

e. Judgment Coordination Test

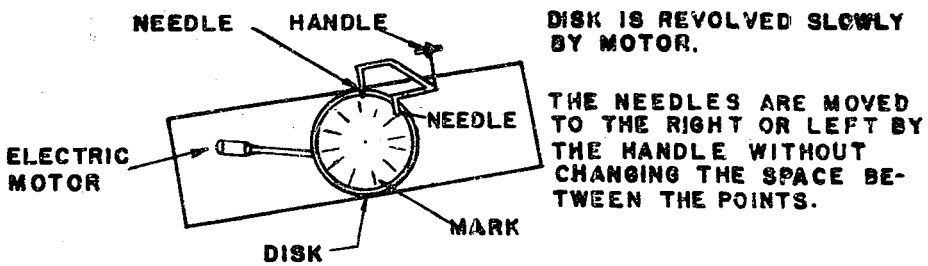


Diagram 3

JUDGMENT COORDINATION TESTER

Test: To control the handle so that the needles always go to the definite side (behind the arrows) of the mark and not touch the border of the disk. The errors are counted on an electric counter.

Scoring: One minute practice and instruction run was given, followed by a three minute test run.

Errors	Score
50 to 60	0.0
35 to 50	1.0
20 to 35	2.0
10 to 20	3.0
0 to 10	4.0

f. Selecting Reaction Test

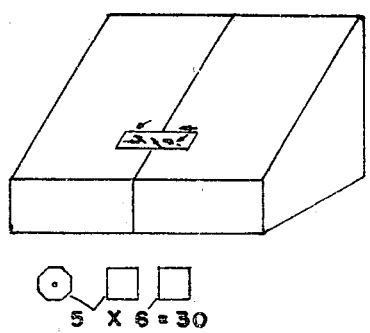


Diagram 4

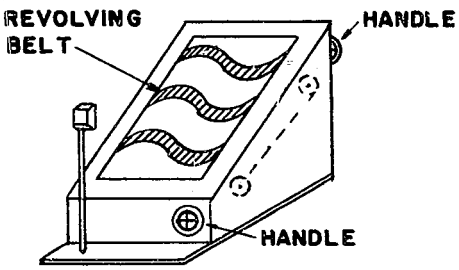
SELECTING REACTION TESTER

Test: From the window, six marks appear and change their directions once a second. When two of these six marks show the definite direction such as is marked above the window, push the key. The mistakes are counted by an electric counter. When one arrow in each half of the window points in the same direction as the guide arrow above, push the key. The guide arrows also change direction once a second.

Scoring: Test run equals three minutes, as a rule, although various air stations had their own conceptions of the ideal time for a test-run. During a three minute run a perfect score was 60, the arrows pointing in the correct direction 60 times. The total of correct reactions indicated by the electric counter was subtracted from 60, giving the error. This was converted into a final score for the test as follows:

Errors	Score
55 to 60	0.0
41 to 54	1.0
27 to 40	2.0
13 to 26	3.0
0 to 12	4.0

g. Speed Memory Correction Test



Revolving belt is driven by an electric Motor. Its speed is variable and is controlled by the handle at the back or front side of the box.

Diagram 5

SPEED MEMORY CORRECTION TESTER

Test: Before starting the test the applicant is to memorize the definite speed (the landing speed for instance), then the speed is changed, and must be adjusted by the applicant until it coincides with the original speed. Errors are measured by gradations. The belt is run to simulate the speed at which ground objects would appear to pass a plane at 25 meters altitude, coming in for a landing (usually at 50 m.p.h.).

Scoring: The test was repeated eight times. The speeds reproduced by the applicant in his attempts to equal the speed of the test run were recorded. Speeds below 50 m.p.h. (the test run) were recorded as minus errors, and speeds over the test run speed as plus errors. The plus and minus errors were totalled for the 8 trial runs. The total error was scored as follows:

Total Error	Score
50 to 80 m.p.h.	0.0
40 to 50 m.p.h.	1.0
25 to 40 m.p.h.	2.0
10 to 25 m.p.h.	3.0
0 to 10 m.p.h.	4.0

h. Figure Regenerating Test

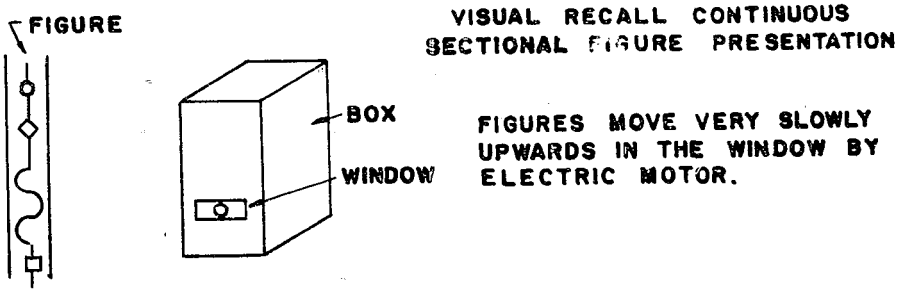


Diagram 6

FIGURE REGENERATING TESTER

Test: There were 10 groups of figures on the rolls. One of three to four figures was run through while the applicant concentrated on memorizing them. Afterward the applicant was required to sketch accurately from memory what he saw. The difficulty of the test run was increased by showing progressively more complicated figures, and also by increasing the rate of speed.

Scoring:

No. of Correct Reproductions	Score
1	0.0
2 to 3	1.0
4 to 5	2.0
6 to 7	3.0
8, 9, or 10	4.0

Total Score

The final scores of each of the above six tests were summated, and divided by six for an average score, giving 0.0 to 4.0. The only completely disqualifying score was 0.0. The qualifying requirements were determined by testing 100 "normals", drawing norm curves, and determining the median. Total scores were scaled up or down from time to time as demands for personnel increased or decreased. At the beginning of the war a total score of 2.0 or higher was required for acceptance. Toward the end of the war any score higher than 0.0 was accepted.

1. Motion Control Test

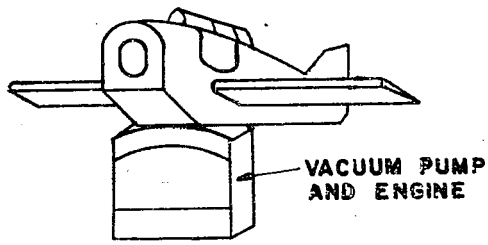


Diagram 7
MOTION CONTROL TESTER

The examinee is shut in the mock-up model with a stick and rudder bar. The model is tilted forward, backward, and sideways by the motor. Correct control and correction by rudder and stick control are judged.

Figure 1
MOTION CONTROL TESTER

Figure 2
MOTION CONTROL TESTER
Top folded down

2. Oxygen Equipment and Masks

Oxygen sources were (1) the standard compressed oxygen cylinder (150 kg. pressure per sq. cm), (2) the chemical oxygen generator, packed with $KCLO_3$, and heated electrically. In order to drive off the early CO that was formed, the flow was not to be used by the aviator for the first few minutes.

The standard equipment to which all masks were attached was a belt-shaped O_2 bag having a 2 to 3 liter capacity, strapped on the chest, to which O_2 was passed from the reducing valve on the O_2 tank at a rate of 20 liters per minute. No oxygen demand-flow breathing valves were used by the Naval Air Corps. The O_2 tank was mounted in the cockpit. A gauge on the dash or instrument panel indicated the pounds of pressure available in the tank.

The pressurized helmet was made of rubber 1mm thick, opening up the back, secured by straps, and self-sealing around the chin and neck with gas (O_2) inflated rubber pad insets. An earphone (left side) was incorporated, as was an exhaust valve above the ear, regulated to maintain 20 to 40mm pressure. The facepiece was of plexiglass, reinforced with nichrome wires, electrically heated to prevent fogging. This mask had been chamber tested for 16,000 meters altitude for 30 minutes, and at 14,000 meters for two hours. Separate temperature tests had been made for one to two hours at a 40° C. The standard masks were designated Mark I, II, III, IV, and Modification 1 of Mark IV. Marks I and III were open-breathing masks, mouth and nose covered, a microphone or open voice tube optional. Mark II had a hard rubber mouth piece with a metal tube lead-in for O_2 delivery. Mark IV was an open-breathing type mask with a valved voice tube. The nose piece connected to the chest reservoir giving a constant rate of flow delivery, and was so designed that the mask and exhaust tube held 200 c.c. of O_2. It had a maximum useful ceiling of 11,000 meters.

The modification of the Mark IV was produced for use by the Shusui pilot. It had a one-way automatic exhaust valve, a hand-controlled intake valve for mixing air with O_2 for use below 4000 meters. Above this altitude the air was shut off. The pilots were to be trained to tolerate a change from sea level to an altitude of 12,000 meters in 1½ minutes. Gas distension, and Caisson's disease were reported, but the problem was solved by requiring the pilot to start breathing O_2 and air from the minute he entered the cockpit to gain equilibrium.

3. Diet and Rations

Air corps flight personnel were fed on starches and fiberless foods, with an increased ration of fat and protein. Diet is shown in Table III.

4. Pilot Fatigue

The air corps had a policy (which was never followed) that a pilot flying on two successive days should be off duty the third day, and that six month's continuous flight duty called for one month leave in Japan. This was found unnecessary during the days of the China war as flight duty was no strain and fatigue did not develop. In the latter part of the war, pilots and crews were in such demand that they had to fly. No one ever revolted or refused to fly, no matter how tired. Less than 2% suffered fatigue symptoms. When fatigue was noticed by the pilot he was to report to the medical officer. No routine checks were made to detect fatigue, nor were any diagnostic tests or standard examinations of any kind in use for the detection of fatigue. Fatigue was usually evidenced by sleeplessness, loss of appetite, headache, and restlessness. These were corrected by "promoting sleep", feeding extra gratifying rations, encouraging recreation (athletics, movies, etc.) and using male sex hormone injections daily, which the pilots felt "did a lot of good". Rest camps at hot springs were organized for Japanese pilots on the mainland, and three day leaves granted.

During the latter years of the war pilots and crews did not live long enough to develop fatigue and no special measures were required to combat this problem.

Table III

TABLE OF ADDITIONAL RATIONS FOR AIRPLANE CREWS

	Regulation Item	Daily Amount	Amount per Meal	Substitute Items	Amount	Remarks
Ordinary Additional Ration	Eggs	180 gm		Fresh Milk	0.54 lit.	
				Powdered Milk	36 gm	
				Canned Milk	180 gm	
				Powdered Eggs	60 gm	
	Combined Vitamin Foods	6		Vitamin A for mixing with liquid	1	
				Vitamin B for mixing with liquid	0.1	
				Vitamin C for mixing with liquid	0.2	
	Special Flight Beverage	0.03 lit.		Lemon	50	
				Orange	50	
Additional Ration During Flight	Flight Endurance Food		30 gm			Main Ingredient is Chocolate
	Black Tea		5	Coffee, Cocoa	5	
				Sugar	20	
	Sugar		20	Black Tea Coffee Cocoa Milk	0.18	For a flight of over 2 hours
				Black Tea Coffee Syrup	0.06	For a flight above 3000 meters
	Fresh Fruit		300	Canned Fruit	225	
				Dried Fruit	75	
	Special Nourishing Food		50			Supplies heat energy
	Special Cold-Endurance Food		50			
	Sleep-Preventive Food		30			
	Strengthening Vitamin Food		12			For flight above 5000 meters or more than 5 hrs.
	Fruit Juice		0.14	Grape juice containing carbonic acid	0.14	
				Brandy	0.036	
Additional Ration After Landing	Special beverage for recuperation from fatigue		0.06			
	Essence of hot syrup (Ame and hot water)		40 gm	Starch	15	
				Sugar	20	
				Syrup	75	
				Canned sweet liquor	75	
Flight Emergency Ration	Emergency ration while on board	Contains main and secondary rations, brandy, and energy-producing food to extent of 1300 calories				
	Forced Landing Rations	Same as above				16 meals for large-type planes
						6 meals for small-type planes

C. AVIATION MEDICAL RESEARCH FACILITIES

1. Naval Aero-Medical Research Division of the First Naval Technical Research Institute

The Japanese Naval Medical Corps had no connection with air-borne acoustic or earth wave research. Research projects in this field were underway at the Naval Technical Research Station, Psychological Dept., Meguro-Ku, TOKYO, where various projects were in progress for the formulation of selection and aptitude tests for radio operators, hydrophone operators, etc. There also was an attempt to produce training aids and recommend training programs for "listeners". The problem, the research, and the solution or recommendation made for the various problems are reported in the section on "Training", NavTechJap Report, "Organization, Administration, and Facilities of the IJN Medical Corps.", Index No. M-AA.

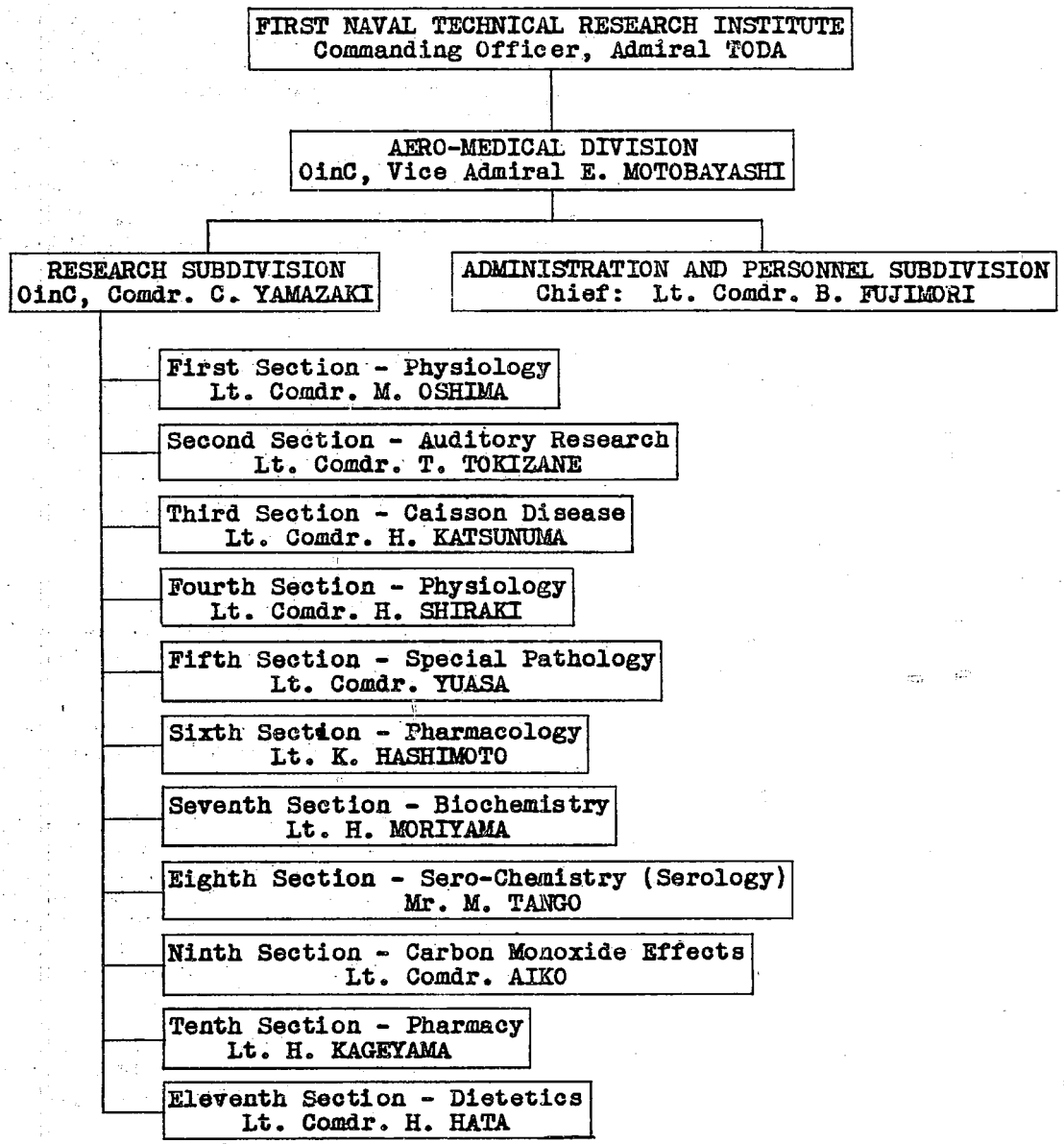
The Naval Aero-Medical Research Division of the First Naval Technical Research Institute at YOKOSUKA carried on all research activity for the Naval Air Corps. Aero-Medical problems were submitted for solution as they arose both by Naval Air Corps Headquarters (Koku Hombu), and by the commanding officers of various naval air units afloat and ashore. The Division, under the command of Vice Admiral E. MOTOBAYASHI, was divided into an Administration and Personnel Subdivision and a Research Subdivision, which in turn was organized into various sections. The organizational chart was as shown of the opposite page.

The installations comprised three completed buildings, two of three stories and one of two stories, all of concrete (wire lath reinforcement, with stone composition or cement floors, and some wood overlay in certain rooms). A large wooden tin-roofed gable shed between two incompleted buildings had been partially stripped for firewood. Some of the rooms in all buildings were in use by U.S. forces. The removal of equipment, cleaning, remodeling, and use of the other rooms for food storage made a detailed layout description impossible.

After the surrender, on orders from Naval Air Headquarters, all research documents, results, records, etc., were burned and much of the equipment was destroyed. The accompanying photographs illustrate the remaining equipment.

The animal centrifuge had been in use for about four years. This was a five-meter centrifuge, electrically operated, counterweighted at one end, with a shielded animal cage clamped to the other end. Animals used were marmots and rabbits. An overhead platform with a reflecting prismatic sight enabled the experimenter to see the animal clearly at all times. A moving picture camera mounted two feet from the cage recorded the behavior and appearance of the test animal. Wiring and tubing were arranged to permit the operator to obtain electro-cardiographic tracings at any time, as well as to record blood pressures.

A human centrifuge was in process of construction when the surrender occurred. A 21-meter diameter machine had been designed to be started by compressed air and attain maximum velocity in 10 to 30 seconds. An electric motor cut-in would maintain its rotation. Both centrifuges were designed to achieve a 20g's maximum. Due to shortages of material and the urgent necessity for repairing combat ships, the catapult production shop could not supply the equipment to be used in the starting mechanism. The motor and control board had been delivered, and the building erected.



A large "Encephalography" room 12x15 feet, metal shielded, was in operation. The "Vibration" room was equipped with three vibrators:

a. A small electric drum-seat of the "Fine Curve" type (Japanese description) achieving 60,000 RPM.

b. A seat mounted on a shaft with an eccentric on the power shaft below, from 500 to 2500 vibrations per minute and a suspension vibration.

c. Machine with dark cloth enclosed cage for 2 to 4 men and a counter-weighting platform opposite.

A padded, sound-proof dark chamber 12x10 was used for directional sound locating experiments. Also used was a large (diameter, 3/m x 15/m) low temperature (-56° C.) chamber; a small low pressure chamber 3 in. x 2 in.; a small low pressure and low temperature chamber; and a new humidity and wind chamber (not yet completed).

Temperature control was from 60° C. maximum to 5° C. minimum. Wind velocity was 10m per second maximum with a delivery aperature 70cm wide and 1.70m high. In the roof, anterior half, were ultra-violet lamp installations, and in the posterior half, infra-red lamps for simulating high altitude flight and recording ray effects on fliers' skin and eyes, etc. A shower pipe was built in to give rain, rain and wind, etc. effects. The chamber was 4.5m x 6m x 5m

From appearances and interrogations it seemed that considerable research was proposed and the equipment being set up in view of the expected production of the Shusui - Japan's new rocket plane, having a flying time of 5 to 8 minutes but being able to climb to 12,000 meters in 1 to 1½ minutes, and designed to travel 600 m.p.h. Several of these planes had been flown experimentally. The various sections in the Aero-Medical Research Division were organized to meet this problem. Their functions and achievements are listed below as given by OinC, Comdr. YAMAZAKI.

a. First Section - Physiology. Dr. OSHIMA was working on oxygen mask improvement, and had modified the Mk 4 Model and improved it. He also had designed and produced an experimental pressurized mask. This was not yet in production but had been tested and perfected. It was destroyed along with his research data.

b. Second Section - Auditory Research. Dr. TOKIZANE had not started experiments. He was to attempt to improve fliers' hearing devices, earphones, lines, circuits, etc.

c. Third Section - Caisson Disease. Dr. KATSUNUMA had been recapitulating the work of Armstrong in his "Principle and Practice of Aviation Medicine". He had determined that the Shusui pilot must start breathing O_2 plus air immediately on entering his plane on the ground, to achieve sufficient O_2 saturation by the time he reached dangerous altitudes to prevent the "bends". The Mk 4 (improved) mask, a sample of which has been forwarded to NMRI, was to be employed. The pilot was to go on full O_2 when he reached 4000 meters.

d. Fourth Section - Physiology. H. SHIRAKI had been studying animal physiology in connection with animal centrifuge experiments but had reached no helpful conclusions, except in the development of the "pressure suit" to offset "blackout".

e. Fifth Section - Special Pathology. Dr. YUASA was studying autopsy slides of animals used in the simulated "high altitude" flight experiments, and those that died on the centrifuge from "g" effect. The physiology of altitude was his problem and since the Navy had encountered very little difficulty due to altitude his work was to be important in respect to the Shusui. He achieved no results save observations on the tissue changes of animals.

f. Sixth Section - Pharmacology. Dr. HASHIMOTO is reported to have made no contributions.

g. Seventh Section - Biochemistry. Dr. MORIYAMA was making blood and urine analyses on animals used in the various low pressure or high altitude experiments, (as a contribution to the fourth Section), and observing the variations therein. Although he had many records, nothing of any value to pilots of the "high altitude" planes had been deduced.

h. Eighth Section - Sero-Chemistry. Dr. TANGO was in reality an assistant to the fourth and fifth Sections, studying serology and blood. No helpful contributions had been made by him.

i. Ninth Section - Carbon Monoxide Effect. Dr. AIKO was apparently studying the effects of CO of varying concentrations on animals and human beings. Although the Navy was not using the chemical O_2 generator to any extent, Dr. AIKO was attempting to develop a method of reducing the CO percentage by using "Hopcalite" ($CuO.\ MnO_2$) which he reported could be so arranged in the chemical O_2 generator as to reduce the CO content of the involved gas from 0.15 to 0.01. This method of purification was still in the experimental stage. Apart from this practical attempt at solving the problem Dr. AIKO was concerned chiefly with CO physical and biological determinations and observations. The physiological tolerance limits for CO for aircraft personnel were variously fixed from 0.3% to 0.15%. That it was not satisfactory is inferred from the experiments.

j. Tenth Section - Pharmacy. Dr. KAGEYAMA made no therapeutic contribution. However, certain drugs, caffeine, benzedrine, desoxycarte, hormone, meranophormone (Ant Pit) etc., as well as mixtures such as spiritus frumenti, vitamin B_1 and glucose, were employed in the prevention of fatigue, drowsiness, etc., and may have been investigated in this section. Apparently no new significant contributions had been made by this section to the problem engaging the attention of all sections, namely high-altitude flight, a subject that was evidently given top priority, in view of the approaching production of the rocket plane.

k. Eleventh Section - Dietetics. Dr. HATA was carrying out experiments in feeding animals various diets, and correlating their dietary content with high-altitude flight conditions.

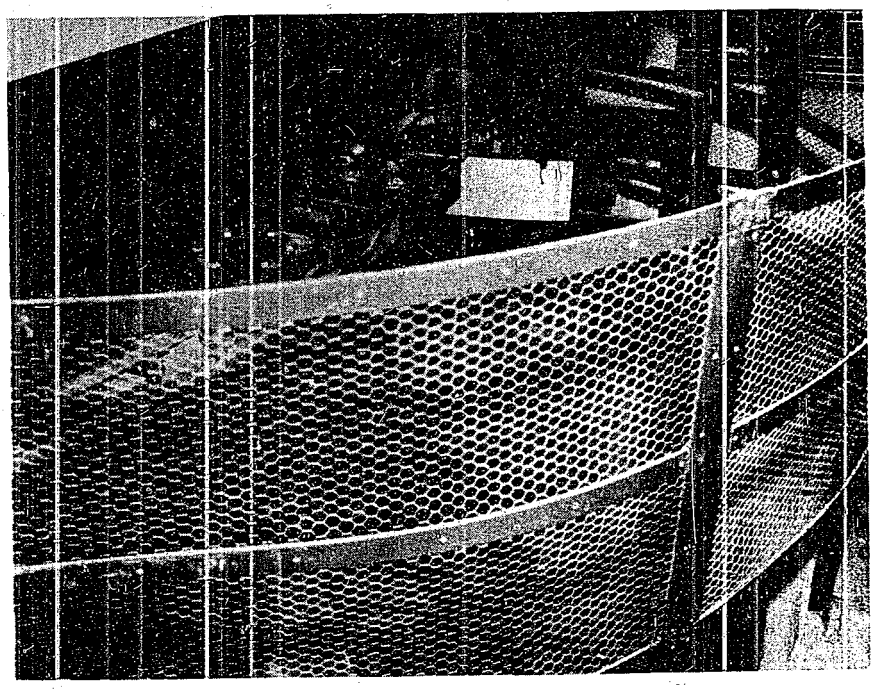


Figure 3
ANIMAL CENTRIFUGE

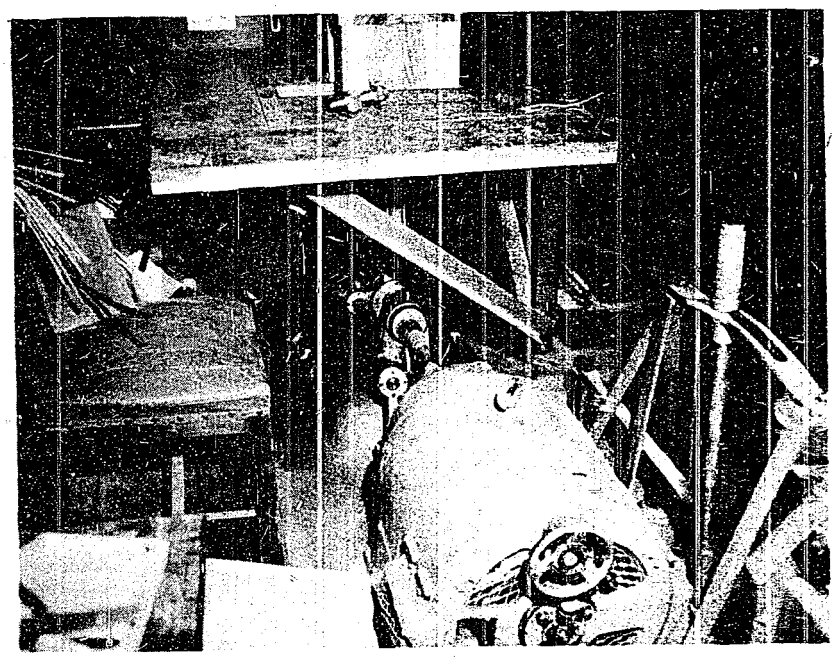


Figure 4
SEAT VIBRATION TESTER

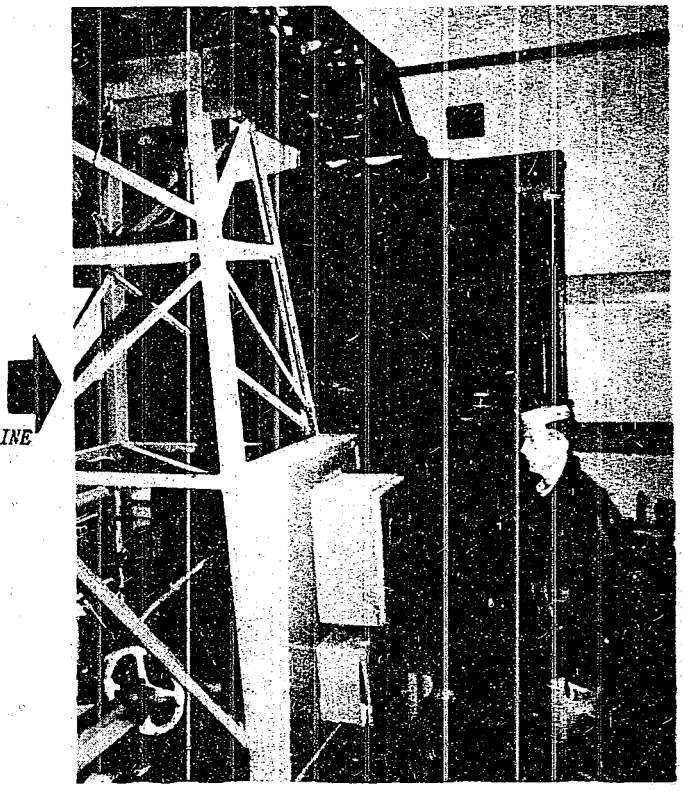


Figure 5
LARGE PERSONNEL VIBRATION TEST CHAMBER AND MACHINE

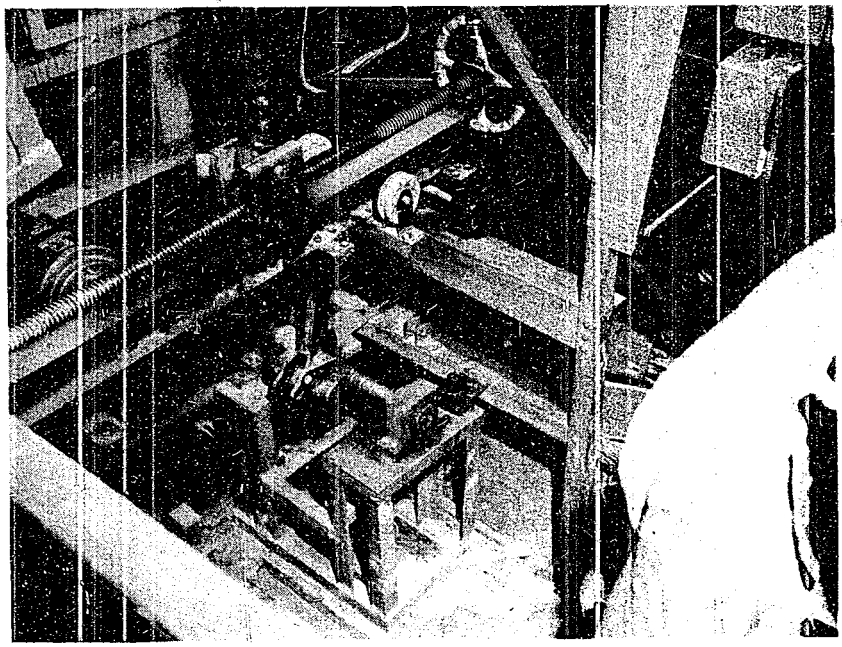


Figure 6
ECCENTRIC, MOTOR, AND CAM OF VIBRATION TEST MACHINE SHOWN IN FIGURE 5

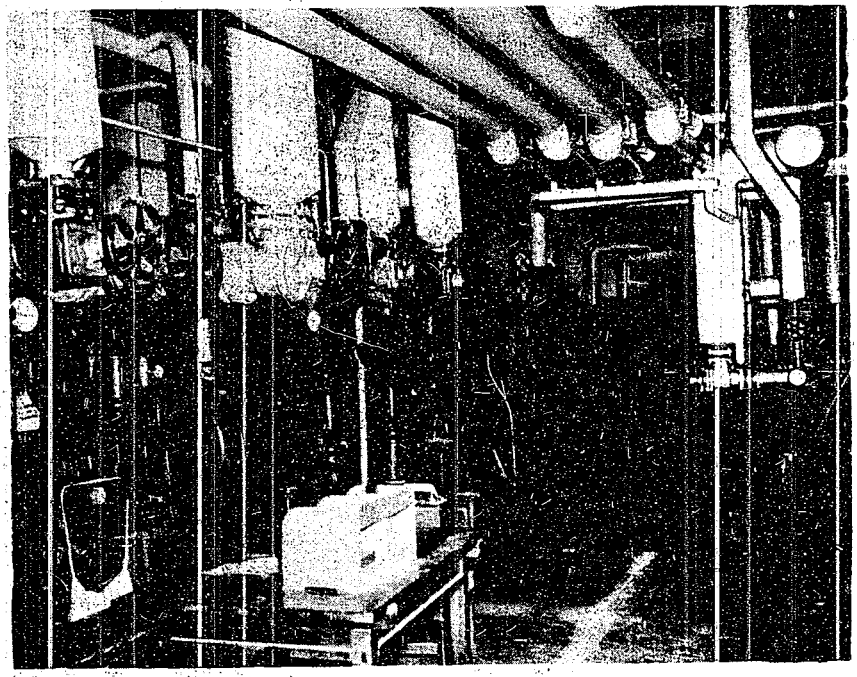


Figure 7

LOW TEMPERATURE REFRIGERATION PUMPS AND MACHINERY

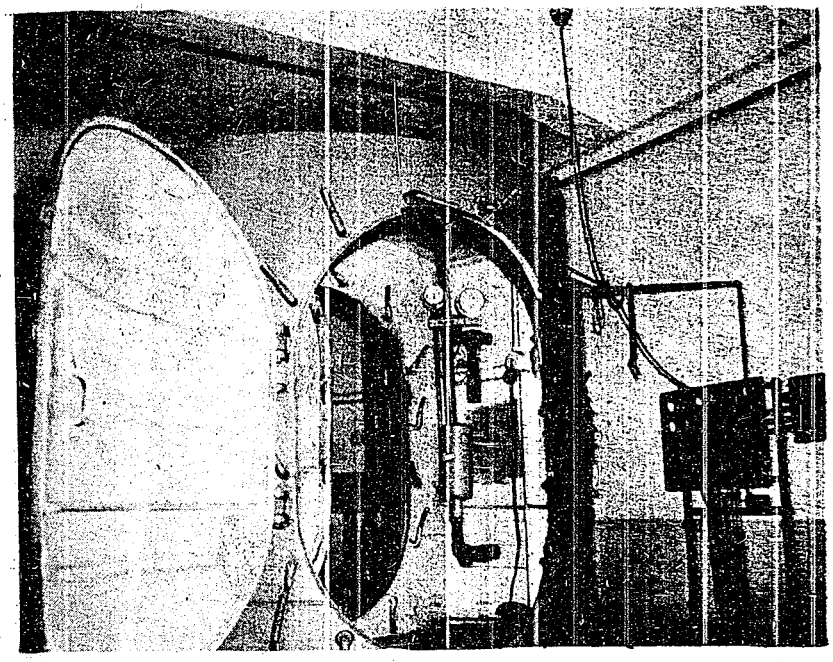


Figure 8

LOW PRESSURE (ALTITUDE) TEST CHAMBER
Five persons capacity

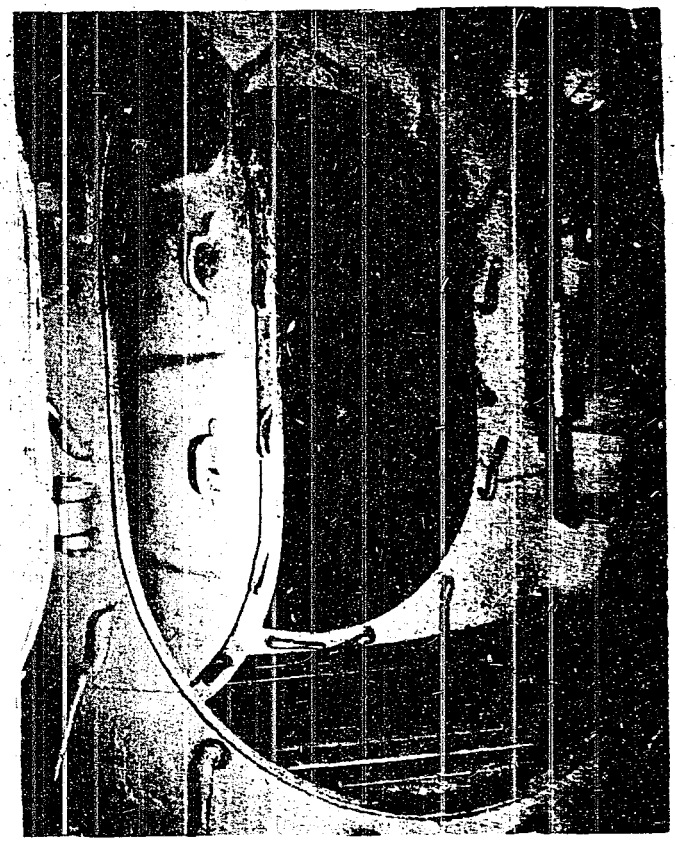


Figure 9
CLOSE-UP OF CHAMBER SHOWN IN FIGURE 8

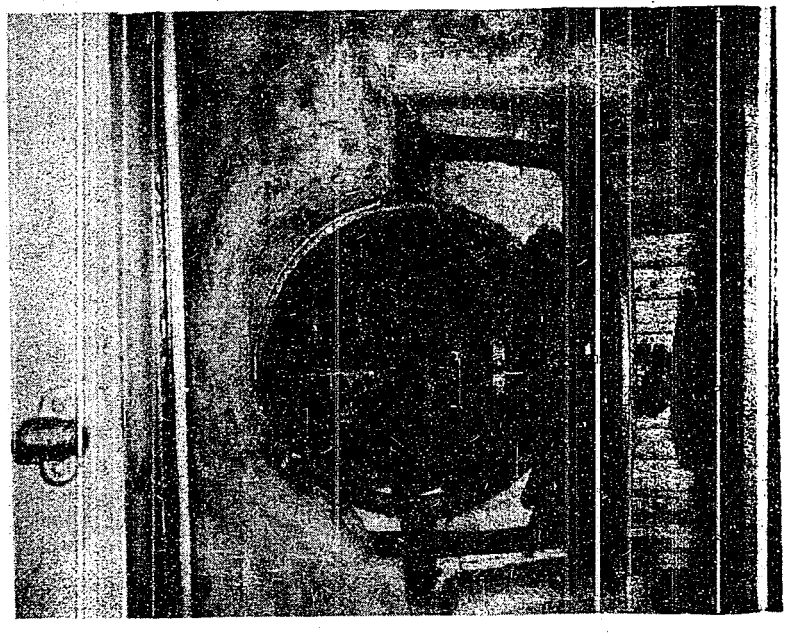


Figure 10
LOW PRESSURE (ALTITUDE) AND LOW TEMPERATURE TEST CHAMBER
Two persons capacity

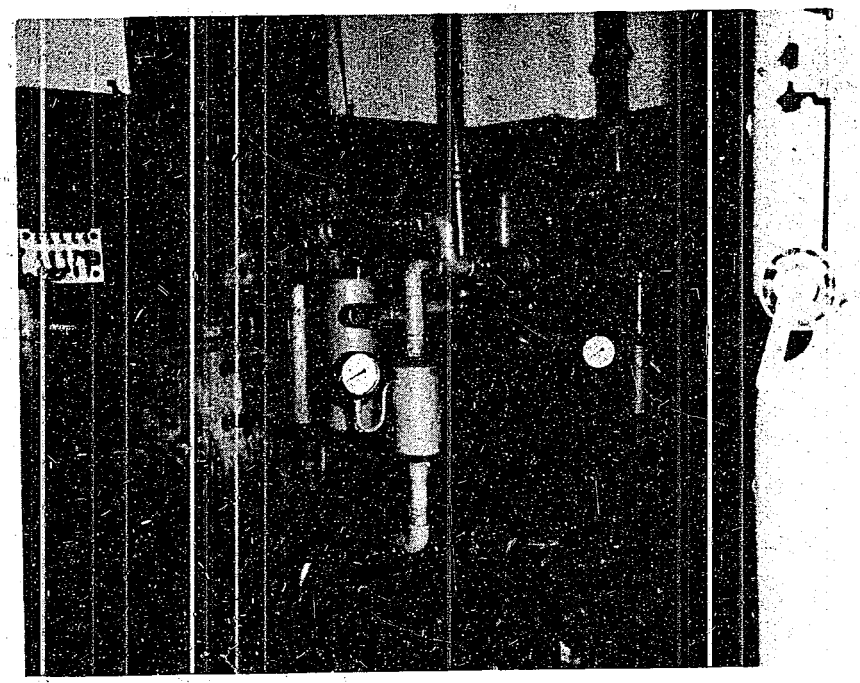


Figure 11

AIR COMPRESSORS FOR LOW PRESSURE CHAMBER

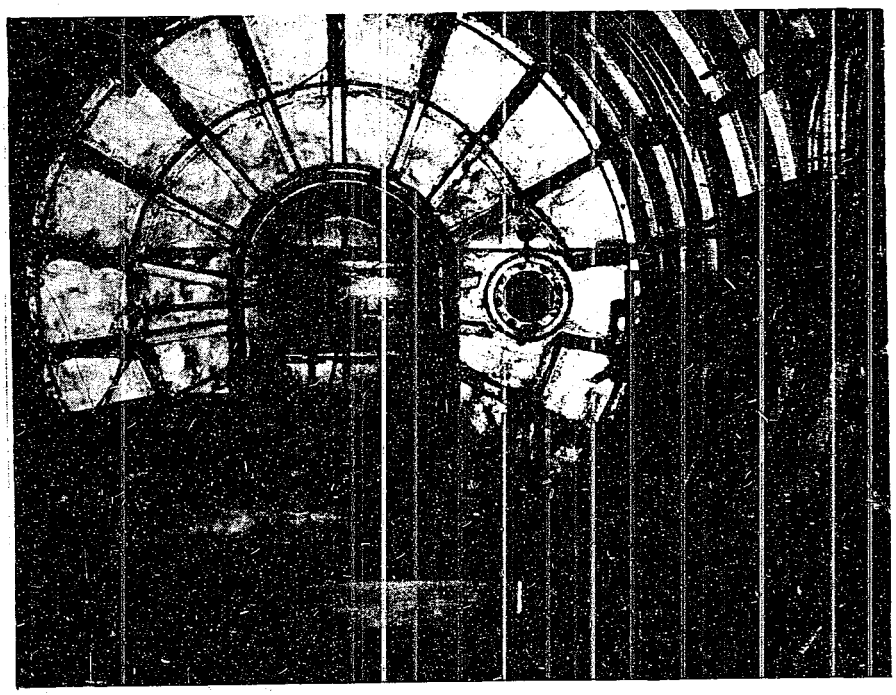


Figure 12

WIND TUNNEL INTERIOR

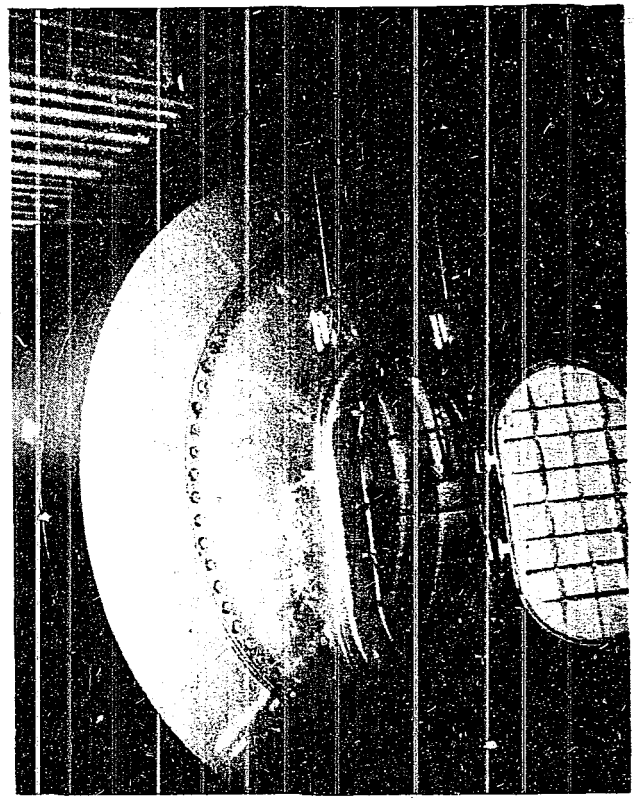


Figure 13
ENTRANCE TO WIND TUNNEL
Refrigerated

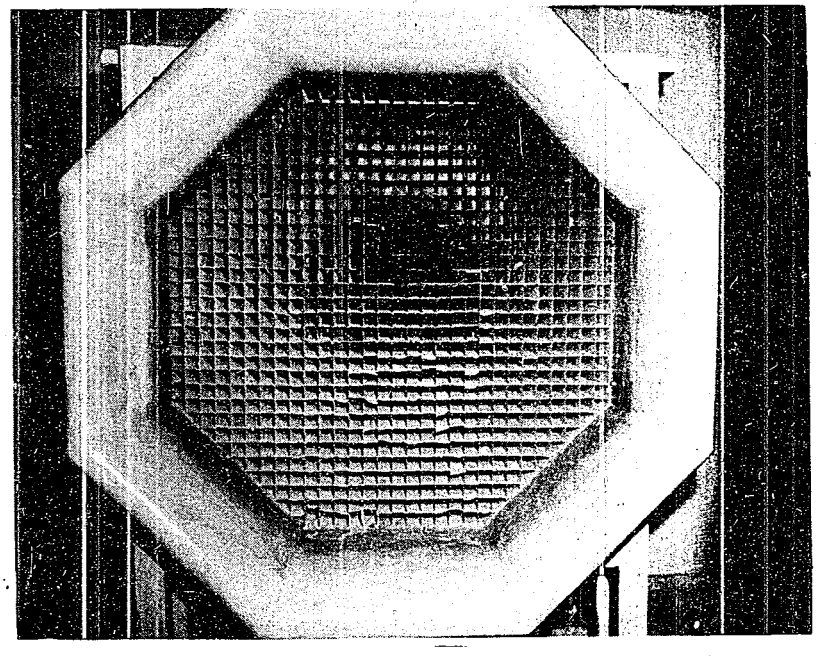


Figure 14
SMALL WIND CHAMBER
View from intake

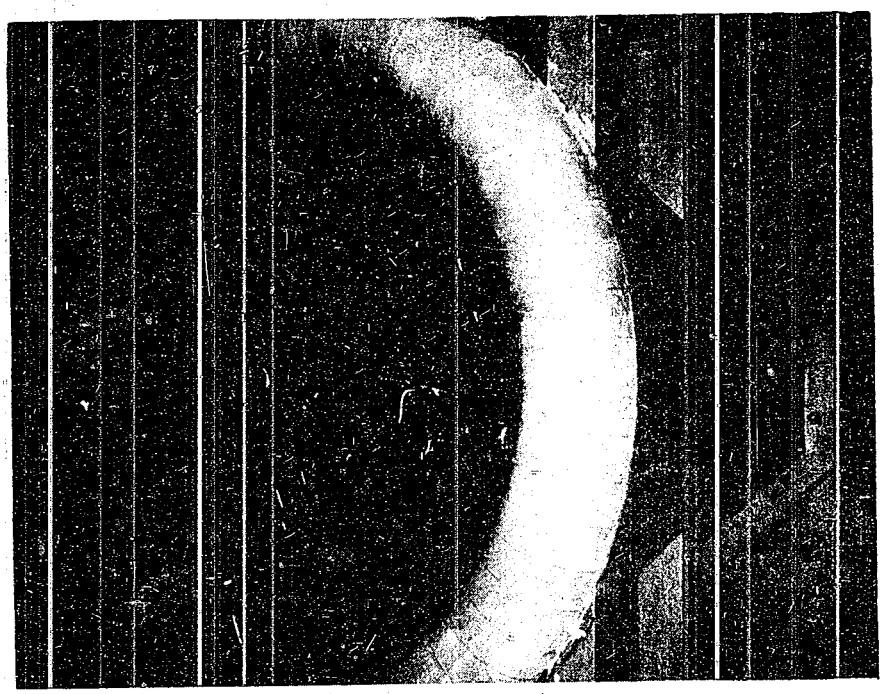


Figure 15
BLOWER – LARGE WIND TUNNEL

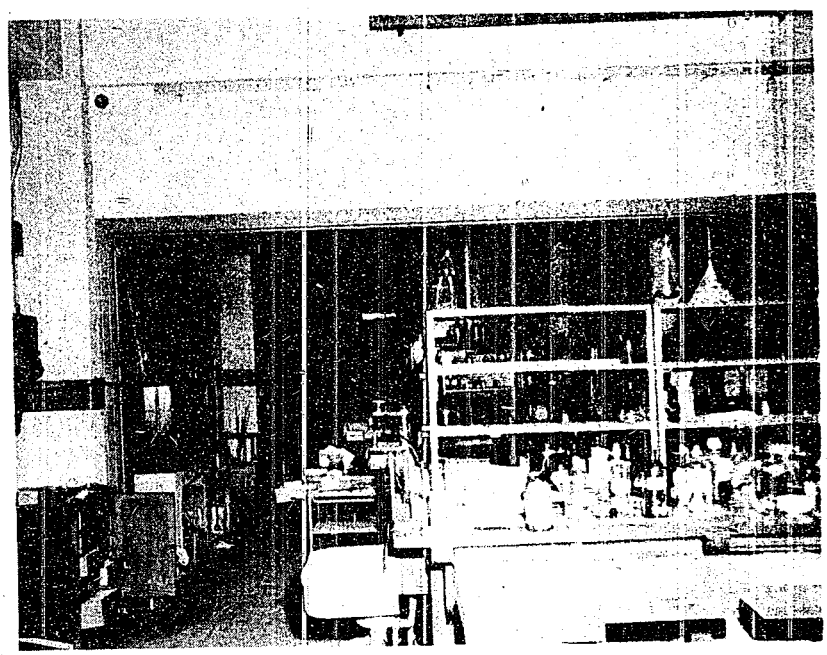


Figure 16
CHEMICAL LABORATORY

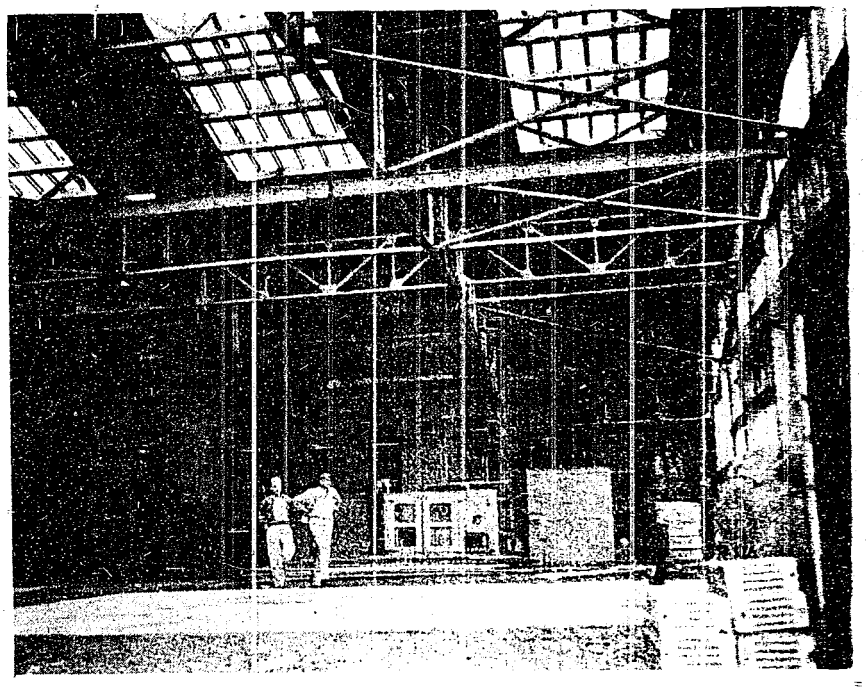


Figure 17

BUILDING TO HOUSE PROPOSED HUMAN CENTRIFUGE

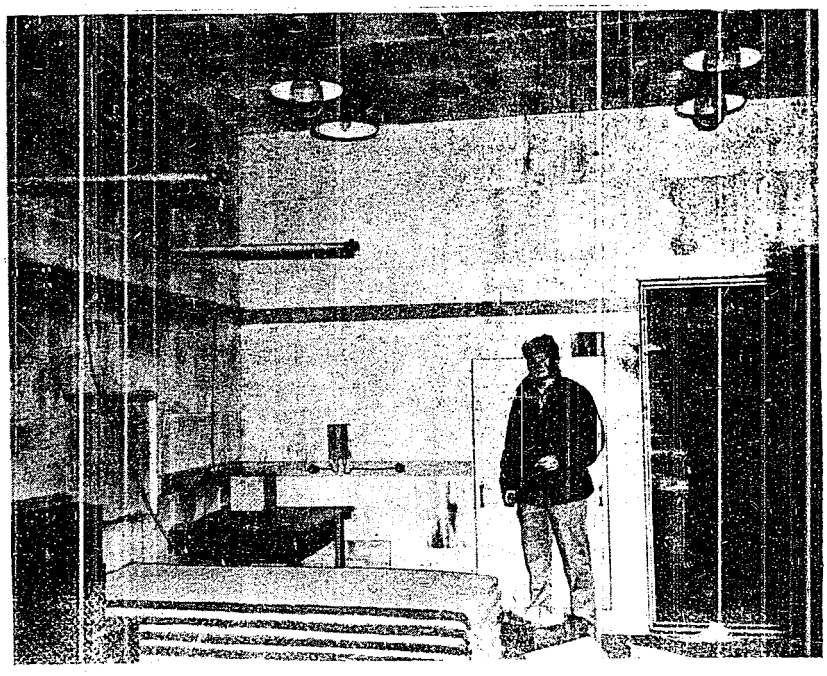


Figure 18

WEATHER CONDITION SIMULATING CHAMBER
Note pipes for showers or rain, infra-red lamps, entrance of wind tunnel (door behind figure)

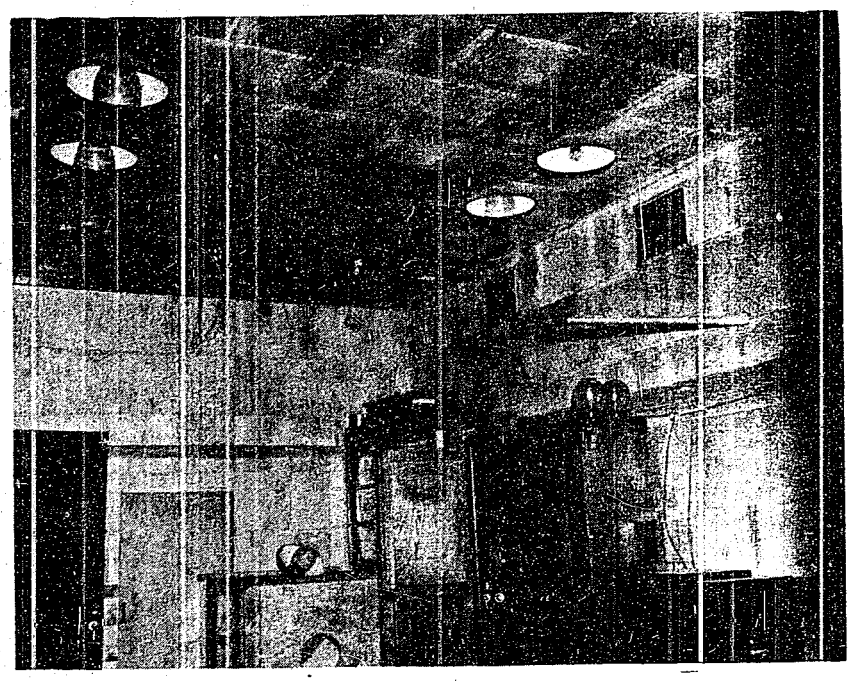


Figure 19

WEATHER CONDITION SIMULATING CHAMBER - FAR END
Note ultra-violet lamps

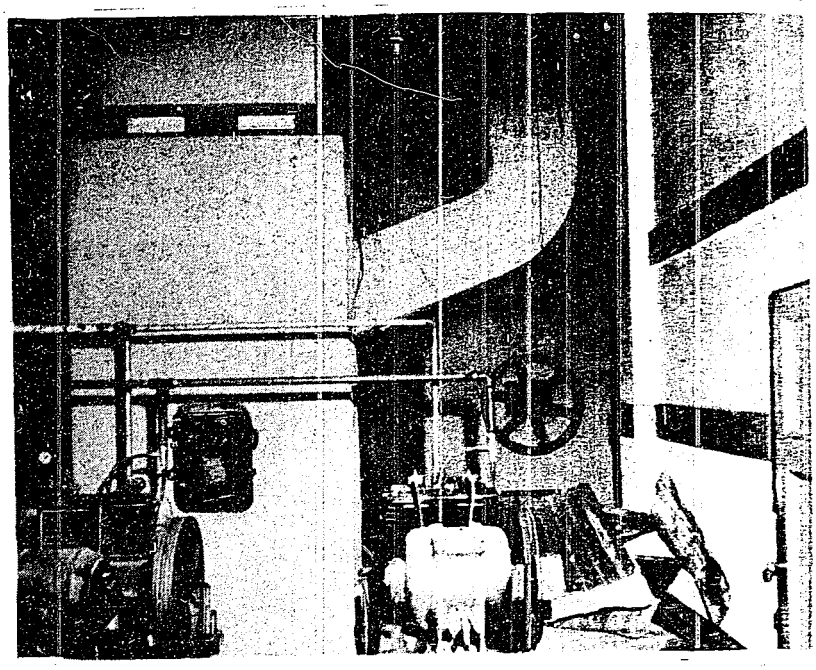


Figure 20

MOTOR AND BLOWER FOR WEATHER CONDITION SIMULATING CHAMBER
Compressors in foreground

Figure 21
COORDINATION TESTER

Figure 22
JUDGMENT COORDINATION TESTER

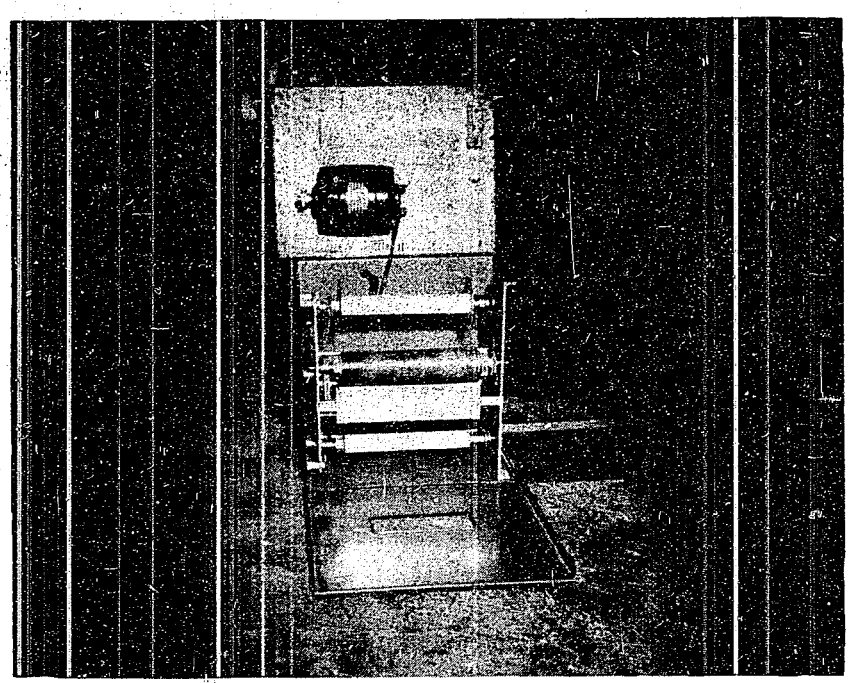


Figure 23

SELECTING REACTION TESTER
Box opened to show rollers

Figure 24

SPEED MEMORY TESTER

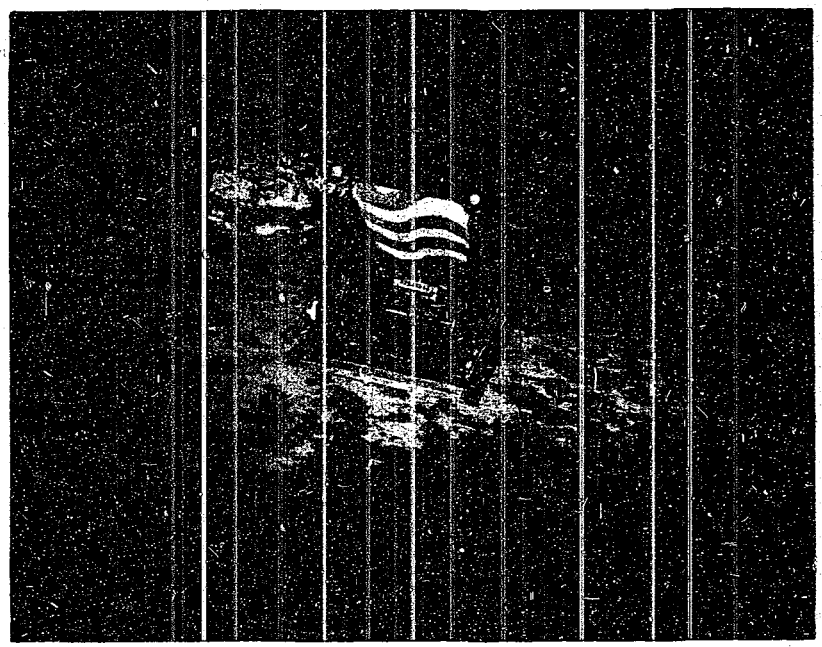


Figure 25
SPEED MEMORY TESTER - REAR VIEW
Cover removed

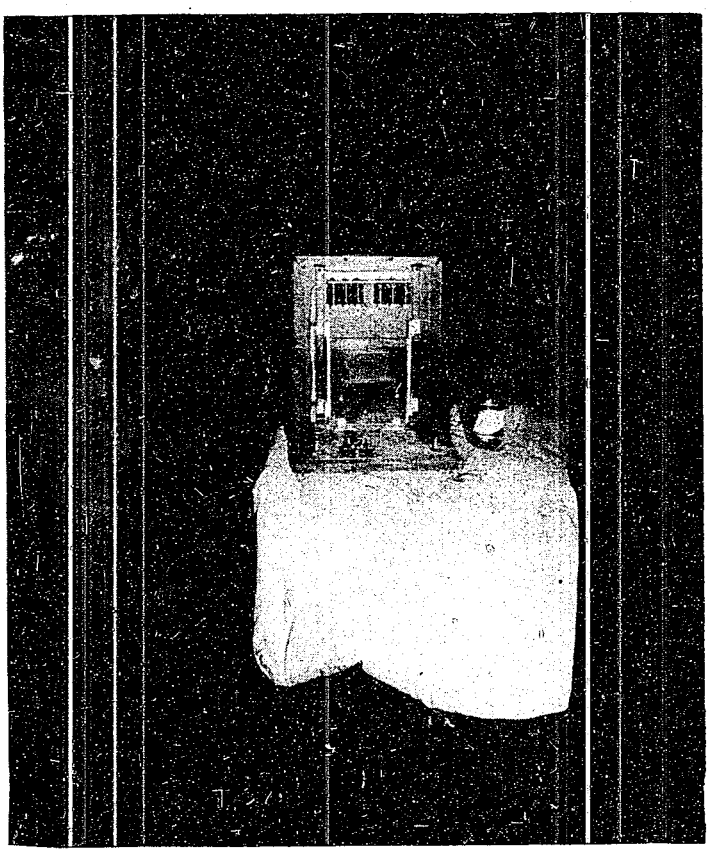


Figure 26
CARD SORTING TESTER

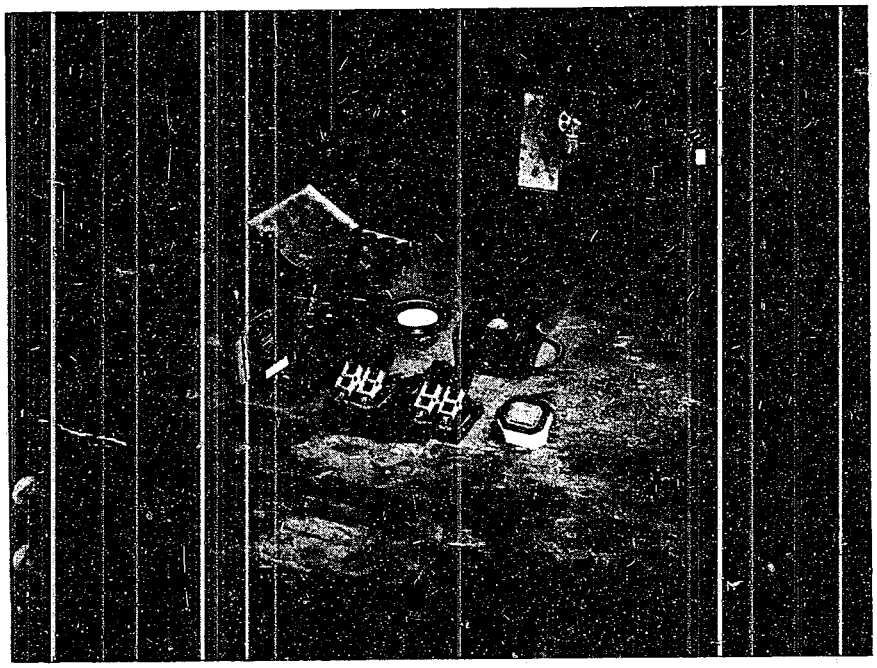


Figure 27

WEIGHT DISCRIMINATION, TACHISTOSCOPE, TWO-HAND COORDINATION. MACHINE, RHEOSTAT, TIMER, ELECTRIC COUNTERS.

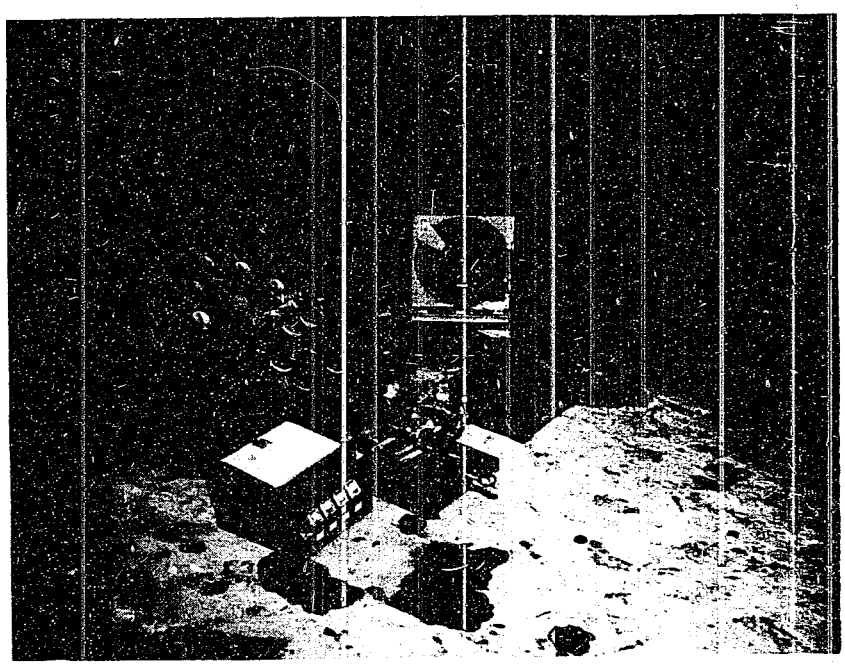


Figure 28

PEG TEST, PHONOGRAPH RECORDS FOR CODE TEST, MEMORY EXPERIMENT APPARATUS

PART II - SUBMARINE MEDICINE AND RESEARCH

A. GENERAL

1. Air Purification

Japanese submarine air purification equipment very closely resembled German equipment. The air was passed through NaOH cannisters in an air circulation system by blowers in order to absorb CO_2. Oxygen was released from flasks as required.

2. Oxygen and CO_2 Percentages

The maximum allowable CO_2 percentage was 3% in Japanese submarines. The minimum O_2 percentage permitted was 17%.

In the one-man and two-man submarines the crews were given a chart or graph showing the amount of O_2 they would consume and the amount of CO_2 they would exhale per unit time of submerged operation. When the predetermined conditions of minimum O_2 or maximum CO_2 concentration were approached, the crews were instructed to use the CO_2 absorber and release a given amount (flow in minutes) of O_2.

3. Air Cooling Apparatus

Air conditioning units and a Freon-gas refrigeration unit for the ice box were installed in the more recent submarines. This was not a very efficient piece of equipment, and when most required (i. e. when hiding on the bottom) it had to be shut off, for the noise of the machine revealed the whereabouts of the submarine to the enemy.

4. Selection of Personnel

The special selection methods are detailed in the following translation. Table VI gives a ration and diet list.

* * * * *

MEDICAL SECRETARIAT NO. 15, CONFIDENTIAL

The following matters regarding physical examinations of submarine personnel during wartime are shown below:

Navy Minister, 13 November 1944

Special Wartime Measures for the Physical Examinations of Submarine Personnel

The following regulations regarding the physical examination of Navy submarine personnel during the Greater East Asia War are established by this order, other conflicting Navy regulations or procedures for physical examinations notwithstanding.

The standards of measurement of the Navy Physical Examination Regulations are as follows:

	W.O. & Above	Rated and Enlisted Men			
		18 yrs. or over	Under 18 yrs.	Under 17 yrs.	Under 16 yrs.
Height (cm)	(175.0)	(176.0)	(175.0)	(174.0)	(173.0)
Weight (Kg)	47.0 (78.0)	48.0 (77.0)	46.0 (72.0)	44.0 (70.0)	40.0 (68.0)
Chest Meas't. (cm)	76.0	78.0	77.0	76.0	73.0
Lung Capacity (cc)	3000	3100	3000	2900	2700
Grip (Kg)	25.0	27.0	25.0	23.0	21.0
Breath holding (sec)	48.0	50.0	48.0	46.0	44.0

N.B. Those who exceed the standards enclosed in parentheses in the height and weight columns are disqualified.

The physical examination covers the following points, but tests of urine, blood, blood sedimentation, and blood pressure are only taken when considered necessary.

a. Heredity and Medical History.
b. Teeth.
c. Height.
d. Weight.
e. Chest Measurement.
f. Lung Capacity.
g. Grip.
h. Chest.
i. X-Ray Chest Examination.
j. Stomach
k. Skin, Genito-Urinary Organs.
l. Urine.
m. Blood.
n. Blood Sedimentation.
o. Blood Pressure.
p. Breath-Holding.
q. Eyes.
r. Vision.
s. Ears.
t. Hearing.

The prescribed examination and the special examination may be shortened to suit the circumstances.

* * * * *

Table VI

RATIONS FOR SUBMARINE CREWS

		Regulation Item	Amount	Ten-day Period Amount	Substitute Items	Amount
BASIC RATIONS	Principal Food Items	Rice	640 gm		Hard Biscuit Sugar Soda Biscuit Sugar Fresh Bread Sugar Glutinous Rice Dry Macaroni Canned Rice Canned Meat, Rice and Vegetables Canned Vegetables and Rice Rice Cake (including canned rice cake) Rice Essence	480 gm 15 gm 400 gm 35 gm 540 gm 35 gm 640 gm 540 gm 1380 gm (1 can, 460 gm per meal) 1920 gm (1 can, 640 gm per meal) 1710 gm (1 can, 570 gm per meal) 1080 gm 540 gm
	Supplementary Food Items	Boneless Fresh Meat Boneless Fresh Chicken	80 gm 95 gm		Canned Chicken and Meat Smoked Meat Dried Meat Eggs Powdered Eggs Canned Fish Bonito Salt Fish Smoked Fish	70 gm 60 gm 40 gm 75 gm 25 gm 70 gm 25 gm 80 gm 60 gm
		Fresh Vegetables	600 gm		Dried Vegetables Canned Vegetables Fresh Vegetables Bean-Curd Essence Canned Fruit Dried Fruit	55 gm 460 gm 600 gm 200 gm 460 gm 150 gm
		Pickles	100 gm		Fresh Pickles	180 gm
	Items For Flavoring and Cooking	Beans Flour		75 gm 75 gm	Flour Beans	75 gm 75 gm
		Soy Sauce		0.65 lit	Powdered Soy Miso (bean paste) Dried Miso	2.30 gm 1.230 gm 580 gm
		Vinegar		0.06 lit	Thickened Vinegar Soy Sauce	0.06 lit according to thickness
		Vegetable Oil Lard		0.07 lit 35 gm	Lard Vegetable Oil Fat and Lard	106 gm 0.023 lit
		Miso		750 gm	Soy Sauce Powdered Miso	0.4 lit 350 gm
		Salt Sugar Spice		80 gm 240 gm 5 gm		
		Dried fish for flavoring		50 gm	Aji-no-moto (basic seasoning)	5
		Sauce		0.05 lit	Lactic Acid Beverage Cold Beverage	0.05 lit 0.05
		Dried Vegetables used for flavoring		36 gm	Beverage according to taste	35 gm

Table VI Continued

	Drinks	Tea		30 gm	Black Tea	10 gm
		Canned Milk	30 gm		Powdered Milk Eggs	6 gm 30 gm
		Black Tea, Cocoa Sugar	(10) (30)		Black Tea, Coffee, Milk, Cocoa Black Tea } Syrup Coffee } Canned Sweet Liquor Orange and Grape Juice Apple Juice	0.18 lit 0.06 75 gm
		Fruit Juice			Syrup and Lactic Acid Beverage	0.06 lit
	Health Foods	Eggs or Milk	60 0.18 lit		Powdered Eggs Canned Milk Powdered Milk	20 gm 60 12
		Vitamin A Food Vitamin B Food Vitamin C Food	1 gm 0.1 gm 0.2 gm		Sweetened Whole Rice Yeast	7 5
ADDITIONAL RATIONS FOR CRUISING SUBMARINES		Cold Drinks	0.35 lit		Fruit Juice Powdered Syrup	0.35 lit 60 gm
		Fresh Fruit	200 gm		Canned Fruit Dried Fruit	150 50
		Cold Pickles			Salted Plums	20
ADDITIONAL RATIONS FOR HOT AND COLD REGIONS AND FOR COMBAT		Fresh Fruit	1	400	Dried Fruit Canned Fruit	100 300
		Vinegar		0.08 lit	Only in hot regions	
		Lard		35 gm		
		Sugar			Only in hot regions	
		Black Tea, Cocoa, Sugar or Lactic Acid Beverage	(5) (20) 0.06 lit		Cold Drinks Syrup Ice	0.175 lit 0.07 lit 250 gm
RATIONS FOR EMERGENCY NIGHT LABOR		Hard Biscuit	120		{Rice {Fresh Vegetables	100 30
		Sugar	10		{Soda Biscuit {Sugar Dried Macaroni Rice Cake/canned Rice Cake Special Nourishing Food	100 30 110 200 50
		Tea	2			
		Rice	30		{Flour {Sugar Sugar	15 20 35
HEALTH DRINK		Brandy	0.036 lit		Sake	0.14 lit

5. Change of Crews After Patrols

Crews were mixed, split, and broken up after every long submarine patrol, and after one or two short cruises. Submariners might remain in the submarine service as long as they desired, but they were constantly shifted from one ship to another.

6. Adverse Effects of Long Patrols

Definite ill effects were manifested in crews after long patrols. "Submarine fatigue" was severe, and the efficiency of the personnel was so decreased that long rest periods between cruises were necessary. These were spent in recreation, light duty, re-fitting ship, etc. Cruises varied from three months maximum to two to four weeks minimum. The former required four weeks rest period, the latter one week of recuperation before efficiency was back to normal.

7. Effects of Submergence in Tropics

The effects of heat and humidity were severe in the tropics. Heat exhaustion was common, although only a few cases of prostration occurred. Prickly heat, fungus infections, and a peculiar facial oedema were the rule. This oedema appeared midway during the cruise, and disappeared on the run homeward after the crews could be permitted to come on deck. Three spells a day of ten minutes each were usual. It was believed the excessive heat and humidity, not nutritional oedema, allergy or other causes were responsible for the condition, although no definite aetiological factor had been established. Avitaminosis was denied as a possible cause.

Living conditions were distressing, as such submarines frequently were reported running below the surface at 90% humidity and 32° C. temperature. An attempt was made, when possible, to keep the interior between 28° to 30° C. with as low a humidity as practicable.

8. Medical and Hygienic Problems

The outstanding problems demanding solution were the control, prevention and treatment of "submarine fatigue" and the prevention or cure of the "oedema syndrome".

B. SUBMARINE MEDICINE

1. Heat Rash and Fungus Infection

Heat rash was treated by frequent bathing or washing the affected part, and applying starch powder. A mixture of alcohol and water for washing was also a standard prescription. Fungus infections were treated along the lines described in NavTechJap Report, "Podiatry in the Japanese Navy", Index No. M-03.

2. Odor Control and Sanitation

There was no provision for odor control aboard submarines, and sanitation was generally poor. In the one, two, and five-man submarines, the crews had no means of disposing of excreta or garbage, save overside or by collecting it in a bucket when overside disposal was impracticable.

3. Length of Cruises and Submergences

The longest recorded cruise made by a Japanese submarine during the war was three months. The longest submergence was 40 hours in a 100-man submarine.

4. Two-Man Submarines

The effects on the personnel of the two-man submarines were admittedly distressing. It was pointed out, however, that the two-man submarine was more or less of a suicide venture, so that physiological considerations were not very important.

C. SUBMARINE MEDICAL RESEARCH

1. Carbon Dioxide Absorption

In September 1944, as a result of research carried on at the Otake Submarine Base, a new method for absorbing CO_2 was introduced. The old NaOH filter use was discontinued, and "alka-cellulose" was placed aboard all submarines, particularly the smaller types. "Alka-cellulose" was a commercial preparation, obtained from plants by processing staple fibre. The first stage in the processing apparently was an alkalinization of the fibre to soften and shred it. This first stage product was found to possess excellent CO_2 absorbing qualities. It was packed in 4kg tins, and when required, the fibre was simply strewn on the deck of the ship. It was said to take up 400 liters of CO_2 per 4kg of material.

The CO_2 concentration of 3% was determined in submarines by use of a buffer solution containing phenolphthalein so adjusted that the presence of 3% CO_2 in the air caused a physical change sufficient to decolorize the pink solution. The vials were opened and the liquid poured into a dish, where the reaction was observed.

2. Living Conditions

a. In 1944 the Japanese Navy, through the government, requested that various Imperial University medical schools undertake research on "how to improve the living and operating conditions of submarine crews". A committee of some ten professors was formed with Dr. KUNO, Professor of Physiology of Nagoya Imperial University, as its chairman. Professor KUNO was well known for his previous research on "sweating" and he was considered the logical choice. Among the members of the committee were:

Professor TSUNAOKA, Professor of Anatomy, Kyoto Imperial University.

Professor KATSU, Prefectural Medical College, KYOTO

Professor TODA, Professor of Physiology, Kyoto Imperial University.

Professor KAJIWARA, Professor of Public Health and Hygiene, Osaka Imperial University.

Professor SUGIMOTO, Nutrition Research Institute, Tokyo Imperial University.

Professor YAZAKI, Tokyo Gikei Medical School, TOKYO.

The problem was divided into five projects and each of these was assigned to the man best qualified to conduct the research. The work was done in the various institutions, and the committee met regularly to report progress and discuss problems.

Until June 1944 the Navy refused to let the committee visit and inspect its submarines, although this was strongly advised and requested by the members. At that time, however, owing to unsatisfactory progress, the committee convinced the naval authorities that it was necessary for them to gain first-hand information about the problems they were attempting to solve. A party was then shown the most obsolete type of Japanese submarine at the Kure Naval Base, although newer design and construction had changed the nature of the problems incident to submarine operation. The Navy insisted on secrecy, and advised that the results of the researches were still to be turned over to naval medical authorities for practical application and actual operation. Several suggestions from the committee had already been so handled and rejected as unsatisfactory by the naval medical authorities, and the committee, with its hands so tied, dissolved and ceased further work several months before the war ended.

This lack of cooperation between the various government agencies, stress on military secrecy, and an independent attitude seem to have characterized the whole war effort at this level.

b. The problem of air purification was assigned to Professor TSUNAOKA of OSAKA. After considerable investigation he decided that some chemical or chemicals more efficient than the standard NaOH could be recommended. He set out to find a material that would give the maximum result in the removal of CO_2, CO, H, and Cl from air, using the regulation air-purification equipment, but substituting a new chemical for the NaOH. His conclusions were that sodium peroxide or silver peroxide were best and made recommendations to this effect to the Navy, which replied, after trials, that the explosive dangers of these two drugs prohibited their use. Professor KATSU, whose forte was "activated carbon", attempted to use this in various filters for air purification by absorptive action, but his experiments did not come to a successful conclusion and he made no recommendations to the Navy.

c. The subject of illumination and properties of light was assigned to Professor YAZAKI, who was assisted by a Mr. SEKI, "a specialist in lamp construction" from an industrial lamp factory. His activities were confined to calculating the quantity of ultra-violet rays required to maintain health in submarine crews per 24 hours exposure. Having determined this he set about designing a lamp bulb which would give adequate illumination and emit sufficient ultra-violet to keep the vitamin D requirements up to normal, and to stimulate the skin. This project was unsatisfactory since no bulb could be devised which would not burn out quickly; and further, it was accidentally discovered that the Navy was having the bulbs made of ordinary glass, which vitiated the whole purpose of the research.

d. Under the heading of dietetics Professor SUGIMOTO was working on the single problem of producing an "appetizer", or "appetite stimulating" pickle to take the place of the usual Japanese pickle, so relished by the crews. The ordinary condiment could not be kept without spoilage in the submarines' high interior temperatures during a cruise or patrol, and it was found that the amount of food consumed by the crews decreased as the supply of pickles was exhausted. This problem was solved by using cocoanut as a base for the pickle, and the formula was turned over to the Navy.

e. The committee was requested to determine the cause for the high percentage of dental pathology among submarine crews, and to make recommendations for the preservation of dental health. This group began its investigation by a careful collection of statistics based on its own observations on the dental health of submarine personnel, in an effort to discover whether any factors peculiar to the submariners' life and living conditions were responsible for the problem. After considerable study, and comparison of dental defects before and after cruises, it was clearly demonstrated that nothing incident to the submarine service was to blame, but that the dental condition of submariners was a direct result of previous dental ill health and defects. A report was so made.

f. The last problem, and that with the widest scope, was assigned to Dr. KUNO. He was requested:

(1) To devise a simple physical examination procedure to aid in the selection of personnel fitted for submarine duty, depending on their ability to withstand high temperature and humidity conditions. This involved a study of heat production and heat dissipation, and the conclusion reached, after careful physiological studies on weight loss, B.M.R.'s, collection of perspiration from standard localized areas, and compiling tables and charts, was that hairy individuals made the best crews, due to their increased heat dissipation from the evaporation area afforded by the hair.

(2) To devise methods of increasing individual heat and humidity tolerance. His recommendations were:

(a) That proper acclimatization training be required of all submariners during their training program, under environmental conditions corresponding to those in submarines, and by gradually increased exposure achieve the maximum development of heat tolerance.

(b) Unaccustomed severe muscular effort gives only a 10% muscular efficiency quotient, the rest being dissipated in heat production. Hence to attain maximum efficiency and minimum heat expenditure each man should be trained to the exact muscular operations he would perform aboard ship in the submarine service, and this training should be part of his basic training ashore.

(c) That adequate salt intake be maintained by adding excess sodium chloride with meals, and not between meals. A rough rule of 25 grams excess salt for strenuous physical exercise in 90°, 90% conditions was advocated.

(d) Tolerance to cold could be increased by immersion in cold water for gradually increasing periods of time. It was shown that skin temperatures would react to immersion by first dropping, then developing a compensatory rise over pre-immersion temperatures, and then returning gradually to normal. If, however, the immersion training was continued, the skin temperature would remain consistently higher than previously, and cold tolerance could be increased.

These conclusions of the committee were submitted to the Navy, but no information was received whether any, all, or none had been accepted and put into practice.

PART III - SURFACE CRAFT MEDICINE AND RESEARCH

1. Tolerance to Heat and Cold

There was no specific research done by the Navy or the Naval Medical Corps relative to increasing the tolerance of its personnel to heat and cold. The Medical Corps handbooks, documented in NavTechJap Report, "Data Relative to Life in the Jungle and on Sea Islands," Enclosure (A), Index No. M-01, contain the pertinent instructions.

To questions on this subject the Medical Bureau replied as follows:

"To increase tolerance to heat we take salt and bicarbonate of soda, three to five grains of each, and strong vitamin tablets. For cold we rub down with a dry towel under strict supervision to stimulate the skin and circulation."

2. Clothing

The normal clothing of the Navy was cotton regulation uniform for summer and wool-mixture regulation for winter. Cloth was scarce, and no special temperature adapted uniforms were issued. Armored vests were in use for exposed personnel on deck aboard surface craft, and were optional equipment in the air corps flight personnel, chiefly among the crews of long-range bombers. Fire-control parties aboard ships, notably on aircraft carriers, had fire protection apparatus. A suit of thick, quilted kapok or cotton was in use. No immersion suits had been designed.

Actually the ships' crews wore as little as possible aboard when the weather was warm, and as much as they possessed during cold weather. Rain gear, boots, sou'westers, and coats of good quality rubber were available.

3. Tropical Deterioration

No method had devised for the prevention of tropical deterioration of clothing, gear, or equipment, except for food and drugs. Drugs and medicines were wrapped in rubber cloth and sealed with rubber tape to make the package water and moisture-proof, or were sealed in tin cans.

4. Seasickness

Although several research projects on the cause and cure of seasickness had been undertaken by civilian agencies, no solution or recommendation had been adopted by the Navy. No pills or mixtures for seasickness were adopted or prescribed.

5. Hygiene and Sanitation

Sanitation aboard surface ships was provided for, but the living habits of the personnel made for unhygienic conditions, and the lack of proper appreciation of the necessity for clean galleys, heads, baths, and living quarters resulted in gross negligence of health requirements. Living quarters were crowded, and ventilation, though the means were present for satisfactory air flow, was poor.

6. Training of Surface Suicide Craft Personnel

The surface suicide craft included the suicide boat and the one-man torpedo, the later perhaps more properly a submarine suicide craft. Personnel who operated these craft were selected from volunteers, whose numbers are said to have been sufficient, even toward the end of hostilities. The suicide boat pilots were given one test run to familiarize themselves with the craft, before their final mission. Mock-ups, or model one-man torpedoes, were constructed for training the operator, and since practice runs with a dummy war head were possible and practicable, they were carried out. The suicide boat construction (chiefly the engine) was not of sufficient quality to permit many trial runs.

7. Flash-Burn Protection

The procedure for flash-burn protection has been noted under the heading "Pharmacology", in NavTechJap Report, "Pharmacology and Malariology in Japan - Civilian and Naval", Index No. M-12.

ENCLOSURE (A)

REPORT ON THE INVESTIGATION OF AERO-MEDICAL RESEARCH FACILITIES OF THE YOKOSUKA NAVAL AIR STATION

All of the buildings and pertinent equipment investigated were in an extremely poor state of physical repair. This was due to the following three factors listed in order of importance.

1. Most of the small equipment had been destroyed by the Japanese naval personnel prior to the arrival of the occupation forces. Also, all pertinent documents had been burned or otherwise destroyed by the Japanese acting upon orders from TOKYO (Kokuhombu). This conclusion is based not only upon inference, but upon the admission of various officials concerned.

2. Subsequent to the arrival of the occupation forces, these buildings had been occupied by various personnel stationed in the area, and hence had been subject to looting and wanton destruction of equipment otherwise left intact by Japanese naval personnel.

3. At the time of this investigation the buildings were being prepared for immediate occupancy as living quarters for troops stationed in the area.

The actual aero-medical research was carried on in Building 31, a three-story structure. It contained a centrifuge, used for testing animals, an encephalograph, a vibrator, vibration recording equipment, three chemical laboratories, a photo laboratory, complete meteorological equipment, and facilities for the feeding and care of a small number of animals. As mentioned above, most of the equipment was destroyed beyond repair, and, with one exception, no documents were found. This exception is a notebook found in the room containing the encephalograph.

Building 28 was used for testing aircraft instruments. It contained an Eiffel type wind tunnel (max. vel. 30 m/sec), a low-temperature chamber, and two low-pressure chambers, one used to test individuals, the other to test groups. In this building the equipment, being both large and of standard design, had not been destroyed. However, no documents were found, and interrogation of the caretaker, who had been brought there at the request of the First Battalion, Fourth Marine Division, to run the machinery, revealed that all documents had been destroyed on orders from Kokuhombu at TOKYO. This caretaker was Lt. Comdr. Inosuke KIMURA, formerly in charge of the building and its research. He was thirty years old, and possessed the average Japanese technician's command of English scientific terminology. Upon interrogation, he was found to be quite willing, almost eager, to explain in detail the particular research of which he was in charge. However, he claimed at all times a complete ignorance of any other section of the Yokosuka First Naval Technical Research Institute. He admitted interest as a scientist, but disclaimed any actual knowledge of research other than his own.

Certain questions contained in the Bureau of Surgery and Medicine questionnaire were put to him and his answers were as follows:

Q: What is the minimum altitude at which Japanese flyers are required to use oxygen?

A: 3500 m.

Q: What are the lowest cockpit temperatures commonly encountered in Japanese aircraft?

A: -40° C. to -30° C. This was in runs over HOKKAIDO in January and at an altitude of 8000 m.

ENCLOSURE (A), continued

Q: Are electrically heated flying suits available?
A: Yes.

Q: What airplanes use the chemical oxygen generator?
A: Mostly Army planes, and particularly the KC103. The Navy uses them very little, for operational reasons.

Q: Why is the chemical generator used instead of oxygen (compressed) in cylinders?
A: For the following three reasons, listed in order of importance:

1. Carbon steel was lacking for the manufacture of the containers.

2. The cylinders were too heavy.

3. The cylinders were subject to explosion when penetrated by a bullet.

The investigation of the aero-medical research facilities of the Yokosuka Naval Air Station was begun on 16 October 1945, with the information given in a report of the Navy Technical Air Intelligence organization. This report listed buildings devoted to research, the purpose of each building, and the Japanese staff formerly in charge.

ENCLOSURE (B)

EXCERPTS FROM A QUESTIONNAIRE USED IN INTERROGATING THE STAFF AT SASEBO NAVAL MEDICAL HOSPITAL

1. Q: What special training does a flight surgeon of the Naval Air Force receive?
   A: So called "Special Training" does not exist. Whatever training exists pertaining to flight surgeons is given at the Naval Medical School. However, in the event of necessity, medical officers on duty with the Air Force will deliver lectures for several days on the subject.

2. Q: What are the special duties of Air Flight Surgeons?
   A: The duties of a flight surgeon do not in general differ from those of other medical officers. However, with his knowledge of flight medicine he maintains the crews' health for flight efficiency, weeds out the unfit, and investigates those phases in aviation that appertain to medicine.

3. Q: At the present time, what researches or studies are being carried out by the Navy Medical Department, relative to naval aviation?
   A: Basic studies along medical lines of importance to high altitude flying; experimental anti-blackout pressurized suits, pressurized masks, oxygen intake masks, etc., and means of alleviating fatigue in flying.

4. Q: What Medical studies were made pertaining to the selection of air personnel?
   A: Personally do not know of the actual studies carried out during the last year on this subject. Would refer you to Bureau of Medicine and Surgery (Navy Ministry), or the First Air Technical Department in YOKOSUKA.

5. Q: Where are the foregoing experiments being held or where are the research laboratories?
   A: Experiments are being conducted in the Medical Dept. of the First Air Technical Department in YOKOSUKA, in collaboration with the Navy Medical School of the Bureau of Medicine and Surgery (Navy Ministry).

6. Q: What special physical, nervous, emotional, and mental requirements for aviators does the Japanese Naval Medical Corps require?
   A: Physical and psychological examinations are given in the selection of pilots. For the physical examination, the regulations are as prescribed on the separate sheets. The rules stipulated by the League of Nations form the basis of the regulations, with the physical build of the Japanese taken into consideration. Though we do not possess a set of regulations for psychological examination, yet a certain number of regulations have been prescribed to serve for the time being and are being given a try out. For details, would refer to the Bureau of Medicine and Surgery (Navy Ministry).

7. Q: What routine examinations are given naval aviators to test their physical condition?
   A: The regulations prescribed for routine physical examinations are as laid down in "Medical Regulations", pages 411 to 413 under "physical examination".

ENCLOSURE (B), continued

8. Q: What tests determine when they are unable to fly?
A: As a result of periodic and special examinations, unfitness for flying is determined by the occurence of psychological defects, or by a pilot's falling below minimum health requirements (for example, visual deficiency, etc. are prescribed in regulations). (Medical Regulations, pages 411 to 413).

9. Q: How are these tests made?
A: In addition to general, medical, and psychological examinations, opinions are obtained from specialists in cases which require the specialized judgment of the medical department. (Medical Regulations, pages 424 to 434; Naval Physical Examination Procedure)

10. Q: What special training is given submarine Medical Corps doctors? Corpsmen? Submarine personnel? Describe in detail the physical and mental training for underwater service.
A: Submarine and underwater service: Navy Medical Handbook (Kaigun Eisei Gaku), pages 285 to 287 and Navy submarine personnel physical examinations: Medical Regulations, page 415 Chapter 7; ibid page 439. In regard to the details which are recorded in the Navy submarine personnel physical examination certificates, please consult the Medical School of the Navy Bureau of Medicine, and the Navy Submarine School at OTAKE in HIROSHIMA Prefecture.

11. Q: What research and experiments is the Japanese Naval Medical Corps conducting in the line of submarine problems? Where are the research laboratories, or where are experiments conducted?
A: Although it is believed that research concerning the elimination of carbon dioxide and other noxious gases from submarines, the elimination of heat, the recuperation from fatigue by submarine crews, the maintenance of physical strength, etc., is being conducted, we are not cognizant of its details. Such research is being conducted at the Research Dept. of the Navy Submarine School at OTAKE in HIROSHIMA Prefecture.

12. Q: What general research problems in connection with naval medicine is the Japanese Naval Medical Corps investigating? Where?
A: Research Dept. of the First Medical Supply Depot.
Location: MEGURO Ku, TOKYO To. It was transferred to the Toyama Pharmacists School in TOYAMA Shi, but was burned down in an air raid. Subjects of Research: Pharmaceutical plants, synthetic drugs, and substitute drugs.

ENCLOSURE (C)

JAPANESE NATIONAL RESEARCH COUNCIL REPORTS
ON AVIATION MEDICINE RESEARCH

SECTION IN THE NATIONAL RESEARCH COUNCIL

A. STUDIES ON AVIATION MEDICINE UNDER CHIEF MANAGER T. KATO (SENDAI)

1. Studies on the Autonomic Functions in Organisms During Flight

Chief: M. URAMOTO (TOKYO)

a. Aero-physiological studies on the blood, circulation of blood, and respiration. K. FUKUDA (Tokyo Imperial University)

b. Studies on lactic acid and pyruvic acid under various conditions of flight. S. UCHINO (Kyoto Imperial University)

c. On the role of the autonomic nervous system under conditions of flight. H. SATO (Tohoku Imperial University, SENDAI)

d. Role of internal secretion in aviation medicine.
Y. SATAKE (Tohoku Imperial University, SENDAI)

e. On the alteration of the liver function during flight.
F. NAKAZAWA (Tohoku Imperial University, SENDAI)

f. Metabolism and nervous function under low barometric pressure.
T. KUROTSU (Osaka Imperial University)

g. Study of the digestive function by X-rays, under low air pressure or oxygen deficiency.
H. MABUCHI (Osaka Imperial University)

h. On the alteration of various kind of functions in organism at high altitude. S. KATSUNUMA (Nagoya Imperial University)

i. Influences of low air pressure and acceleration on the vegetable functions. F. TANINO (Kanazawa Medical College)

j. Effect of abnormal air pressure on the organism, and countermeasures. S. KODAMA (Kumamoto Medical College)

k. On the disturbance of the circulation, and abnormal intestine movement caused by flying.
K. YOKOTA (Kyoto Medical College)

l. The liver function under low air pressure, and an accelerant in the liver. K. NISHIMURA (Nihon Medical College, TOKYO)

m. On the ability of blood-production under low barometric pressure. T. TOTSUKA (Nihon Medical College, TOKYO)

n. Metabolism in the blood under low air pressure.
K. KAJIRO (Nihon Medical College, TOKYO)

o. Bleeding during flying, and countermeasures.
J. KATSURA (Tohoku Imperial University, SENDAI)

p. Distribution and shifting of carbonic acid in the human blood under low partial pressure of oxygen.
A. SEO (Kyushu Imperial University, FUKUOKA)

ENCLOSURE (C), continued

q. Influence of various barometric pressures on the blood corpuscles. H. TOMITA (Osaka Imperial University)

r. Physico-chemical study of alteration of the blood under low air pressure or oxygen deficiency. K. MATSUTA (Tohoku Imperial University, SENDAI)

s. Studies on respiration and metabolism under low barometric pressure. I. FUJII (Kyoto Medical College)

2. Studies on the Blood Circulation and Respiration

Chief: R. SHOJI (KYOTO)

a. Circulatory disturbances due to acceleration, and countermeasures. T. KATO (Tohoku Imperial University, SENDAI)

b. Physiological and pharmacological studies on circulatory disturbances caused by acceleration. T. FUKUDA (Kyushu Imperial University, FUKUOKA)

c. Influence of low air pressure and low temperature upon circulation of the blood. T. TASAKA (Niigata Medical College)

d. On the influence of acceleration upon the circulatory and respiratory organs. K. HAYASHI (Okayama Medical College)

e. On the function of the respiratory center under low air pressure. K. TAKAGI (Niigata Medical College)

f. Study on respiration and blood-circulation under the effect of extreme low barometric pressure. S. MOCHIZUKI and M. KURUSU (Kyoto Medical College)

3. Studies on the Organ of Audition and Equilibrium

Chief: T. HOSHINO (KYOTO)

a. Study on the tuba auditiva, equilibrium, and tolerance to aviation. T. HOSINO (Kyoto Imperial University)

b. Influence of acceleration and of low air pressure on the auditory organ and nasal cavity. Y. TSUIKI (Tohoku Imperial University, SENDAI)

c. Relation between the circulation of body fluid through the brain and the function of labyrinth. G. HIRAKO (Kyushu Imperial University, FUKUOKA)

d. Influence of decreased air pressure and temperature upon the auditory organ. K. YAMAKAWA (Osaka Imperial University)

e. Passage of air through the oto-rhino-laryngeal cavities. M. AKUNE (Nagoya Imperial University)

f. Ability of hearing and equilibrium during action of the acceleration. E. TORII (Niigata Medical College)

ENCLOSURE (C), continued

g. Study of ear pain due to alteration of air pressure.
E. TORII (Niigata Medical College)

h. On the labyrinth-reflex.
T. HASEGAWA (Nagoya Medical College)

i. Study on the influence of abnormal air pressure on the auditory organ, and countermeasures.
G. MABUCHI (Kumamoto Medical College)

j. Study on the relation of auditory organ and upper serial duct to the tolerance for high altitude.
F. NAKAMURA (Kyoto Medical College)

k. On the function of labyrinth in aviation medicine.
T. OFUJI (Nihon Medical College, TOKYO)

4. Studies on the Optic Organ and its Function in the Aviation Medicine

Chief: Y. SHOJI (TOKYO)

a. Study on the optic organ of military pigeons.
Y. SHOJI (Tokyo Imperial University)

b. Influence of low barometric pressure on the eye. Study on the morphological change of the optic organ after repeated action of acceleration.
Y. HAYASHI (Tohoku Imperial University, SENDAI)

c. Alteration of optic irritability under low air pressure and the application to aviation medicine.
K. MOTOKAWA (Tohoku Imperial Medical, SENDAI)

d. Physiological study on binocular vision under low partial pressure of oxygen.
A. SEO (Kyushu Imperial University, FUKUOKA)

e. Countermeasures to the decrease of light sense at high altitude.
M. NAKAJIMA (Nagoya Imperial University)

5. Pathological and Psychological Studies on the Central Nervous System Under the Condition of Flight

Chief: S. NASU (SENDAI)

a. Study on muscular tone and sense of space.
M. MIURA (Kyoto Imperial University)

b. Study on the fitness to fly; reaction time at low pressure.
G. OWAKI (Tohoku Imperial University, SENDAI)

c. Influence of acceleration upon the central nervous system; pathological study.
S. NASU (Tohoku Imperial University, SENDAI)

d. Psycho-electric-phenomenon under low air pressure and the action of acceleration.
K. MOTOKAWA (Tohoku Imperial University, SENDAI)

ENCLOSURE (C), continued

e. Psychological study on education and the increase of ability of aviators. K. SAKUMA (Kyushu Imperial University, FUKUOKA)

f. Pathological study on the brain under low air pressure. H. ANBO (Hokkaido Imperial University, SAPPORO)

g. Pathological study on the brain under low air pressure. T. ITO (Niigata Medical College)

h. Metabolism in the brain under low barometric pressure. H. AKIMOTO (Kanazawa Medical College)

i. Influence of abnormal air pressure on the functions of the central nervous system. K. MIYAKAWA (Kumamoto Medical College)

j. Pathological study on the central nervous system and its blood-passage under the low air pressure. M. ARAKI (Kyoto Medical College)

k. Intracranial blood-pressure during flight. M. UEMURA (Keio University, TOKYO)

6. <u>Studies on the Fitness, Tolerance, Fatigue, and so on</u>

Chief: S. KATSUNUMA (NAGOYA)

a. Tolerance to oxygen deficient, and plan for its increase. R. SHOJI (Kyoto Imperial University)

b. Fitness and tolerance to flight and alteration of the circulatory system during flight. T. MASHIMO (Kyoto Imperial University)

c. Psychological study on fatigue during aviation. M. MIURA (Kyoto Imperial University)

d. To increase the ability of aviators by means of medicaments. T. FUKUDA (Kyushu Imperial University, FUKUOKA)

e. Study on altitudinal tolerance. H. NAKAMURA (Hokkaido Imperial University, SAPPORO)

f. Study on oxidation reduction potential concerning increase of altitudinal tolerance. H. KUBO (Osaka Imperial University)

g. Study on altitudinal tolerance. I. OGAWA (Nagoya Imperial University)

h. On the sensitivity and immunity of organisms under the low barometric pressure. T. ITO (Niigata Medical College)

i. Training for altitudinal tolerance and metabolism under low air pressure. M. URAMOTO (Jikei Medical College, TOKYO)

j. Study on blood-production as related to altitudinal tolerance. K. KATO (Nihon Medical College, TOKYO)

ENCLOSURE (C), continued

Most of these investigations are now being performed in schools or institutes named. Decisive conclusions have not yet been reached.

B. STUDIES ON AVIATION MEDICINE UNDER CHIEF MANAGER TOYOJIRO KATO (TOHOKU UNIVERSITY)

1. Investigation on Vegetable Functions

Chief: Masataro URAMOTO, (Jikei University, TOKYO)

Objective: To elucidate the changes in vegetable function (Including metabolism and blood) during flight

Kuniżo FUKUTA (Tokyo University) has performed some physiological studies on the aspects of respiration, circulation and blood, and Sakuji KODAMA (Kumamoto Medical College) on respiration and lactate metabolism of blood at extremely high altitudes. Toichiro SAWADA (Kyushu University) affirmed that the liver function, especially its sugar metabolism and detoxicating function, are injured by repeated exposure to low atmospheric pressure, and that the blood pyruvate is apparently increased after steep diving. Masasaburo URAMOTO (Jikei University, TOKYO) estimated the blood lactate and pyruvate under the condition of training upon exposure several times daily to lowered atmospheric pressure up to the critical point. Fusakichi NAKAZAWA (Tohoku University) investigated the change in liver function due to decreased oxygen tension or action of acceleration, based on its function of detoxicating santonin acid. Hideo MABUCHI (Osaka University) investigated the function of digestive organs in low pressure or anoxemic condition. Fuyuo TANINO (Kanazawa Medical College) found that some drugs, like histamim, glutathion etc., can restrain the retardation of stomach movement, histological changes of liver and lowering of the defensive power of the body due to decreased atmospheric pressure. Kozo KAMISHIRO (Nippon Medical College, TOKYO) is studying the effect of high altitudes upon the metabolic process in red blood corpuscles. Takehiko TOTSUKA (do) ascertained that low atmospheric pressure exaggerates the diameter of the red blood cell, but, on the contrary, it diminishes at high altitudes. Katsuji KATO (do) found augmentation of blood cell volume at low pressure, also the fact that the increase of the reticulocytes is the greatest on the second day of repression. Aizaburo SEO (Kyushu University) has examined the problem of whether the distribution of blood carbon dioxide between the blood plasma and corpuscles is subject to combine oxygen content of the red cells, since he confirmed that the decrease in blood carbon dioxide is in blood plasma several or more than ten times as intense as in blood cells. Tokumitsu TSUTSUI (Kumamoto Medical College) found that at high altitude the oxygen consumption is increased, but the production of carbon dioxide decreased, RQ being lowered; he is investigating the influence of vitamins upon those changes. Haruo AKIMOTO (Kanazawa Medical College) has studied the metabolism in the brain at low oxygen tension. Hiroshi SATO (Tohoku University) confirmed that the adrenalin content of the surrenal gland is apparently diminished by repeating sudden changes of barometric pressure. He thought this is of peripheral origin, as it does not depend on the existence of splanchnic nerves. Takatoshi HASEGAWA (Nagasaki Medical College) ascertained that lineal acceleration causes increase of blood pressure and retardation of intestinal movement, accompanied by certain physico-chemical changes in blood and urine; those changes do not occur when the labyrinth is on both sides or previously excised; also the rise in blood pressure fails to appear after the excision of the cervical sympathetic ganglion, and the slowing of the gastro-intestinal movement after severing the splanchnic nerves, while the

severing of the vagus has no effect. He concluded that the lineal acceleration causes a raising of the sympathetic tonus through the otolinth. Kanae HAYASHI (Okayama Medical College) assumed that the changes in blood pressure due to momentary action of the centrifugal acceleration appear first hydynamically, then following the pressure change, the regulation of the blood pressure comes on secondly by the cardiovascular reflex, which is chiefly based on the vagus nerves. Kojiro MATSUDA (Tohoku University) found the blood-pH of the rabbit tended to acidity in 30 minutes after cessation of the acceleration action.

2. Investigations on the Circulatory Function

Chief: Shunichi MASHIMO (Kyoto University)

Objective: To find the changes in circulatory system during flight;

On the basis of Shunichi MASHIMO's aero-physiological research of the heart, it was assumed: (1) In rabbits there exists a constant relation between the frequency of the heart beat and the time duration in low pressure. (2) In guinea-pigs, when the acceleration acts in the direction of "head to tail", P and R of electrocardiagram are exaggerated and S-T is lowered. Toyojiro KATO, Hiroshi SATO and Kijiro MATSUDA (Tohoku University ascertained on ECG of rabbit and dog that rapid action of acceleration in the direction of "head to tail" is mostly followed by augmentation of the heart rate, sometimes after preliminary decrease. In rare cases it is decremented so intensely that it nearly stops. When the acceleration suddenly ceases, the heart beat is retarded, accompanied by irregularity (chiefly extra-systol), sometimes with negative T. This retardation may sometimes appear before the cessation of the acceleration. Above mentioned changes fail to appear when the acceleration acts quite slowly. In the direction of "tail to head" it always brings about a lessening of the heart frequency, which is more apparent, the more rapid the acceleration. Seijin MOCHIZUKI and Masao KURUSU (Kyoto Prefecture College) found that the more the oxygen tension of air is diminished, the more the blood stream in the lung is increased; in the case of inhalation with a one-sided lung it is increased more in the non-inhaled side. The inhalation of carbon dioxide gives rise to the augmentation of blood stream in the lung; in the experiment of inhalation with one side the increase on the non-inhaled lung is more evident. They observed that during the increase of lung circulation in low barometric tension the abdominal organs especially become anemic, suggesting the mobilization of blood to more important organs, like the brain and lungs. Fuyuo TANINO (Kanazawa Medical College) confirmed that after daily treatment of a rabbit with exposure to low pressure the minute volume of the heart and the circulating blood volume are lessened, accompanied by a decrease of blood plasma and increase of blood cells. Those phenomena of adaptation are quite eminent after 14 days, while they become less apparent after 21 days, a phenemenon of acclimatization by the increases of blood cells, but not fatigue of the heart. Sadataka TASAKA (Niigata Medical College) is investigating the influence of low pressure upon the body temperature and blood circulation by means of the change in thermoelectric current.

3. Investigations on Respiratory Functions

Chief: Rinnosuke SHOJI (Kyoto University)

Objective: To elucidate the state of respiratory functions during flight.

Rinnosuke SHOJI (Kyoto University) measured respiratory minute volume,

composition of alveolar air, gaseous metabolism, gas content of arterial blood, etc., in man upon inhalation of air with low oxygen tension, such as in 5 to 10 kilos altitude. He confirmed that the intake of oxygen does not diminish even at the critical point of consciousness (fainting), and that in order to keep the function of the brain (mental capability) normal, it is necessary to maintain the arterial oxygen saturation, i.e. the alveolar oxygen tension over a certain limit. Fumio NAKAMURA (Kyoto Prefecture Medical College) has investigated the physico-chemical and chemical changes of blood in albino rats with experimentally provoked stricture of the trachea in low atmospheric pressure. According to the experiments of Kentaro TAKAGI (Niigata Medical College) the vagus stimulation by a special stimulation apparatus with vacuum tube gives rise to the expiratory cessation of respiration over the inspiratory one, when the frequency of the stimulation is gradually lessened. The reflectoric irritability of the respiratory center, observed on the basis of above mentioned findings, reaches its maximum at a low barometric pressure corresponding to 2 to 3 kilos, but is lessened above this height. Since the respiratory volume increases usually up to the altitude of 8 kilos, it is suggested that the irritability and reflectoric irritability of the respiratory center must be separated from each other.

4. Investigations on the Auditory and Equilibrium Function

Chief: Teiji HOSHINO (Kyoto University)

Objective: To find the changes in acoustic and balancing organs in flight

Keiji TORII (Niigata Medical College) is performing investigations on ear pain occurring at changes of barometric pressure, Minoru SASAKI (Kyushu University) the questions on the Eustachian tube, Mutsumi AKUNE (Nagoya University) on the ventilability of the pneumatic cells of the mastoid process, Takatoshi HASEGAWA (Nagasaki Medical College) on the Labyrinth reflex, Kyoshiro YAMAKAWA (Osaka University) on the auditory function, Gen WANIBUCHI (Kumamoto Medical College) on the sound disturbance in the inner ear, Teiji HOSHINO (Kyoto University) on the relation between the tolerance for flight and equilibrium and auditory tube, Keiji TORII (Niigata Medical College) on the state of equilibrium and acoustic function under the action of acceleration. Most of these experiments have not yet achieved any decisive conclusions. Yutaka TSUIKI (Tohoku University) demonstrated some marked pathological changes in cupula of crista acustica in rabbits after strong action of centrifugal acceleration.

5. Investigations on Visual Organs or Functions

Chief: Yoshiharu SHOJI (Tokyo University)

Objective: To elucidate the change of organs or functions of vision in flight

Aizaburo SEO (Kyushu University) has examined the influence of accommodation and vision field on fusion in low oxygen tension and found that in oxygen-dificient air the sensibility of time by visual sense is quite variable, the accommodation is disturbed and the latent heterophoria manifest. According to the experiment of Minoru NAKAJIMA (Nagoya University) in high barometric pressure, contrary to low pressure, the near point comes closer, the exophoria diminishes, the exophoria goes over toward exophoriasic, the duration of residual image is lessened, the visual sense bettered, the field of vision is enlarged and the dark adaptation accelerated. Shigeyoshi TAMURA (Kyushu University) observed that the pupil reaction becomes weaker and the diameter of the pupil is augmented according to the lowering of barometric pressure. Yuzo HAYASHI (Tohoku Univer-

sity) noticed that in low pressure the field of vision (white) is narrowed upward or to up and outside, that of green is concentrically narrowed. There arises often annular relative scotoma which gradually becomes complete. Seichi YAMAMOTO (Kyoto University) demonstrated that scotoma frequently occurs in aviators who have often repeated deep diving. Misao UEMURA (Keio University, TOKYO) suggested the following facts: the action of acceleration raises the blood pressure in the central retinal artery; the variation of blood pressure caused by change of body position is more apparent in this artery than in the brachial artery. Where changing the sitting position to the lying, the blood pressure in the central artery is elevated, and is especially marked in ages over 30 years. Yasuo MORIYAMA (Osaka University) is measuring the variations of eyeball tension under the action of acceleration by means of an electric ocular tonometer, which he has constructed.

6. Investigations on Central Nervous System and on the Mental Psychological Aspects

Chief: Shozaburo NASU (Tohoku University)

Objective: To elucidate the pathological and functional changes in the central nervous system and in mental and psychological aspects of aviation.

Goichi HIRAKO (Kyushu University) basing on his investigations on the blood stream of the brain, is examining the circulatory disturbance in the brain, which may appear by the action of acceleration or changes of environment. He has not yet come to any conclusions. According to Shozaburo NASU's (Tohoku University) experiments on rabbits, no histological finding in the brain is confirmed after the action of centrifugal acceleration not exceeding lethal doses; the acceleration of 10 g for 10 sec. in either positive or negative direction sometimes brings about hemorrhage per diapedesin pia mater. After submitting the rabbit to acceleration, rather weak but repeated once every day, there is no marked change in the brain even after 30 to 40 days. Hisashi AMBO (Hokkaido University) demonstrated in experiments on rabbits and dogs that steep depression of barometric pressure causes, in addition to aeroembolism, some marked pathological changes, especially the disturbance of blood circulation in the lung by the mechanical influence of rapid barometric change. This is confirmed in an altitude less than nine kilos where no aeroembolism appears, and cannot be demonstrated in organs other than the lung. Yonezo NAGASAWA (Nippon Medical College, TOKYO) demonstrated in dogs and rabbits hemorrhagic changes with bronchitis after violent rotation of the animals; in the brain cortex he could also find appearance of travant-cells, phagocytosis, shrinkage of nerve cells etc. Koichi MOTOKAWA (Tohoku University pointed out from his brain wave studies, that in man, at the height of five kilos, the period of the brain waves is prolonged and the amplitude augmented, and in a rabbit after the action of acceleration of a certain strength the waves are abolished, or sometimes come up in groups. Any acceleration of short duration is always followed by changes in brain waves over a long period. Masaya ARAKI (Kyoto Prefecture Medical College) is performing investigations of brain waves and the histological changes of nervous tissues in rabbits and guinea-pigs intoxicated with gasoline or tetraethyl lead. Concerning the question of fitness for flying as viewed from the psychological aspect, Giichi OWAKI (Tohoku University)

has examined the reaction time and frequency of erroneous reaction with more than two sorts of reactive finger movements on the visual stimulation of more than two kinds. He found that in an altitude of five kilos there are marked individual differences in the reaction time and the frequency of erroneous reactions or great variations in individual reactions. Kanae SAKUMA (Kyushu University) suggested a method for the proof of fitness for flying, which can be conveniently applied to mass examination in a short time.

7. Investigations of Fitness, Tolerance, Fatigue, Etc. of Aviators

Chief: Seizo KATSUNUMA (Nagoya University)

Objective: To get some new ideas of the improvement of examination method of fitness, promotion of tolerance for flying, premature finding, treatment and prevention of fatigue in aviation.

Seizo KATSUNUMA (Nagoya University), Iwao OYAWA (do) and Hiroshi NAKAMURA (Hokkaido University) are studying training and fitness of aviators; Teiji HOSHINO (Kyoto University) and Yutaka TSUIKI (Tohoku University) tolerance of aviation with special regards to the aspect of body equilibrium; Shunichi MASHIMO (Kyoto University) that of circulatory organs, and Hideo KUBO (Osaka University) has investigated the potential of oxydo-reduction of tissues in respect to the promotion of tolerance of aviators. Concerning the question of fatigue of an aviator, Senji UCHINO (Kyoto University) has studied the lactate metabolism in low barometric pressure, and Yoshisada NAKAJIMA (Kyushu University) performed some clinical experiments on accelerating the recovery from aviation fatigue by inhalation of negative ions of magnesium oxide. These investigations have had no decisive results.

ENCLOSURE (D)

REPORTS OF AERO-MEDICAL SECTION
AIR TECHNICAL INTELLIGENCE GROUP, ADVON, FEAF

Naval Air Technical Institute (Aero-Medical Section)
Interdepartment Report No. 3
From January 1945

Report No.	Subject
175	The effect of low pressure on the digestion of food (in mice).
177	Regarding the devices for warning of oxygen discharge stoppage.
178	Regarding the micromethod of determining CO content of blood.
179	Regarding the quantitative determination of haemotin in the blood.
180	The effect of extremely sudden changes of pressure on the human body.
181	Re: the law of Bur and haemotin.
182	Re: the use of the electro-spectroscopic light meter in their dept.
183	Experiments on the UXSU (Light measuring) circuit for use in medical research.
184	Re: the amount of urea in the viscera of a mouse under a low pressure load.
185	Re: the amount of sugar in the viscera of a mouse under a low pressure load.
186	Variations of necessary time to drown a mouse under repeated low pressure loads.
187	The effect of various vitamin injections on the degree of pressure variation necessary to kill a mouse.

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JAPANESE AERO-MEDICAL REPORTS

Section in the National Research Council - Studies on Aviation Medicine (A bibliography of studies on aviation medicine under Chief Manager T. KATO, SENDAI; IV - 1945; III - 1946.)

Studies on Aviation Medicine. KATO, Toyojiro (Tohoku University) in Charge of Experimentation. 1944.

1. "Investigations on Vegetable Functions", (metabolism blood, etc.) URAMOTO, Masataro (Jikei University, TOKYO).
2. "Investigations on the Circulatory Function" (as affected by aviation). SHUNICHI, Mashimo (Kyoto University).
3. "Investigations on Respiratory Function" SHOJI, Rinnosuke (Kyoto University).
4. "Investigations on Auditory and Equilibrium Function", Teiji, HOSHINO (Kyoto University). (To find changes in acoustic and balancing organs in flying.)
5. "Investigations on Visual Organs or Function", SHOJI, Yoshiharu (Tokyo University). (Organic or functional changes in vision during

ENCLOSURE (D), continued

flight.)

6. "Investigations on Central Nervous System and on the Mental and Psychological Aspects", NASU, Shozaburo (Tohoku University). (Pathologically and functionally.)
7. "Investigations on Fitness, Tolerance, Fatigue, etc. of Aviation", KATSUNUMA, Seiji (Nagoya University). (A list of projects in these fields, without statement of results.)

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On the Influence of Centrifugal Acceleration Upon the Intermediate Carbohydrate Metabolism

MIURA, Minoru (Tohoku University). Reprint from the "Tohoku Journal of Experimental Medicine", Vol. 42, No. 2, Mar. 20, 1942. In German.

The Influence of Centrifugal Acceleration Upon the Circulating Blood Volume

YAMAGUCHI, Tadashi, (Tohoku University). "Flight Medicine" Vol. 1, 1944, pp. 62-67.

The Action of the Vegetable Nervous System on the Change in Blood Sugar and Lactic Acid in Reduced Atmospheric Pressure

OTOMO, Sosuke (Tohoku University). "Flight Medicine" Vol. 1, No. 2, 1944, pp. 189-201.

The Effect of Monosaccharides on the Change in Blood Sugar and Lactic Acid in Reduced Atmospheric Pressure

OTOMO, Sosuke (Tohoku University). "Flight Medicine" Vol. 1, No. 2, 1944, pp. 172-186.

On the Change of Metabolism in the Muscle at Rest and During Muscular Exercise in Deficient Oxygen Tension

ENDO, Kiyoshi (Tohoku University). Reprinted from "Tohoku Journal of Experimental Medicine" Vol. 47, Nos. 3-4, Aug. 25, 1944, pp. 195-221.

On The Metabolism of the Carbon-Rest in the Liver and the Liver and the Influence on it of Inhaling Pure Oxygen or Air with Deficient Oxygen or Excess of Carbon Dioxide

AKAZAWA, Hirotake (Tohoku University). Reprinted from "Tohoku Journal of Experimental Medicine" Vol. 42, Nos. 3-4, April 25, 1942, pp. 231-257.

On the Change of Metabolism in the Muscle at Rest and During Muscular Exercise Under CO_2 Respiration.

ENDO, Kiyoshi. Reprinted from "Tohoku Journal of Experimental Medicine" Vol. 47, Nos. 3-4, Aug. 25, 1944, pp. 223-235.

Studies on the Intermediate Metabolism of Protein and Carbohydrate in the Lung Under Various Conditions

ENDO, Shinichiro (Tohoku University). "Tohoku Journal of Experimental Medicine" Vol. 40, Nos. 5-6, Sept. 1941, pp. 542-561. (Report 1 contains observations under normal conditions and during the inhalation of air with deficient oxygen or excessive CO_2.)

ENCLOSURE (D), continued

* * *

"Aviation Medicine" Vol. 1, No. 1, Oct. 15, 1943, Japan Aviation Medicine Society.

Organization of the Japanese Army Air Force Medical and Research Service

Army Air Hq. Med. Dept. Oct. 11, 1945, T/C in Japanese for General GROVE.

Reference on the Prevention of Frostbite

Army Med. Group Sept. 1944, pp. 113, printed.

Study in Peripheral Vision

Col. YAMAGATA, Army Medical College n/d 2 pp. handwritten App. 14.

Plan for Measurement of Aviation Fatigue by Color Perception Fatigue

Col. YAMAGATA, Army Medical College n/d 5pp. mimeo App. 14.

Report on the Mechanism and Performance of the Human Centrifuge at TACHIKAWA Army Air Base

Major TAKAHASHI n/d 8 pp. written App. 18.

Report on Pilot Fatigue in Japanese Army Air Forces

Col. YAMAMOTO, Asst. Air Surg. Oct. 5, 1945, pp. 23 App. 11.

Research on Seasickness Prevention

Army Medical School, Ear, Nose and Throat Section, Major YAMAZAKI n/d pt. 1, pp. 41 App. 7.

Training to Achieve Resistance of Semicircular Canal to Flight Conditions

Major SEIDA, Army Medical Corps pp. 14 Mimeo.

Research on Seasickness Prevention

Army Medical School, Ear, Nose and Throat Section, Major YAMAZAKI n/d pt. 2, pp. 36 App. 7.

Eye, Ear, Nose and Throat Medicine in Aviation

Compiled by U.S. War Dept. Washington 1940 Brigadier General Adams.

ENCLOSURE (E)

REPORTS AND DOCUMENTS COLLECTED BY ATIG, ADVON, FEAF

Report on the Far East of ATIG, ADVON, FEAF, Section III "Material," Subsection Ald, "Miscellaneous Equipment", covering the following categories of personal equipment:

Aids to Vision.
Body Armor.
Casualty Care.
Clothing.
Communication Equipment.
Ditching Equipment.
Food in Flight.
"G" Equipment.
Harnesses to Belts.
Luggage.
Oxygen Equipment.
Parachutes.
Sanitation Facilities.
Seating Comfort.
Survival Equipment: Component items of kits.
Survival Equipment: Land.
Survival Equipment: Water.

Medical Organizations

1. Air Surgeons Office, Organization, names of officers, duties. Japanese, translated, one copy.
2. Aviation Physical Examination Unit. Organization, names of officers, duties. Japanese, translated, one copy.
3. Aero-Medical Research Group, TACHIKAWA, names of officers, research duties. Japanese, translated, one copy.
4. Organization of the Japanese Army Air Force Medical Service and Research Service. Submitted by Gen. ABE, Air Surgeon. One copy, Japanese, not translated. Microfilmed as Appendix 20 of ATIG, Report #36.

AIR MEDICAL SERVICE

1. Hospitalization report. Policy on hospital construction. Number of beds required. Utilization by all branches, special devices and examining units, convalescent and rehabilitation provisions, handling of crippled veterans. Submitted by Gen. ABE, Air Surgeon, Japanese, untranslated, one copy.
2. Aero-Medical Division, Naval First Air Technical Arsenal, YOKOSUKA, (Research Subdivision). Organization, names of officers and civilians, research duties. Japanese, translated.
3. Organization chart of Naval Aeronautical Medical Service. (As of 1 May 1945. English, photo-reproduced, negative in ATIG photo laboratory.)
4. Organization of Medical Bureau, Navy Dept. Hqs., from interrogation notes, English.

Army Personnel Equipment

1. Goggle Data, mfrs., accompanying goggles. Japanese, not translated.
2. Experimental lenses, data accompanying. Japanese, not translated.
3. Parachutes, hardware, specifications. One copy, Japanese, not translated.

ENCLOSURE (E), continued

Navy Personnel Equipment

1. Manual, Electrically heated flying suit, accompanying equipment. Japanese, not translated.

Army Oxygen Equipment

1. Data accompanying chemical generator frames. Two copies, Japanese, not translated.
2. Handbook of instructions accompanying chemical generator frames, three-tube type. One copy, Japanese, not translated.
3. Drawing, demand oxygen system, German type, showing parts. One copy.

Army Research Reports

1. Relation between acceleration-resistance and breathing. One copy, Japanese, translated.
2. Fatigue. Japanese, untranslated. One copy.
3. Chart, Aero-Medical Research Group Area, buildings. Photo-copies, negative in ATIG, photo laboratory.
4. Study on the Treatment and Prevention of Frostbite. Army Medical College, TOKYO. Two copies. Japanese, not translated. Appendix #9, ATIG, Report #36.
5. Plan for Measurement of Aviation Fatigue by "Color Vision Fatigue", Col. YAMAGATA, Army Medical College, TOKYO. Two copies. Japanese, not translated. Microfilmed as Appendix #14 of ATIG Report #36.
6. Air Sickness. Parts I, II, and III. Army Medical College, TOKYO. One copy. Japanese, not translated. Microfilmed as Appendix #7 of ATIG Report #36.
7. Studies in Peripheral Vision. Col. YAMAGATA, Army Medical College, TOKYO. One copy. Japanese not translated. Microfilmed as Appendix #14 of ATIG Report #36.
8. Report on the Mechanism and Performance of the Human Centrifuge at TACHIKAWA. Major TAKAHASHI. One copy. Japanese, not translated. Appendix #18, microfilmed as ATIG Report #36.
9. On the Fatigue of Pilots. Summary by Col. KONO, 1943. One copy English. Army Medical School. ATIG Report #36.
10. Research Concerning the Prevention of Sea and Air-sickness. Col. TODA, Army Medical School, 15 Nov. 1945. One copy. English Summary.

Navy Research Reports

1. Aero-Embolism. Physico-Chemical Studies on Occurrence of Bubbles etc. 15 Jan. 1945. Preliminary report. YOKOSUKA. Submitted by MOTOBAYASHI. One copy. Japanese. Title and summary translated. Author: Yoshio KUSAMA, M.D., Prof. Preventive Medicine, Keio University.
2. As above Part I. July 1944. One copy. Japanese. Title and subject summary in English.
3. As above. Part II. Same author. One copy. Japanese. Title and subject summary in English.
4. As above, Part III. Same author. Two copies. Japanese. Title and subject summary in English.
5. As above, Part V. Same author. One copy. Japanese. Title and subject summary in English.
6. Fatigue. Relation to Rest. Submitted by MOTOBAYASHI, one copy. Japanese. Titles and subject summary in English.

ENCLOSURE (E), continued

7. Vibration, Effects on the Human Body. Mashimitsu OSHIMA, Lt. Comdr. Aero-Medical Laboratory, YOKOSUKA. One copy. Japanese. Title and subject summary in English.
8. Method of Determining Small Amounts of Carbon Monoxide in the Blood. YOKOSUKA. One copy. Japanese, translated.
9. Lectures and References on the Study of Aero-Medicine. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
10. Sleep and the Method of Resting. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
11. Report of Tests on the Digestion of Food. YOKOSUKA. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
12. Air Corps Study of the Nose, Ear and Throat. (46th Meeting of the E.N.T. Dept.) Japanese, not translated.
13. Clothing, Food, and Medical Research for the Air Corps. YOKOSUKA. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
14. Introduction to Research on Sleep and Hypnotism. YOKOSUKA. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
15. Research on the Essence of Air Fatigue. Part I, YOKOSUKA. Submitted by MOTOBAYASHI. 1 copy. Japanese. Not translated.
16. As above. Part II.
17. Report of the Aero-Medical Division of the First Naval Air Technical Arsenal, YOKOSUKA. Submitted by MOTOBAYASHI. One copy. Japanese, not translated.
18. As above. No. 2.
19. As above. No. 3.
20. Study on the Practical Application of the Melanophore Hormone which Increases the Visual Power in Low Illuminations. Comdr. S. YAMAZAKI. 12 Nov. 1945. One copy. In English.
21. A Method for Obtaining a Preparation of the Melanophore Hormone of the Pituitary Gland. Shiro HIRANO and Takeo SATO. Sankyo Pharmaceutical Co., Laboratories, TOKYO. In English.

Training, Navy

1. Altitude Training Program for Snusui Pilots at YOKOSUKA. Submitted by Lt. Comdr. Mashimitsu OSHIMA (MC). One copy. Japanese, not literally translated.
2. Night Vision Training and Improvement. Comdr. Senri YAMAZAKI (MC). Yokosuka Aero-Medical Laboratory. One copy. Japanese, translated.
3. Method of Training for Increasing the Visual Power in Loco-illumination Executed in Japanese Navy. Surgeon Comdr. Senri YAMAZAKI. One copy. English.

Food, Drugs, Medical Supplies

1. Special Rations for Japanese Naval Air Force, Air Crews. Outline. One copy. Japanese, not translated.

Medical Reports

1. Wound Survey, Japanese Navy Air Casualties, 1941-1942. Article in Zeitschrift. d. Jap. Chir. Gesellschaft, 43 Jahrg. No. 7. 1 Oct. 1942. One copy. Japanese, not translated.
2. Set of 21 Charts, Wound Survey of Naval Personnel, 1941-1943, all causes, including air arm. Submitted by Masao KIMURA, Captain, Section 2, Naval Medical Bureau. Japanese, partly translated.
3. Report on Pilot Fatigue in the Japanese Army Air Forces. Col. YAMAMOTO, Ass't. Air Surgeon. One copy. Japanese, not translated. Microfilmed as Appendix 11, ATIG Report #36.

ENCLOSURE (E), continued

Diagrams, Charts, Photos, Sketches, Etc.

1. Diagram of Human Centrifuge at Army Medical School, TOKYO.
2. Diagrams of Animal Centrifuge at SENDAI.
3. Photos of Sendai Centrifuge.
4. 22 Photos of Tachikawa Human Centrifuge.
5. Five Photos of Refrigerated Low Pressure Chamber at TACHIKAWA.

Medical Textbooks and Journals

1. Eye, Ear, Nose and Throat in Aviation. Army Medical College, TOKYO. One copy. Japanese, not translated.
2. Introduction to Aero-Medicine. Ruff and Stronghold. One copy. Japanese, not translated.
3. Japanese "Air Force Medical Journal". Japanese, not translated.

   Vol. 1, No. 1, Oct. 15, 1943, one copy.
   Vol. 1, No. 2, Feb. 11, 1944, one copy.
   Vol. 1, No. 3-4, Dec. 29, 1944, two copies.
   Vol. 1, No. 1-2, April 9, 1944, two copies.

4. Zeitschrift der Japanischen Chirurgischen Gesellschaft. 43 Jahrgang. No. 7, 1 Oct. 1942. Article on Air Arm Casualties, Japanese Navy. Not translated.

University Research Reports

1. Studies on the Influence of Breathing Hydrogen and Carbon-Dioxide-Rich and Oxygen-Deficient Air on the Energy-Yield and Intermediate Carbohydrate Metabolism.

   I. Mitteilung. Influence on Lactic Acid Metabolism. Kongo Kodera.
   "Tohoku J. Exptl. Med." Vol. 23, No. 1 and 2, March, 1933. German. one copy.

2. As above. Part V. Influence on Lactic Acid Synthesis in "Meren" - Extirpated Animals. German. One copy. Ibid. Vol. 24 and 1 and 2, Sept. 1934.
3. As above. Part II. Influencing Gas-metabolism by Physical Work. German. One copy. Ibid. Vol. 23, No. 3 and 4, May 1934.
4. As above. Part IV. Influence on the Distribution of Lactic Acid between Plasma and Erythiocytes. Ibid. Vol. 23, No. 5 and 6, July 1934.
5. Influence on Blood Protein Bodies and the Colloid-Osmotic Pressure of the Blood by Respiration of O_2 Deficient and CO_2-Rich Air. Part I. Investigation on normal dogs. Fusao KASUGAI. German. One copy. "Tohoku J. Exptl. Med." Vol. 27, No. 5, Nov. 1935.
6. As above. Part II. Investigation on Dogs with Liver Damage. Ibid. No. 6, Dec. 1935.
7. On the Intermediate Carbohydate Metabolism with Oxygen-Lack in the Conditions of Acidosis and Alkalosis. German. One copy. Tetsusaburo ISHIKAWA. Ibid. Vol. 36. No. 4-5, Sept. 1939.
8. On the Alternating Blood Gases under Oxygen-Lack in Conditions of Acidosis and Alkalosis. German. One copy. Ibid. Same date.
9. On the Alterations of Blood Protein and Colloid-Osmotic Pressure in Oxygen-Lack under Acidosis and Alkalosis. German. One copy. Ibid. Same date.

ENCLOSURE (E), continued

10. On the Alterations of Blood Protein and the Colloid-Osmotic Pressure upon Rapidly Successive Decreasing and Restoration of Air Pressure. Tetsusaburo ISHIKAWA. German. Two copies. Ibid. Vol. 36, No. 6, Oct. 1939.

11. The Influence of Intravenous Injection of Oxygen of Gas-Metabolism and Intermediate Carbohydrate Metabolism with Respiration of O_2 Deficient and CO_2-Rich Air. Same author. German. One copy. Ibid. Vol. 36, No. 6, Oct. 1939.

Reprints From Journals

1. Ueber den Einfluss der Fliegkraft auf den Intermediaren Kohlenhydratsstoffwechsel. Monoru MIURA. Inst. Luftfahrtmedizin, Tohoku Reichsuniversitaet zur SENDAI. One copy. "Tohoku J. Exptl. Med." Vol. 42, No. 2, 1942.
2. The Effect of Centrifugal Acceleration upon the Circulating Blood Volume. One copy. Japanese, not translated.
3. The Action of the Vegetable Nervous System on the Change in Blood, Sugar and Lactic Acid in Reduced Atmospheric Pressure. One copy. Japanese, not translated.
4. The Effect of Monosaccharides on the Change in Blood Sugar and Lactic Acid in Reduced Atmospheric Pressure. One copy. Japanese, not translated.
5. On the Change of the Metabolism of the Resting Muscle and during Work under Lack of Oxygen. Kiyoshi ENDO. Luftfahrtmedizinischen Institut Reichsuniverstaet zu SENDAI. Vol. 47, Nos. 3-4, 1944. German, not translated. "Tohoku Exptl. Med." One copy.
6. On the Deposit of Carbon Residual Substance in the Liver and the Influence on it by Respiration of Pure Oxygen as well as O_2-deficient and CO_2-Rich Air. Hirotake OKAZAWA, Medizinische Klinik von Prof. T. KATO and the Luftfahrtmedizinischen Institute. Tohoku Reichsuniversitat zu SENDAI. Tohoku J. Exptl. Med. Vol. 42, 3, 4, 1942. Two copies. German, not translated.
7. On the Alteration of the Metabolism of Muscle at Rest and during Exercise with Respiration of CO_2. Kiyoshi ENDO. One copy. German, not translated. Luftfahrtmedizinischen Institute, Reichsuniversitaet zu SENDAI. "Tohoku J. Exptl. Med." Vol. 47, No. 3-4, 1944.
8. Studies on the Intermediate Protein and Carbohydrate Metabolism in the Lungs under Different Conditions.

   I. Mitteilung: Determinations under Normal Conditions and with the Respiration of CO_2-Rich as well as O_2-Deficient Air. Two copies. German. Shin-ichiro ENDO. Not translated. Medizinischen Klinik von Prof. T. KATO, Tohoku Reichsuniversitaet zu SENDAI. "Tohoku J. Exptl. Med." Vol. 40, No. 5-6, 1941.
9. Studies on Miscellaneous Aviation Medicine. Report of the X Section National Research Council. English. Outline of studies submitted in accordance with SCAP General Order #1 to GHQ.
10. Early Discovering of Fatigue and Considerations of its Degree. Seizo KATSUNUMA. Nagoya Imperial University, 1942-1943.
11. Pharmacological Researches in Aviation. Takeo MAZAKI. Hokkaido Imperial University, 1944.
12. Biochemical Researches in Aviation. Hideo MABUCHI. Osaka Imperial University. Mar. 1943-April 1945.
13. Studies on the Influence of Acceleration on Changes in the Composition of Blood. Toyojiro KATO. Tohoku Imperial University,

ENCLOSURE (E), continued

SENDAI. No date.

14. Electro-Physiological Studies on the Function of the Central Nervous System. Shimane SAKAMOTO. Tokyo Imperial University. No date.

15. Thyrathron Type Electro-Cardiograph. No date. No issuing authority. Diagram and photograph of electro-cardiogram.

ENCLOSURE (F)

LIST OF DOCUMENTS FORWARDED TO WDC THROUGH ATIS

NAVTECHJAP DOCUMENT NO.	ATIS NO.	TITLE
ND21-7525	3130	Hygiene in Cold Districts
ND21-7514.1	3122	"Krapelin-test" Chart for the Selection of Japanese Aviation Personnel.
ND21-7514-2	3122	Aeronautical Intelligence Test Book.

ENCLOSURE (G)

LIST OF EQUIPMENT FORWARDED TO NMRI BETHESDA, MD.

JE21-7505	Flight Fatigue Pills. Flight Pills.
JE21-7508	Pressurized Flying Mask.
JE21-7519	Electrically Heated Flying Helmet. Sponge Rubber Belly-Band for Pilots. Pilots Boots. Fur-Lined Flying Cap. Electrically Heated Flying Goggles. Green-Tinted Flying Goggles. Light Protective Suit (shoes).
JE21-7523	Electrically Heated Flying Suit.
JE21-7525	Vision Pills for Pilots. Vision Pills. Improved Seasickness Pills. Seasickness Pills.