

Aerospace Medicine

Abstracts of Current Literature

Prepared under the Direction of ARNOLD J. JACOBUS, Ph.D.

For the reader's convenience, papers are classified by their principal contents into thirteen broad categories. Readers are advised to consult all related categories for full coverage of their field.

History and General Aspects

I

Recent Developments in Aviation Medicine.

J. HORAK [Abstract].—*South African Med. Jour.* (Cape Town), 34 (28):582. July 9, 1960.

A summary is given of a paper presented at the Staff Scientific Meeting of the South African Institute for Medical Research, held at Johannesburg, on March 8, 1960. The paper dealt with three important factors affecting space flight: (1) the physical environment of space; (2) speed of space vehicles in relation to linear, angular, and radial acceleration; and (3) distances space ships will travel over and away from the earth. The medical problems of space flight were discussed, including weightlessness, spatial disorientation, and the "break-off" phenomenon, and devices to preserve the normal physiological environment were outlined.

2

The Practice of Medicine in the Navy. E. C.

KENNEY—*Military Med.*, 125 (1):12-14. Jan. 1960.

The complexity of modern therapeutic practices and the creation of new medical problems by advances in military technology have necessitated an emphasis in

From the Science and Technology Division, Library of Congress, Washington, D. C.—Eugene Marrow, Ph.D., Editor of Abstracts. Dr. Jacobus is senior editor of *Aerospace Medicine: An Annotated Bibliography* (formerly *Aviation Medicine*). Volume II (1953 literature), published by the Aerospace Medical Association is available from Bruce Publishing Company, 2642 University Avenue, Saint Paul 14, Minnesota. Volumes I and III can be purchased from the Office of Technical Information, U. S. Department of Commerce, Washington 25, D. C.

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the U. S. Naval Medical Department on specialized training, cooperation among medical specialties, and research. The operation of naval aircraft from the confined spaces of aircraft carriers has presented unique problems of ground and air crew protection against noise, vibration, heat, and blast, increased acceleration stresses resulting from catapult take-off and arrested landings of jet aircraft, and psychological problems of crew confinement. Among research projects conducted by the Navy are the testing of developmental aircraft and control systems by the simulation of complete missions on the human centrifuge, development of the full pressure suit to be used by Project Mercury astronauts, and testing of the Project Mercury manned space capsule.

3

Lunar Journey.—*Lancet* (London), 1960, v. 1 (7134):1117-1118. May 21, 1960.

The physiological problems of orbital and space flight are briefly reviewed, including: (1) the typical aviation stresses of acceleration, low barometric pressure, and temperature and humidity extremes, for which adequate measures of protection are available; (2) prolonged weightlessness, the "breakoff phenomenon," and primary cosmic radiation, about which little is known; and (3) problems of lunar flight which will require further development of existing techniques, such as increased acceleration stress, the mental strain of extended flight, the additional radiation hazard of the Van Allen belts, and the necessity for the provision of large quantities of food and oxygen.

4

Space Research in the Life Sciences: An Inventory of Related Programs, Resources, and Facilities.—U. S. Senate, 86th Congress,

2nd Session. *Report of the Senate Committee on Aeronautical and Space Sciences*, July 15, 1960. vii + 269 p.

This report was prepared to serve Congress, and members of the Senate Committee on Aeronautical and Space Sciences in particular, as a source of factual information about research conducted in the life sciences related to aeronautical and space programs. Such programs include the major aspects of aviation and space medicine; of aerospace biology; and of human factors research. The most significant life sciences programs in space-related areas presently conducted by various Government agencies are identified for the purpose of providing a factual basis to evaluate the adequacy of present and proposed efforts of coordinating and utilizing such programs.

5

First Army-Wide Aeromedical Symposium.

P. L. WIGGIN—*U. S. Army Aviation Digest*, 6 (8): 6-9, 22-31. Aug. 1960.

Extracts are presented from the proceedings of the first Army-wide Aeromedical Symposium, held at Pensacola, Florida, on June 8-9, 1960. The symposium was conducted to introduce army surgeons, hospital commanders, and staff aviators to the aeromedical factors in aircraft accidents. Papers were presented in the fields of personnel selection for flight training, physical standards for airmen, medical aspects of aircraft accident prevention, including the role of vertigo, disorientation, restricted vision, fatigue, and temporary incapacitation in the causation of accidents, aviation psychology, particularly motivation, and aviation crash injury research.

Biology

6

Agriculture in the Atomic Age. J. E. GUNCKEL.
—*SRJ Jour.*, 4 (3):106-112. 1960.

Among the problems of modern agriculture is the need for the development of methods for the supplying of food to space travelers. Two alternative solutions to the problem of the preservation of life in space are (1) development of methods to supply a manned space mission with oxygen, water, food, and controlled temperature to maintain earth plants and man in the normal earth environment; and (2) development of plants better suited to the peculiar conditions of space life. The former alternative may be accomplished by the use of a closed system (carbon cycle) in which plants, such as algae, and possibly small animals, such as the water flea, could be used as a food supply. For extended missions and for maintenance of space stations, psychological problems of diet monotony as well as agricultural difficulties may be avoided by the development of relatively free-living space plants through artificial synthesis of specialized life forms, "retrogressive evolution" breeding in which recessive

genes may have a survival potential in a new environmental situation, cross-breeding, and by artificial mutation.

7

Diurnal Rhythm in Plasma Corticosterone and Lack of Diurnal Rhythm in Plasma Compound F-Like Material in the Rat. J. L. MCCARTHY, R. C. CORLEY, and M. X. ZARROW.—*Proc. Soc. Exper. Biol. and Med.*, 104 (4):787-789. Aug.-Sept. 1960.

The concentration of corticosterone in the blood of rats was observed to vary as a function of time of day. Highest levels of corticosterone were found between 2 and 3 p.m. and between 9 and 10 p.m. There was no diurnal variation in the concentration of an unknown component of adrenal origin in the blood. The data supply additional evidence for the presence of a diurnal rhythm in the secretory activity of the adrenal cortex, and support the concept that corticosterone is the glucocorticoid of physiological significance in the rat. (Authors' summary, modified)

Physiology (General)

8

Effects of Breathing Carbon Dioxide Upon the Pulmonary Circulation. A. P. FISHMAN, H. W. FRITTS, and A. COURNAND.—*Circulation*, 22 (2):220-225. Aug. 1960.

The effects of the inhalation of five per cent carbon dioxide in air on pulmonary arterial blood pressure and blood flow were investigated in five normal subjects and in ten patients with chronic pulmonary emphysema. In normal subjects, with an average increase in arterial CO₂ pressure of six mm. Hg and a three-fold increase in minute ventilation, both pulmonary arterial blood pressure and blood flow remained unchanged. In emphysematous patients, with a similar increase in arterial CO₂ pressure and a two-fold increase in ventilation, a 14 per cent increase in cardiac output and a rise of four mm. Hg in pulmonary arterial mean pressure were observed. An appreciable increase in pulmonary blood flow was invariably associated with an increase in pulmonary blood pressure. The mechanisms responsible for the increase in pulmonary blood flow in emphysematous patients during CO₂ breathing are not apparent.

9

Ventilatory Mechanics and Strength: Long-Term Re-examinations and Position Change. A. W. BRODY, P. S. O'HALLORAN, H. J. WANDER, J. J. CONNOLLY, E. E. ROLEY, and E. KOBOLD.—*Jour. Applied Physiol.*, 15 (4):561-566. July 1960.

Pulmonary function tests were performed in normal subjects in the standing, seated, and supine positions and in normal subjects and poliomyelitis patients at

intervals during a period of 2-39 months. Significant changes were observed in normal subjects in tidal volume, expiratory reserve volume, inspiratory capacity, and in k_2 (turbulent factor in resistance) with position change. Tidal volume was increased nearly 20 per cent during the change from a sitting (or supine) to a standing position; expiratory reserve volume was decreased during the change from a supine to a standing position or from a standing to a seated to a supine position, and inspiratory capacity was increased 18 per cent during the change from a sitting to a supine position. No significant changes were observed in maximal flow, maximal pressure, elastance, total resistance, or vital capacity. Significant variations were observed with repetition of the tests at intervals of one week or nine months; no evidence was seen, however, for any systematic effect of training except for an average increase of 20 per cent in maximal pressures.

10

Effect of Food, Alcohol, and Hyoscine on Body-Temperature and Reflex Responses of Men Immersed in Cold Water. W. R. KEATINGE and M. EVANS.—*Lancet* (London), 1960, v. 2 (7143):176-178. July 23, 1960.

Administration of 75 ml. alcohol, a heavy meal, or hyoscine to men 45 minutes before immersion for 30 minutes in water at 15° C. had no significant effect on the rate of fall of rectal temperature during immersion. Finger blood flow fell rapidly to low levels in the water, but fell significantly less rapidly after alcohol. The occurrence of ventricular extrasystoles was increased after hyoscine or a heavy meal; no extrasystoles were observed after alcohol. Both metabolic rate and the increase in heart rate during immersion were reduced by alcohol or hyoscine. Alcohol greatly reduced discomfort and sensation of cold in the water.

11

On a Few Methods of Revival from Deep Hypothermia (O nekotorykh metodakh vyvedeniia iz glubokoi gipotermii) N. V. ALISH'EV [Abstract].—*Patologicheskaiia fiziologiia i eksperimental'naia terapiia* (Moskva), 3 (5):75. Sept.-Oct. 1959. In Russian.

Procedures for inducing deep hypothermia in cats and methods of subsequent revival are described. Cats anesthetized by an ether-oxygen mixture received atropine intramuscularly and were chilled with ice bags or by immersion to 11.8° C. rectal and 16° C. oral temperatures. Chilling was not interrupted when cardiac crisis set in (at 15° C. rectal and 19.4° C. oral temperature). Anesthesia was discontinued, and artificial respiration with O₂ was introduced at 26-22° C. body temperature. A total of 114 cats were used.

The following combination was found to achieve the best results of revival from deep hypothermia: artificial respiration with pure O₂; quick warming of the animal to 31-33° C. body temperature in water of 40-45° C., followed by more gradual warming; intra-arterial infusion of noradrenaline and saline, and heart massage through the rib cage. Complete recovery was obtained in at least a few animals after cardiac crisis of 30-92 min. duration. No survival was obtained after longer crises. Anodization of the head (anode at the occiput, intensity 10 mA., for a duration of 30 min.) during cardiac crisis and preadaptation of the animals to lowered barometric pressure significantly improved their chances of survival after deep hypothermia. An infrequent complication noted was mild edema.

12

Attempt to Demonstrate the Distribution Component of the Alveolar-Arterial Oxygen Pressure Difference. P. HAAB, J. PIPPER, and H. RAHN.—In: H. Rahn, *Studies in pulmonary physiology* . . ., p. 91-100. Univ. Buffalo School of Medicine, New York (Contract AF 33(616)-5606); issued by Wright Air Development Division. Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-1, April 1960. viii+153 p. (Project no. 7163, Task no. 71819). Unclassified

The role of the lung ventilation distribution (ventilation-perfusion ratio) in the production of the alveolar-arterial oxygen pressure difference (AaD) was investigated in dogs by measurement of the AaD during air breathing at normal ambient pressure and, at the same O₂ pressure of inspired air (but without the N₂ component), during pure oxygen breathing in a decompression chamber. No significant difference in AaD was observed between the two experimental conditions. It is suggested that ventilation distribution is not a significant factor in the alveolar-arterial oxygen pressure difference.

13

Uniformity of Ventilation Distribution in Man During Positive and Negative Pressure Breathing. P. HAAB and J. E. CIMINO.—In: H. Rahn, *Studies in pulmonary physiology* . . ., p. 28-35. Univ. Buffalo School of Medicine, New York (Contract AF 33(616)-5605); issued by Wright Air Development Division. Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-1, April 1960. viii+153 p. (Project no. 7163, Task no. 71819). Unclassified

Ventilation distribution at varying lung inflations was investigated in three subjects by nitrogen washouts during pure oxygen breathing at pressures from +25 to -25 cm. H₂O. The anatomical dead space

was observed to increase approximately 17 ml. with each liter increase in functional residual capacity. The slowly ventilated compartment of the lung was increased in volume with increasing applied pressures and functional residual capacities, and was decreased at negative pressures. The volume of the fast compartment was increased slightly at both negative and positive pressures. Between 50 and 150% of the total normal lung volume the alveolar dilution ratios of the two compartments were fairly constant. The increase in volume of the fast compartment during negative pressure breathing indicates that the fast compartment is composed of a changing number of alveoli rather than an anatomically defined area of the lung. The constancy of the alveolar dilution ratios in each compartment suggests the existence of a proportionality between changes in the volume of each compartment and changes in ventilation.

14

Positive Pressure Breathing and the Alveolar-Arterial O_2 Difference in Anesthetized Dogs. P. HAAB and J. PIPPER.—In: H. Rahn, *Studies in pulmonary physiology . . .*, p. 108-112. Univ. Buffalo School of Medicine, New York (Contract AF 33(616)-5606); issued by Wright Air Development Division, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-1, April 1960. viii + 153 p. (Project no. 7163, Task no. 71819). Unclassified

An investigation was conducted of the effect of positive pressure breathing on the alveolar-arterial oxygen pressure difference (AaD) and the mechanism of the large inter-subject variability in AaD observed in lying anesthetized dogs. Positive pressure breathing was observed to decrease the AaD and the inter-subject variability of measured AaD values. Similar results were obtained with the venous admixture eliminated by pure oxygen breathing. The large decrease in AaD in certain animals was produced by an increase in arterial oxygen pressure and was proportional to the initial level of AaD. It is suggested that the initially high AaD observed in certain dogs is produced by an increased lung venous shunt caused by spontaneous atelectasis.

15

Theoretical Middle Ear Gas Compositions After Flights Breathing Oxygen, Air Mix, Air and Combinations of These. G. MELVILL JONES.—RAF Inst. of Aviation Medicine (Gt. Brit.), Farnborough; issued by Flying Personnel Research Committee (Gt. Brit.). FPRC Memo 131, June 1960. 7 + iii p. Unclassified

A method is described of calculating approximate values of the final partial pressure of oxygen in the middle ear after descent to sea level; results are given

for the effects of breathing pure oxygen, air-mix, air, or combinations of these, on single and double ascent/descents for cabin altitudes of 25,000 and 30,000 feet. The calculated excess partial pressure of oxygen introduced using an actual air-mix regulator during descent from 25,000 feet to sea level is 40% of that observed when using pure oxygen all the way. If air is used instead of air-mix below 10,000 feet, the excess value is 56%, but this is outweighed by the necessity for reducing the change-over height to 4,000 feet at night when breathing air, where the corresponding value is 85%. Although employment of air-mix throughout flight should be aimed at, a good compromise is obtained by breathing pure oxygen above and air-mix below 16,000 feet. This reduces the calculated excess oxygen in the middle ear after flight to approximately half that introduced by breathing pure oxygen all the way. With changeover altitude lowered to 10,000 feet, worthwhile gain is still obtained.

16

Possible Errors Using the Esophageal Balloon in the Determination of Pressure-Volume Characteristics of the Lung and Thoracic Cage in Various Postures. J. H. KNOWLES, S. K. HONG, and H. RAHN.—In: H. Rahn, *Studies in pulmonary physiology . . .*, p. 10-16. Univ. Buffalo School of Medicine, New York (Contract AF 33(616)-5606); issued by Wright Air Development Division, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-1, April 1960. viii + 153 p. (Project no. 7163, Task no. 71819). Unclassified

The simultaneous pressure-volume relationships of the lung, thoracic cage, and total respiratory apparatus in various postures was determined by the esophageal balloon technique to assess the magnitude of the compression artifact observed with this technique in the supine position at various lung volumes, and to describe the interrelationships of the elastic forces in the chest for the entire range of lung volumes. At lung volumes above 50 per cent of the vital capacity, the slope of the three lung pressure-volume curves (supine, prone, and sitting positions) was essentially identical. Below 50 per cent of the vital capacity, the prone and sitting curves remained parallel, while the supine curve was shifted in the direction of decreased pressure (reduction in compliance). A large discrepancy in thoracic cage pressure at small lung volumes was observed for all postures. It is concluded that the effect of posture on the lung pressure-volume curve is negligible and that the difference recorded in the supine position is due to a compression of the esophagus by the mediastinal content, particularly the heart.

17

Cardiovascular Adjustments in Dogs During Continuous Pressure Breathing.

C. LENFANT and B. HOWELL.—In: H. Rahn, *Studies in pulmonary physiology* . . . , p. 22-27. Univ. of Buffalo School of Medicine, New York (Contract AF 33(616)-5606); issued by Wright Air Development Division, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-1, April 1960. viii + 153 p. (Project no. 7163, Task no. 71819). Unclassified

Simultaneous measurements of pulmonary and systemic vascular pressures, intrapleural pressures, and cardiac output were made in dogs exposed to positive and negative intrapulmonary pressures of +25 to -25 cm. H₂O. Changes in the pressures of the vena cava, pulmonary artery, and pulmonary vein were observed to parallel changes in intrapleural pressures. The changes were equal to approximately one-half the pressures applied to the intrapulmonary space. Systemic (aorta) pressures and cardiac output were relatively stable at negative pressures but fell at positive pressures. Calculated resistances of the systemic and pulmonary air circulation were markedly increased only during positive pressure breathing. Applied pressure in the lung is well distributed over all vessels within the thorax, and the normal pressure differential between the vessels is not disturbed. The increased resistance of the greater circulation in positive pressure breathing is attributed to a vasomotor change, the increase in pulmonary circulatory resistance to the passive stretch of the vessels by the application of pressure and by a reduction in blood volume.

Physiology of Stresses

18

Effects of Acute Hypoxia and Exercise on the Pulmonary Circulation.

A. P. FISHMAN, H. W. FRITTS, and A. COURNAND.—*Circulation*, 22 (2):204-215. Aug. 1960.

The effects of acute hypoxia (12-14 per cent O₂), graded exercise, or both, on the pulmonary circulation were studied in 17 normal subjects and in three patients with restricted vascular beds. Both hypoxia and exercise produced increases in minute ventilation, oxygen uptake, respiratory exchange ratio and cardiac output. Systemic blood pressure was increased during exercise, but showed no consistent change during hypoxia. Despite larger blood flow, exercise was associated with lower pulmonary artery pressures than was hypoxia. During exercise, with an increase in cardiac output of 25 per cent, there was a gradual rise in pulmonary artery pressure of three mm. Hg to a stable plateau, while in hypoxia, with an increase

in cardiac output of five per cent, an abrupt increase of four mm. Hg was observed. In patients with restricted vascular beds, equal increments in blood flow in either hypoxia or exercise elicited linear and equivalent increments in pulmonary artery pressure. In one subject, surgical resection of the preganglionic fibers and ganglia supplying the sympathetic efferent nerves to the pulmonary vascular tree was without effect on the responses of the pulmonary circulation to acute hypoxia and to exercise. The mechanism and site of action of acute hypoxia on the pulmonary circulation remain unidentified.

19

The Effect of Acclimatization to Cold on the Action of Drugs in the Rat.

HERBERT A. BRAUN and L. M. LUSKY.—*Toxicol. and Applied Pharmacol.*, 2 (4):458-463. July 1960.

Pentylentetrazol and sodium amobarbital were less toxic to rats exposed to cold (4° C.) for twenty-four hours than to rats kept at room temperature (24° C.). The median convulsive dose of pentylentetrazol and the median hypnotic dose of sodium amobarbital in rats exposed to cold temperatures for five to six weeks did not differ significantly from those determined at room temperature, and paralleled acclimatization of the rat to its environment. Both drugs were more toxic to clipped acclimatized rats than to unclipped acclimatized animals.

20

Effects of Acute Hypoxia on the Volume of Blood in the Thorax.

H. W. FRITTS, J. E. ODELL, P. HARRIS, E. W. BRAUNWALD, and A. P. FISHMAN.—*Circulation*, 22 (2):216-219. Aug. 1960.

The effect of hypoxia (12-14 per cent O₂) on the volume of blood in the thorax was estimated by the Stewart-Hamilton dye-dilution technique, and by measurement on a balanced teeter-board of changes in the relative weights of the two ends of the body. No appreciable alteration in blood volume was observed by either method.

21

Some Clinical Aspects of Life at High Altitudes.

A. HURTADO.—*Ann. Int. Med.*, 53 (2):247-258. Aug. 1960.

A discussion of functional and organic changes in subjects acclimatized for long periods to high altitude is presented from observations made chiefly in the Peruvian Andes at an altitude of 14,900 feet. Alterations observed in healthy people living permanently at high altitude include electrocardiographic indications of tight ventricular hypertrophy and moderate pulmonary hypertension associated with low peripheral blood pressure, normal cardiac output, and increased lung blood volume. Of interest is the syndrome associated with loss of tolerance to the low-pressure

environment, or "chronic mountain sickness." The varied symptoms indicating a loss of acclimatization include a considerable increase in circulating blood volume due to an elevated cell component, a decrease in plasma volume, erythropoietic hyperactivity, marked right heart hypertrophy, elevated cardiac output, accentuated pulmonary hypertension and low peripheral blood pressure, increased blood hypoxia, absence of the hyperventilation observed in normal acclimatized subjects, and decreased sensitivity of the respiratory center to CO₂ stimulation. Other clinical observations of altitude-acclimatized subjects include the occasional occurrence of acute pulmonary edema in residents returning to high altitude after living at sea level for several days, an extremely low incidence of hypertension and symptoms of cardiovascular sclerosis, and a higher incidence of patent ductus arteriosus, peptic ulcer, and liver disease.

22

The Effects of Subcutaneous Fat and of Previous Exposure to Cold on the Body Temperature, Peripheral Blood Flow and Metabolic Rate of Men in Cold Water. W. R. KEATINGE.—*Jour. Physiol.* (London), 153 (1):166-178. Aug. 1960.

The fall in rectal temperature of ten young men immersed motionless for 30 minutes in stirred water at 15°C. varied little in successive immersions and was closely related to the man's subcutaneous fat thickness. The falls bore relatively little relation to finger blood flow, which was always low during immersions, but both were slightly greater when the men were hot rather than cool at the time of immersion. Metabolic rates during immersion were substantially lowered by a small increase in body temperature at the time of immersion, and increased by exposure to cold air, though not by moderate exercise several hours before immersion. In the first 10 minutes of immersion the metabolic rates of thin men were slightly higher than those of fat men, with a number of substantial and consistent individual differences not related to fat thickness or fall in rectal temperature. In the last 20 minutes of immersion the metabolic rates of thin men increased but those of fat men did not. (Author's summary, modified.)

23

Hormonal Determinants of Mammalian Tolerance to Acceleration Stress. B. D. POLIS.—Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa. Report no. NADC-MA-6025, Aug. 12, 1960. ii+13 p. (Task no. MR005.15-0002.7, Report no. 2). Unclassified

The pituitary-adrenal hormonal axis has been implicated as a critical factor in the survival of the rat to acceleration stress. The physiologic end-point for

the tolerance of animals to high positive acceleration stress was obtained by determining the time to reduce the heart rate from eight to two beats per second at 20 g. With this technique, a significant increase (300 per cent) in the survival time of rats to 20 g was found following hypophysectomy. A significant loss (60 per cent) of tolerance to high acceleration stress was found in adrenalectomized rats. The procedures of hypophysectomy and adrenalectomy essentially cancelled the effect of each operation alone in the rat to yield an animal approximately similar to the normal rat in its ability to tolerate acceleration. Possible mechanisms for these effects are offered. (Author's abstract.)

24

Exercise in a Weightless Environment. P. POTTS and J. I. BOWRING.—*Physical Therapy Rev.*, 40 (8):584-587. Aug. 1960.

A chair was designed to provide restraint for working, exercising, and eating in a weightless environment. The chair is constructed of adjustable nylon mesh and is equipped with mesh supports for the chest, arms, and femurs. Opportunity for exercise is provided by reels attached to the arms and arm rests which can be adjusted to exert a desired amount of resistance, and by a spring attachment on the foot board.

25

Effects of High Altitude on Cholesterol-Fed Rabbits: Production of Severe Pulmonary Atherosclerosis with Calcification. P. D. ALTLAND and B. HIGHMAN.—*A.M.A. Arch. Pathol.*, 70 (3):349-357. Sept. 1960.

Rabbits fed a cholesterol diet were exposed 23 hours daily to 16,000 ft. simulated altitude for a maximum of 17 weeks. The distribution and severity of atherosclerotic lesions were compared with the lesions of cholesterol-fed rabbits maintained at ground level. The rabbits exposed to high altitude showed much more severe atherosclerotic lesions in the pulmonary vessels than the ground-level controls, but the lesions in the descending and abdominal aorta were milder. In addition, the altitude group showed a much higher incidence of marked calcium deposition in atherosclerotic lesions involving both the aorta and pulmonary vessels. This higher incidence of calcification in altitude rabbits, and, perhaps, the greater severity of the pulmonary lesions, are attributable, at least in part, to hypoxia. Serum cholesterol values of the cholesterol-fed rabbits exposed to altitude increased more than those of the ground-level controls. The serum cholesterol values of the rabbits fed a stock diet were not altered by exposure to altitude. Cholesterol-fed rabbits maintained at ground level developed a persistent anemia after four weeks. Both the rabbits fed the

cholesterol diet and those fed a stock diet developed the same degree of polycythemia during the first eight weeks of the altitude exposure, and then the hematocrit values of the cholesterol-fed rabbits declined by about 20 per cent, though still above normal. (Authors' summary, modified.)

26

The Effects of Shock and Vibration on Man.

D. E. GOLDMAN and H. E. VON GIERKE.—Naval Medical Research Inst., Bethesda, Md. Lecture and Review Series no. 60-3, Jan. 8, 1960. 48 p.

Unclassified

A review is presented of the following items: (1) determination of the structure and properties of the human body considered as a mechanical as well as a biological system; (2) effects of shock and vibration forces on this system; and (3) protection required by the system under various exposure conditions and means by which such protection is provided. The methodological and instrumentation problems and criteria of the measurement of the effects of shock and vibration on the human body are discussed. Consideration is given to the evaluation of data obtained from simulations of the mechanical environment, and to factors in the design of human simulations. The physical characteristics of the body tissues are described, and data concerning the passive mechanical responses of the human body and tissues exposed to impact forces and to infrasonic, sonic, and ultrasonic vibration applied in various directions are summarized. The mechanical, physiological, and psychological effects of mechanical vibration, the effects of blast and shock waves on the lungs, gastro-intestinal tract, heart, and the ear, and the effects of impact or rapid deceleration in the longitudinal and transverse direction on the head and on the neck are described. Protective measures accomplished by isolation, to reduce the transmission of forces to the body, or by an increase in mechanical resistance to force are discussed, including elastic cushioning by seat suspension, and use of body harnesses, helmets, and shelters. Experimental data are presented concerning the levels of tolerance to vibration and rapid deceleration, vibration levels produced by vehicles, and typical crash impact forces.

27

Time Study of Acute Cold-Induced Acceleration of Thyroidal I^{131} Release in the Hamster.

K. M. KNIGGE.—*Proc. Soc. Exptl. Biol. and Med.*, 104 (3):368-371. July 1960.

Analysis of time sequence in pituitary and thyroid phenomena involved during acute response of hamsters to cold exposure (5-6°C.) indicates a rapidly activated neural component. Within 0.5-1 hour after cold, sensory perception of this temperature change generated sufficient input into hypothalamic effector mech-

anisms to deplete pituitary thyrotropin by 60%. After a latent period of 1.5 hours, accelerated release begins and results in 25-30% decrease of thyroidal I^{131} during 12 hours of cold. Thyroxine (10 micrograms) is capable of inhibiting thyroidal I^{131} release when administered as long as 2-3 hours after exposure to cold. (Author's summary)

28

The Significance of the Inhibition of the Central Nervous System in Anoxia (Znachenie tormozhennia tsentral'noi nervnoi sistemy pri kislorodnom golodanii.) V. A. KONSTANTINOV.—*Patologicheskaya fiziologiya i eksperimental'naya terapiya* (Moskva), 4 (2):58-62. March-April 1960. In Russian, with English summary (p. 62).

Hypoxia was induced in white mice by placing them in hermetically sealed boxes of 100 cubic centimeter volume. It had been established in control experiments that if animals were removed from the container 20-40 seconds before the appearance of terminal breaths, respiration was resumed and the animal survived. The threshold survival time for mice in these hermetic containers averaged between 12-13 min., as established by the above method. It was shown that repeated exposure to hypoxia in the container prolongs the survival time, which is explained on basis of developing inhibition of the central nervous system during hypoxia. Repetition (10 times) of hypoxic exposures while there is still sufficiently intensive trace inhibition present, leads, as a result of summation, to more profound inhibition of the central nervous system. The threshold survival time of the experimental mice after repeated exposures exceeded their initial threshold values eight to nine times. (From the author's summary)

Neuro- and Sensory Physiology

29

Changes in the Functions of the Skin Analysor in Sailors in the Arctic (Ob izmeneniiakh funktsii kozhnogo analizatora u matrosov na Severe). N. I. BOBROV.—*Voennno-meditsinskii zhurnal* (Moskva), 1960 (1):71-74. Jan. 1960. In Russian. English translation in: *Military Medical Journal*, 1:114-118. New York: U. S. Joint Pub. Research Serv., No. 1374-N/26, May 31, 1960. (Available at Office of Technical Services, U. S. Dept. Commerce)

The chilling of parts of body of unacclimatized personnel in the arctic raised the threshold for cutaneous sensation of touch and lengthened the sensory chronaxy. These changes decreased as acclimatization progressed. In sailors with a prolonged term of service in the Arctic they disappeared completely. This lack of response to cold in acclimatized sailors is associated partly with an increase in the heat

metabolism. Furthermore the high work capacity of acclimatized personnel at low outside temperatures is apparently dependent not only on the high metabolic level but also on a lack of disturbances in the cutaneous analyzer function.

30

Spectral Sensitivity of the Eye Based on Visual Acuity. JOHN L. BROWN, L. PHARES and D. E. FLETCHER.—Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa. Report no. NADC-MA-6006, April 26, 1960. iii+28 p. (Task no. MR 005.13-6002.1, Report no. 12). Unclassified

Threshold relative energy measurements were made with monochromatic light at 10-millimicron intervals between 400 and 710 millimicrons for threshold criteria which represent a series of visual acuities in addition to light detection. The data can be approximated by summing cone and rod sensitivities derived from earlier independent measurements of light detection by the dark-adapted eye in the fovea and the periphery. The relation between the logarithm of threshold energy and visual acuity required by the criterion of threshold was predicted from monochromatic energy data for several broad spectral distributions of illumination. Predictions are compared with empirical data. (Authors' abstract)

31

Visual Pattern Identification as a Function of Fill and Distortion. W. A. HILLIX.—*Jour. Exper. Psychol.*, 59 (3):192-197. March 1960.

Subjects were required to choose from three presentations with an element distortion of 10 to 40 per cent, an alternative which most closely resembled a standard 10x10 grid which was 10 to 50 per cent filled. Changes in fill and distortion and their interaction were found to have significant effects on the time to response and on the number of correct responses. An "index of relative similarity" developed to predict problem difficulty showed a close relation to the number of correct responses and the time to respond.

32

Abilities at Different Stages of Practice in Rotary Pursuit Performance. E. A. FLEISHMAN.—*Jour. Exper. Psychol.*, 60 (3):162-171. Sept. 1960.

Extended practice was given to 224 subjects on the Rotary Pursuit apparatus. These same subjects also received a battery of 17 reference ability measures. The intercorrelations were obtained among scores at eight stages of proficiency on the practice task together with the scores on the reference measures and

these were subjected to factor analysis study. A total of 10 factors was extracted. The Control Precision factor, defined as the ability to make highly controlled, precise muscular adjustment, was found to be the main common factor which contributed to individual differences in rotary pursuit performance, both at early and late stages of practice. The Rate Control factor contributed slightly to differences in early proficiency. Of the two factors, which could not be identified from the reference battery, one increased while the other decreased as practice continued. The first is thought to reflect individual differences in task-acquired habits and skills. The decreasing factor may reflect "learning sets" which facilitate early learning, but decrease with experience. (Author's summary, modified)

33

The Empty Visual Field in the Laboratory and in the Air. J. W. MILLER.—*Naval Research Rev.* (Washington), 1960 (July): 1-6. July 1960.

The characteristics of the Ganzfeld (an illuminated field containing no visible objects) were studied in laboratory experiments and in an experiment in which the visibility of aircraft was determined in the air, with and without artificial contrails (smoke streams). Under laboratory conditions the subjects experienced difficulties in locating targets in an empty visual field. Also, the targets would fade out or disappear when located. In general, as the size of the test object increased, the time needed to locate it decreased. The probability of locating the target in a given time interval decreased as the length of time spent searching increased. This coincided with subjective feelings of increased disorientation. In field investigations the use of artificial contrails increased the visibility range from 8 mi. to 20-24 mi. for F11F aircraft using other than a head-on approach. The smoke was of little value for a direct head-on course. In the latter case the plane was not sighted until it was at a distance of only $2\frac{1}{2}$ to 3 mi.

34

Speed and Accuracy of Matching Tactually Coded Related Pairs of Items. J. L. SEMINARA.—*Eng. and Indus. Psychol.*, 1 (4):128-133. Winter 1959.

The speed and accuracy of matching related pairs of simulated plugs and receptacles was determined under tactual coding conditions (raised letters on each element) with visual cues present or excluded. Performance under visual conditions was four times faster than under tactual conditions. Performance accuracy was 97% under tactual conditions, and 100% under visual conditions. It is concluded that tactual cuing provides a useful method of communication in certain matching operations.

35

On Size-Perception in the Absence of Cues for Distance. H. WALLACH and V. V. MCKENNA.—*Amer. Jour. Psychol.*, 73 (3):458-460. Sept. 1960.

Retinal image size as a cue for perception of size in absence of distance-cues was investigated with twenty-six observers. Each observer matched under dark-room conditions the size of a standard object with the distance-cues removed to a comparison object with the distance-cues provided. The method of limits was used. The results show that in the absence of distance-cues for the standard object only a minority of observers produced matches where the retinal images were equated. The majority was influenced by the size of the comparison-object, making large matches when the comparison-objects were small. The assumption that image-size in the absence of distance-cues has the power to determine size-perception directly is contradicted by the inconsistency of responses.

36

Perception of Linear Motion Following Unilateral Labyrinthectomy: Variation of Threshold According to the Orientation of the Head. E. G. WALSH.—*Jour. Physiol.* (London), 153 (2):350-357. Sept. 1960.

A suspended stretcher moved by compressed air was used to test human sensibility to linear acceleration. Unilaterally labyrinthectomized patients were required to ascertain direction in which motion occurred, and the least acceleration needed was measured. When the patient lay on his back, sensitivity to movement towards and away from the damaged side appeared to be the same. Sensitivity was consistently reduced when the patient lay with the damaged side downwards. These results indicate that the saccule partakes in the responses, and that it is responsive to a shearing force parallel to the main part of its macula. The direction of the gravitational bias is important in determining the effectiveness of a given shearing force. Greater sensitivity to horizontal motion results when the saccular otoliths hang than when they press on the macula.

Psychology

37

The Role of Error Density and Set in a Vigilance Task. H. C. ELLIS and A. E. AHR.—*Jour. Applied Psychol.*, 44 (3):205-209. June 1960.

This experiment was designed to determine the effects of signal density on frequency of correct and false detections, to study the types of errors detected, and to examine the effects of shifts in signal density on error detection in a proofreading situation. A total of 216 subjects proofread material of neutral

emotional content. Differential treatment of the groups consisted of six levels of error density for the first 10 pages, and then shifts to three levels of error density for the last five pages. The results show that error detection efficiency in a proofreading task is a curvilinear function of the density of errors in the manuscript, however, at high levels of error density the detection efficiency is reduced. False detections were not a function of error density, but were positively correlated with correct responses. Shifts in error density, after experience with a fixed level, produced no significant change in the percentage of errors detected. (Authors' summary, modified)

38

A Device and Tests for Measuring Intellectual Functions During Acceleration. I. MILLER, G. B. SIMON and E. COHEN.—Link Division of General Precision, Inc., Binghamton, N. Y. (Contract AF 33(616)-6467); issued by Wright Air Development Center, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-366, May 1960. v+43 p. (Project no. 7222, Task no. 71746). Unclassified

In manned space flights, a vehicle operator will be expected to perform control functions or act as a systems monitor under high levels of acceleration. To determine the extent to which man's intellectual functions might be impaired under high g, a device was designed for use with the human centrifuge. This device, the Link Intellectual Functions Tester (LIFT), can be operated up to 14 g, and features automatic scoring, tabulation of responses, and automatic pacing of stimulus presentation. Three test batteries of 14 one-minute tests were used to evaluate verbal, reasoning, mathematical, and perceptual abilities under the limitations of high g on the centrifuge. The median reliability of the one-minute tests was 0.27; the estimated reliability of the 14-test battery was 0.83. Until new data actually gathered during acceleration are made available, the reliability of all the tests remains undetermined for any values above 1 g. (Authors' abstract)

Medical Problems (Including Toxicology and Pharmacology)

39

Decompression Disorders under Conditions of Reduced Atmospheric Pressure (Dekompressionnye rasstroistva v usloviakh ponizhennogo atmosfornogo davleniia.) N. A. AGADZHANIAN and D. V. ABAEV.—*Voenno-meditsinskii zhurnal* (Moskva), 1960 (1):58-62. Jan. 1960. In Russian. English translation in: *Military Medical Journal*, 1:92-98. New York: U. S. Joint Pub. Research Serv., No. 1374-N/26, May 31, 1960. (Available at Office of Technical Services, U. S. Dept. Commerce)

This is a review of Soviet and foreign research on decompression disorders. Of the Soviet contributions two studies are mentioned, the first on the rate of nitrogen elimination while breathing pure oxygen at high altitude, the second on the appearance of symptoms of dysbarism in the 12-14th hour during a 20-hour stay at 8,000-12,000 m. altitude while breathing pure oxygen. The rest of the article describes the findings of American researchers published in the *Journal of Aviation Medicine* and in *Military Medicine*.

40

Drugs May Halve Radiation Damage. H. DAVID.—*Missiles and Rockets*, 7 (13):39-40. Sept. 26, 1960.

Among potential methods of protecting against the damaging effects of radiation is the administration of chemical derivatives of the protein-bonding elements, which protect the cell by (1) the trapping of free radicals through lack of oxygen; (2) the inhibition of the formation of free radicals; and (3) shielding of proteins by the diversion of energy and change in metabolic activity resulting from the combination of proteins and chemicals. Other potential methods of protection against radiation damage which are being considered for use in space flight include the induction of hibernation and the use of bone marrow, spleen, and liver extracts.

41

Acute Pulmonary Edema of High Altitude. C. S. HOUSTON.—*New England Jour. Med.*, 263 (10):478-480. Sept. 8, 1960.

A report is presented of a case of acute pulmonary edema observed in a healthy young mountain climber with a normal heart. Symptoms observed after hospital admission included moderate cyanosis, slightly elevated temperature, doubtful electrocardiographic irregularities, dyspnea, and lung rales. The patient was symptom-free 36 hours after admission. The condition is attributed to the combined stresses of cold, exertion, and anoxia (12,000 feet altitude). Several other cases suggestive of high altitude pulmonary edema are briefly reported.

42

Pathophysiological Characteristics of Experimental Deep Hypothermia (Patofiziologicheskaia kharakteristika glubokoi gipotermii v eksperimente.) E. V. GUBLER, N. V. ALISHEV and I. I. LASSI.—*Patologicheskaya fiziologiya i eksperimental'naya terapiia* (Moskva), 3 (5):41-48. Sept.-Oct. 1959. In Russian, with English summary (p. 48).

A total of 53 experiments investigating reactions to deep hypothermia were performed on cats. It was shown that the esophageal temperature may exceed the rectal by 5-6° C. Cardiac crisis initiated by cardiac arrest appears when the rectal temperature

drops to 10.6-20° C. and the esophageal to 15.2-24.3° C. Periodic weak cardiac contractions which generally disappeared upon rewarming, were noted in 50% of the cases. During cardiac arrest, the EKG showed slow gradually descending waves. In some cases, respiration was preserved at a rectal temperature below 15° C. for one hour at complete circulatory arrest. The appearance of nervous and circulatory disturbances, and the possibility of restoring normal functions after deep hypothermia depend primarily upon the duration of the cardiac crisis. Death in deep hypothermia was due to failure to restore cardiac activity after the crisis. In these cases, post-mortem findings revealed frequent pulmonary edema. (From the authors' summary)

43

Medical Experiences in Peru. H. HULTGREN and W. SPICKARD.—*Stanford Med. Bull.*, 18 (2):76-95. May 1960.

The material for this discussion of the physiology and pathology of altitude acclimatization was gathered during a trip to Peru by personal observation, discussions with hospital staff members, and by examination of clinical records. The geography, medical education, research programs, and clinical facilities of the country are briefly described. Medical conditions discussed include: (1) acute mountain sickness suffered by unadapted individuals at high altitude and by acclimatized people returning from trips to low altitudes; (2) chronic mountain sickness, which is probably a hypoventilation syndrome; (3) blood pressure changes observed in unacclimatized individuals arriving at high altitudes, suggesting transient peripheral vasoconstriction; (4) acute pulmonary edema, sometimes seen in acute mountain sickness; and (5) severe altitude disease among burros, horses, cattle, newborn pigs (enlargement of the right ventricle and hepatomegaly), and lambs (hydropericardium). The physical and physiological characteristics of altitude-acclimatized men are briefly described, including short stature, large chests, large lung volume, possible right ventricular hypertrophy demonstrated in some cases by electrocardiographic examination, pulmonary hypertension, a high incidence of patent ductus arteriosus and gallstones, a rarity of coronary disease, atherosclerosis, diabetes, and hypertension, increased tissue vascularity, and decreased blood fibrinogen.

44

Medical Examination of Flyers.—*New England Jour. Med.*, 262 (24):1242. June 16, 1960.

The requirement is discussed that student and private pilots be given medical examinations by designated medical examiners, and that the examining physicians be thoroughly trained and acquainted with their duties. Purpose of the ruling is (1) to maintain a group of medical examiners clearly responsive to

the needs of public safety in the performance of examinations and issuance of medical certificates to airmen; (2) to permit the administration of training programs to maintain the quality of performance of medical examiners and to permit the dissemination of special instructions pertaining to the needs of civil aviation, and (3) to bring into the program those qualified physicians demonstrating an interest in the medical certification field. (Quoted in part)

45

The Effect of Increased Partial Pressure of Oxygen in Experimental Hypoxemia Induced by Carbon Monoxide Poisoning (O deistvii povyshennogo davleniia kisloroda pri eksperimental'noi gipoksemii, vyzvannoi otravleniem okis'iu ugleroda.) K. M. RAPOPORT.—*Patologicheskaiia fiziologiia i eksperimental'naia terapiia* (Moskva), 3 (3):27-32. May-June 1959. In Russian, with English summary (p. 32).

Hypoxemia may be corrected in animals poisoned with carbon monoxide by increasing the partial oxygen pressure in the inspired air up to 3-4 atmospheres. The mechanism of oxygen action under increased pressure consists in the rise of its solubility in the blood plasma (up to values which are able to maintain body activity even in complete hemoglobin block), as well as in the intensification of carboxy-hemoglobin dissociation. In animals poisoned with carbon monoxide the oxygen intoxication develops later and at higher oxygen pressures than in the unaffected animals. This may be explained by the combination of the carboxy group with tissue respiratory enzymes preventing direct action of oxygen on the brain. (Author's summary)

46

On Decompression Disorders in Flight Personnel during Flight (O dekompressionnykh rassstroistvakh u letnogo sostava v polete.) M. D. VIADRO and A. S. PANFILOV.—*Voenna-meditsinskii zhurnal* (Moskva), 1960 (1):62-65. Jan. 1960. In Russian. English translation in: *Military Medical Journal*, 1:99-103. New York: U. S. Joint Pub. Research Serv., No. 1374-N/26, May 31, 1960. (Available at Office of Technical Services, U. S. Dept. Commerce)

Three cases of decompression sickness due to failure of the pressurized cabin during high-altitude flight are reviewed. In all three cases the first symptoms of dysbarism appeared in the right arm or shoulder. The fixation of the initial symptoms is thought to be due to heavier exertion of the right arm in the manipulation of the controls. In the first case the pilot suffered loss of vision and consciousness after descent, with general cerebral and vaso-dystonic sequelae. In the other two cases the pathological process affected the diencephalic-brain stem area, however, without

any residual symptoms. In each case the flier neglected to inform others of his condition at the appearance of the first symptoms. This indicates inadequate knowledge of the symptoms and consequences of decompression sickness among the flight crews.

47

Sudden Knee and Abdominal Pain, Dyspnea, Nausea, and Collapse Occurring in an Obese Aerial Photographer. J. D. RISING and M. DELP (ed.).—*Jour. Kansas Med. Soc.* 61 (9): 473-477. Sept. 1960.

At a staff and student conference held at the University of Kansas Medical Center the following case report was presented: An extremely obese patient was admitted complaining of abdominal and knee pain and dyspnea seven hours after a flight in an unpressurized aircraft at an altitude of 33,000 feet. Blood pressure was unobtainable, and pulse and respiration were markedly elevated. Administration of vasopressors failed to produce a sustained increase in blood pressure, and the patient died in ventricular fibrillation. The illness is attributed to extensive air (nitrogen) embolism caused by decompression.

Personnel

48

Factorial Structure of Airman Peer Nominations. E. S. EWART.—Wright Air Development Division. Personnel Lab., Lackland Air Force Base, Tex. Technical Report no. WADD-TN-60-140, June 1960. 12 p. (Project no. 7719, Task no. 17155). Unclassified

A bipolar rating scale was constructed describing twenty traits representing adaptive or maladaptive behavior during basic training and five global behavioral characterizations. The peer nominations were collected from 11 flights of airmen in basic training. A factor analysis yielded four interpretable factors, thought to represent dimensions of a "general" rating factor, "good naturedness," "sociability," and "motivation for military life." (Author's abstract, modified)

49

A Survey of Morale in the U. S. Naval School, Pre-Flight. J. T. BAIR and R. K. AMBLER.—Naval School of Aviation Medicine, Pensacola, Fla. Special Report no. 60-2, March 15, 1960. iii + [18] p. Unclassified

The level of morale among cadets and aviation officer candidates of the U. S. Naval Pre-Flight School was investigated by administration of an anonymous attitude questionnaire. Results of the testing indicate a high level of morale at the School, with most subjects expressing high positive feelings towards their experiences with the training program. Morale was observed to be substantially higher in 1959 than

in 1953 and 1956. Suggested causes of the increase in morale include: (1) the continuous effort of the School to improve student morale; (2) continuous improvement in course content and in the administration of the School; and (3) attraction of the more seriously motivated student to the School by the introduction of the required five-year contract. The testing technique is recommended for the assessment of morale at various stages of training. Repetition of the test in Pre-Flight at three-year intervals and after implementation of major policy changes is also recommended.

50

Factorial Structure of Airman Self-Ratings and Their Relationship to Peer Nominations. L. L. ELLIOTT.—Wright Air Development Division. Personnel Lab., Lackland Air Force Base, Tex. Technical Report no. WADD-TN-60-141, July 1960. iii + 13 p. (Project no. 7719, Task no. 17155).
Unclassified

Over 600 airmen rated themselves on the same traits for which they later made peer nominations. Self-ratings showed a highly differentiated factor structure, with eight factors defined as compared with four for peer nominations. There was no direct correspondence between the two sets of factors. In combination with the Armed Forces Qualifying Test category and amount of education, the self-ratings were moderately predictive of peer ratings of positive traits. Since peer ratings have been shown to have greater validity for prediction of future performance, the author concludes that further research on self-ratings for selection purposes may not be justified. (Author's abstract, modified)

51

Concerning Certain Psychological Examinations Conducted at the Military Institute of Aviation Medicine (O niektórych badaniach psychologicznych prowadzonych w Wojskowym Instytucie Medycyny Lotniczej) K. GALUBINSKA.—*Lekarz wojskowy* (Warszawa), 36 (8): 804-810. 1960. In Polish, with French summary (p. 810).

Results are presented of psychological tests used in the selection of aviation cadets and of other flight personnel. The tests are also applied in controlling pilot performance. The following methods are used: recording of case histories, direct observation, and administration of aptitude tests.

52

Aeromedical Board Tests of Flight Personnel Suffering from Disturbances in the Autonomous Functions, Excitability, and Conduction of the Heart (Vrachebnaia ekspertiza letnogo sostava pri narusheniiaakh funktsii avtomatizma, vzbudimosti i provodimosti serdtsa) N. A.

GOL'DIN.—*Voenna-meditsinskii zhurnal* (Moskva), 1959 (9):56-63. Sept. 1959. In Russian. English translation in: *Military Medical Journal*, 9:94-104. New York: U. S. Joint Pub. Research Service, No. 2061-N, Dec. 28, 1959. (Available at Office of Technical Services, U. S. Dept. Commerce.)

A detailed discussion is presented of various abnormalities of heart functions. Diagnostic procedures are described to differentiate between functional and organic origin, and aeromedical board flight fitness tests are outlined.

53

A Regression Analysis of One Set of Airman Proficiency Test Scores. C. J. JUDY.—Wright Air Development Division. Personnel Lab., Lackland Air Force Base, Tex. WADD-TN-60-139, June 1960. iii + 11 p. (Project no. 7734, Task no. 17018).
Unclassified

A set of Airman Proficiency Test scores is described in terms of the variance held in common with selected measures of training, experience, education, aptitude, supervisory opinion, and airman attitudes for 384 mechanics tested in 1956 and 1957. Each of these categories, excepting airman attitudes, could be used to predict the Airman Proficiency Test criterion at some level of effectiveness. But only the training variables and the aptitude variables added significantly to the prediction attainable by using all other available information. Results show the utility of the test scores in defining one important aspect of airman proficiency. (From the author's abstract)

54

The Status of Morale Measurement, 1959. G. H. WHITLOCK.—Univ. of Tennessee, Knoxville (Contract AF 41 (657)-247); issued by Wright Air Development Division. Personnel Lab., Lackland Air Force Base, Tex. WADD-TN-60-136, May 1960. vi + 29 p. (Project no. 7719, Task no. 17130).
Unclassified

A review and critical analysis of attempts to measure morale was conducted to determine effective methods of morale measurement among Air Force personnel. The major causes of the inadequate state of morale measurement are the failure to distinguish clearly between validity and relevance, confusion in the selection of morale criteria and in the definition of variable interrelationships, and the lack of agreement on the definition of morale. It is concluded that (1) the factors resulting from factor analyses of morale questionnaire data are dependent on the items used, the groups tested, and the methods of analysis; (2) the morale concept transcends the immediate job situation; (3) use of the same methods of factor analysis or the same questionnaire produces good agreement on morale factors among different investigators; (4) a fair degree of agreement exists among different investigators on

the general scope of morale but not on the number of dimensions of morale; (5) existing evidence favors a general morale factor on which most typical items will load; (6) the number of scales determined *a priori* in a questionnaire always exceeds the number of factors analytically determined; and (7) the value of previous factor analyses would be enhanced by refactorization. (73 references)

55

Airman Classification Test Batteries: A Summary. W. B. LECZNAR and B. F. DAVYDIUK.—Wright Air Development Division. Personnel Lab., Lackland Air Force Base, Tex. Technical Report no. WADD-TN-60-135, May 1960. vi+17 p. (Project no. 7717, Task no. 87002). Unclassified

Assignment to training and jobs has been effectively accomplished by the Air Force through the use of test batteries. Two basic testing instruments have been used: the Airman Classification Battery and the Airman Qualifying Examination. These two tests have been revised periodically to counteract item obsolescence incurred by technology changes, to protect test security, and to use new test theory. Revisions in test content, format, and administration also have been prompted by validation studies. This report compiles a review of each form of these tests, together with development information, and citation of published reports. (Authors' abstract)

Survival and Rescue (Including Nutrition)

56

Space Age Lunches. N. L. BARR.—*Air Line Pilot*, 29 (8):16. Aug. 1960.

Different ways of processing food for nutrition in space are briefly discussed: conversion of indigestible items by enzymes into palatable food; use of dehydrated foods on short space trips; and reconversion of wastes to food and water for extended space voyages. The effects of time expansion at extremely high speeds on space food requirements are pointed out.

57

Escape from Ditched Aircraft. III. An Investigation into the Feasibility of Using the Standard Martin-Baker Ejection Seat Systems for Under-Water Escape from Ditched Aircraft. E. L. BECKMAN, D. C. MC-NUTT, and J. S. P. RAWLINS.—RAF Inst. of Aviation Medicine (Gt. Brit.), Farnborough; issued by Flying Personnel Research Committee (Gt. Brit.). FPRC 1093, July 1959. 21 p. Unclassified

Investigations and evaluations are presented of using the standard Martin-Baker Ejection Seat System for escape from submerged aircraft with reasonable safety. Ejection through the canopy is recommended

for aircraft with frangible canopies. The inherent dangers of injury when using the ejection seat under water are accepted as a reasonable risk for a life-saving procedure. Recommendations are made for modifying the present ejection seat systems so as to improve their performance under water and to decrease the danger to the aircrew in the use of the equipment. (From the authors' summary)

58

Escape from Ditched Aircraft. IV. Evaluation of the Factors Which Affect Survival in a Ditching Accident in Current Operational Aircraft with Recommendations for Increasing the Rate of Survival. E. L. BECKMAN.—RAF Inst. of Aviation Medicine (Gt. Brit.), Farnborough; issued by Flying Personnel Research Committee (Gt. Brit.). FPRC 1094, March 1959. 25 p. Unclassified

The methods by which various factors affect survival from a ditching accident are reviewed and their significance discussed. Manual escape procedures used by an aircrew for making a safe escape after a ditching accident are shown to be inadequate for escape from modern jet aircraft. The use of an ejection seat to assist escape is evaluated and recommended. A research program is proposed for accumulating data on ditching accidents. This includes measurement of accelerations to which the aircrew are subjected during ditching and the measurement of the sinking characteristics of aircraft when subjected to realistic ditching conditions. The results obtained should permit an accurate evaluation of the effectiveness of the present methods of escape from ditched aircraft. An engineering development program is proposed for providing a buoyancy system for the entire airframe in some cases, for the ejection seat in others, and for modifying the ejection seat firing system so as to ensure adequate function under water in addition to providing a slower ejection velocity, when used for escape from a ditched aircraft. (From the author's summary)

59

Water Recovery Systems (Multi-Variable).

H. WALLMAN and S. M. BARNETT.—Electric Boat Division, General Dynamics Corp., Groton, Conn. (Contract AF 33(616)-6425); issued by Wright Air Development Division. Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-243, March 1960. vi+73 p. (Project no. 6373, Task no. 63122). Unclassified

A study has been conducted to determine the optimum design of several urine-to-potable-water recovery systems for use on space flights having different flight durations and crew sizes. Phase change processes, solvent extraction, ion exchange, membrane processes and integrated systems are covered. On this basis of the evidence presented, it has been recom-

mended that: (1) a simple distillation unit be used for flights of six days or more with up to two men, (2) a vapor compression system be used for long flights (four days or more) having large crews (three to twenty men), and (3) sufficient water be stored aboard the vehicle for flights of short duration. Recommendations are also made for a laboratory study of other promising methods of water recovery. A literature search is presented on the implications of a possible slow build-up of constituents or breakdown products from urine. It has been concluded that a healthy man can ingest water reclaimed from urine without incurring any harmful effects. (Authors' abstract)

60

Nutrition of Space Travellers (Die Ernährung der Weltraumfahrer).—*Aviatik* (Chur, Switzerland), 1960 (2):7. Feb. 1960. In German.

The utilization of the *Chlorella* alga as a projected solution of the problem of nutrition and gas exchange during prolonged space travel is discussed. *Chlorella* is the ideal component of a closed ecological system because of its total edibility, high rate of growth, and high protein content. The monotony of a diet composed simply of algae necessitates supplementation by other edible plants.

Operational and Human Engineering Aspects

61

Man-Machine Concepts. G. W. HOOVER.—*Astronautical Sci. Rev.*, 1 (4):30. Oct.-Dec. 1959.

A rendezvous of space ships may be achieved by an automatic man-controlled system for guiding a vehicle into position. Control may be effected remotely from a ship in orbit, from the ground, or from the rendezvous vehicle. An orientation display will be a paramount factor in the pilot's ability to carry out such a task as well as his experience and skill.

62

Spacing of Push Button On-Off Controls. J. V. BRADLEY and R. A. WALLIS.—*Eng. and Indus. Psychol.*, 1 (4):107-119. Winter 1959.

An experiment was conducted to determine performance efficiency in the operation of single on-off push-button controls as a function of spacing between adjacent controls. Level of performance was defined by measurement of operation time and number of errors in touching or operating adjacent controls. A horizontal configuration of controls was observed to be more efficient in all parameters than a vertical array. Operation time was decreased independently of changes in control diameter with increasing distances between push-button centers. Operation time was improved with increasing push-button diameter with control edges spaced at a constant distance.

Touching errors decreased with increasing push-button diameter with constant edge spacing, but decreased with decreasing diameter with constant center spacing. It is concluded that with a permissible control spacing of $1\frac{1}{2}$ inches between centers, a $\frac{1}{2}$ inch diameter push button is superior to larger diameter controls. With an intercenter spacing of two or more inches, push buttons as large as one inch are desirable.

63

A Summary of Research Methods, Operator Characteristics, and System Design Specifications Based on the Study of a Simulated Radar Air Traffic Control System. J. S. KIMB.—Ohio State Univ. Lab. of Aviation Psychology and OSU Research Foundation, Columbus (Contract AF 33(616)-3612); issued by Wright Air Development Center. Aero Medical Lab., Wright-Patterson Air Force Base, Ohio. WADC Technical Report no. 59-236, July 1959. iv+29 p. (Project no. 7184, Task no. 71583). PB 161741

The methodological and conceptual basis for a program of study of air traffic control radar simulation is reviewed. The program of system research was planned around objectives of (1) establishment of general principles relating to human engineering aspects of air traffic control systems, and (2) development of a general theory of the capacities and limitations of individuals and small groups in the performance of the decision-making functions required by complex man-machine systems. From a review of fourteen experiments conducted on the traffic control simulator since 1952, the system characteristics that influence operator performance are defined as distribution of responsibility, input organization, and procedural flexibility.

64

Operator Preferences for Movement Compatibility between Radar Hand Control and Display Symbolology. C. S. MORRILL and L. T. SPRAGUE.—*Jour. Applied Psychol.*, 44 (3):137-140. June 1960.

This study investigated whether (a) the radar display is viewed as a functional representation of antenna movement involving an incompatibility in the direction of the azimuth range symbol and the elevation symbol on the display, or as a direct representation of the hand control movements; and (b) what direction of movement is preferred for the azimuth-range symbol to make it compatible with the movement of the elevation symbol. Three groups of subjects with varying degrees of prior experience as radar operators or pilots were surveyed. The results indicate that all groups in this study preferred a compatible display-control relationship. The display which represents directly the hand control movements was preferred over that representing the functional operation of the antenna. Preferences expressed for a backward

motion of the controls to effect an upward movement of the display symbol were related to prior experience with radar.

Airplane and Space Cabins

65

Environmental Requirements of Sealed Cabins for Space and Orbital Flights: Response of Subjects to Some Conditions of a Simulated Orbital Flight Pattern. E. HENDLER and L. J. SANTA MARIA.—Naval Air Material Center. Air Crew Equipment Lab., Philadelphia, Pa. Report no. NAMC-ACEL-438, Aug. 24, 1960. iv + [17] p. (Project no. TED NAM AE-1403). Unclassified

The effects of exposure to pressure and thermal conditions postulated as characteristic of extreme conditions of orbital flight patterns were studied using subjects wearing ventilated, full-pressure suits. No significant physiologic stress was evidenced in subjects exposed to a modified thermal profile, except for the sweating response of one subject. Exposure of experienced subjects to long duration thermal loads simulating relatively severe post-landing and full thermal profiles resulted in premature test termination when ventilating air temperature was more than a few degrees above the initial mean skin temperature. The environmental conditions (altitude, wall temperature, dry bulb temperature, and ventilating air temperature) for each experiment are shown in tables and graphs. (Authors' summary, modified.)

66

Display and Control Requirements for Manned Space Flight. C. O. HOPKINS, D. K. BAUER-SCHMIDT, and M. J. ANDERSON.—Hughes Aircraft Company, Culver City, Calif. (Contract AF 33(616)-6033); issued by Wright Air Development Division. Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. WADD Technical Report 60-197, April 1960. xii + 204 p. (Project no. 7184, Task no. 71585). Unclassified

A study was made of the display and control requirements for a manned orbital vehicle of the "space-ferry" type. The mission included ground launch, rendezvous with a satellite station already in orbit, re-entry into the earth's atmosphere, and landing at a selected base on earth. Display and control requirements were determined for vehicle attitude control while in orbit, orbital plane change, minimum energy transfer between circular orbits at different altitudes, and de-orbit for re-entry into the earth's atmosphere. Displays, controls, and control panels were designed to meet these requirements. Representations of these displays and controls were constructed and incorporated into full-scale mockups of cockpits for two alternate displays and control systems. (Authors' abstract) (175 references)

67

Environmental Requirements of Sealed Cabins for Space and Orbital Flights—A Second Study. V. Some Physiological Measures on Confined Subjects Breathing Recycled Gases for Eight Days. T. D. HANNA.—Naval Air Material Center. Air Crew Equipment Lab., Philadelphia, Pa. Report no. NAMC-ACEL-417, Sept. 15, 1960. iv + 28 p. (Project no. TED NAM AE-1403). Unclassified

The effect of eight days confinement on four bioelectric measures of six men while monitoring a Vigilance Work Station in a simulated space capsule were presented and discussed. Under the conditions of the experiment, it was concluded that the significant differences which occurred in the four physiologic functions (heart rate, respiration rate, forehead skin temperature, and plantar electrical skin conductance) recorded were due to anxiety provoking stimuli, rather than the confinement *per se*. The interpretation of physiologic measures is discussed. (Author's abstract)

68

Atmosphere Control on Submarines. W. E. MCCONNAUGHEY.—*Bureau of Ships Jour.*, 9 (5):11-14. May 1960.

Atmospheric control equipment developed for use in submarines is reviewed from the standpoint of efficiency, power, weight, volume, reliability and simplicity. The advantages of nonregenerative and regenerative control systems are illustrated by a comparison of the LiOH system and the monoethylamine scrubber for CO₂ removal. Removal of hydrogen, CO, and other gaseous contaminants from the atmosphere is effected by catalytic combustion units employing hopcalite (a mixture of copper and manganese oxides), carbon filters, and partially by the air-conditioning cooling coils. An electrostatic precipitator serves to remove smoke and aerosols. The major limitation of the above atmosphere control facilities is inherent in the O₂ supply system. A number of different processes of oxygen supply are discussed, including the chlorate candle, the sulfate cycle, and the photosynthetic gas exchanger.

69

Space Cabin Design. A. M. MAYO.—*Astronautical Sci. Rev.*, 1 (4):30. Oct.-Dec. 1959.

Data from physiological tests, coupled with information from early orbital operations, will serve as the foundation for detail design criteria for the crew station of the maneuverable satellite and for rendezvous operations. Success of these difficult operations will depend on clear thinking and emotional stability of the crew, and possibly on the use of remotely controlled robot devices in lieu of human movements to perform required tasks.

70

An Approach to Temperature and Humidity Control in Space Cabins. J. H. MILLER, E. B. KONECZI, and N. E. WOOD.—In: Closed Circuit Respiratory Systems Symposium, p. 333-342. Wright Air Development Division. Life Support Systems Lab., Wright-Patterson Air Force Base, Ohio. WADD Technical Report no. 60-574, Aug. 1960. (Project no. 6373, Task no. 63120). Unclassified

An approach to the problem of space vehicle temperature and humidity control is presented, which is independent of orientation or position of the vehicle. Cabin air is drawn in through a screen, a self-charging electrostatic dust filter, and a bed of activated charcoal by an axial flow blower and then ducted to the radiating panel. The ducting on the radiating surface can have many different configurations and be made of many different materials. The system requires no external moving parts, and except for blower power requires no electricity or other external power or complicated control devices, and possesses high flexibility and reliability with minimum weight.

71

System Controls Capsule Environment. W. S. REED.—*Aviation Week and Space Technol.*, 73 (1): 57-60. July 4, 1960.

The system controlling the internal environment (atmospheric pressure, oxygen and water supply, humidity, odor removal, and heat exchange) in the Project Mercury space capsule is briefly described. Pressure within the capsule and pressure suit of the pilot will be maintained at 5 p.s.i. in an all-oxygen atmosphere; therefore, the faceplate on the pressure suit may be opened at any time without risk to the pilot. Continuous recordings will be made in flight of the space pilot's condition—electrocardiograms, measurements of body temperature, and rate and depth of respiration. These data will be telemetered. At a predetermined time prior to re-entry, the pilot will cold-soak the cabin and pressure suit by manually opening the heat exchanger water control valve to allow maximum water flow into the heat exchanger.

Protective Equipment and Clothing

72

A Device for the Humidification of Dry Oxygen. R. G. BARTLETT and N. E. PHILLIPS.—Naval School of Aviation Medicine, Pensacola, Fla. April 27, 1960. ii+5 p. (Research Project no. MR005.13-3100; Subtask 6, Report no. 3).

Unclassified

An aviator's mask was designed for the prevention of the damaging effects of prolonged dry oxygen inhalation. The device transfers moisture from the humid expired breath by surface absorption to silica gel

crystals contained in the oxygen inlet of the mask. Moisture is released into the inspired oxygen by the evaporative effect of the dry gas. The device provides an oxygen humidification of approximately 70 per cent.

73

A Device for the Humidification of Inspired Dry Oxygen and the Conservation of Breathing Oxygen. R. G. BARTLETT and N. E. PHILLIPS.—Naval School of Aviation Medicine, Pensacola, Fla. April 27, 1960. ii+9 p. (Research Project MR005.13-3100, Subtask 6, Report no. 2). Unclassified

A self-regulating breathing mask has been designed which transfers moisture from the expired breath to the inspired dry oxygen. The dead space oxygen is saved by being trapped in a "bellows" and is used during the next breath. Laboratory tests show that the mask brings about a 40 to 60% humidification of the inspired oxygen and a saving of 15 to 20% of the oxygen. (Authors' abstract)

74

Magnetic Shoes for Human Orientation in Space. J. F. NICHOLSON and D. W. NAAS.—Wright Air Development Division. Aeronautical Research Lab., Wright-Patterson Air Force Base, Ohio. WADC Technical Note 59-352, Feb. 1960. iii+9 p. (Project no. 7021, Task no. 70651). PB 161727

This report describes both permanent and electromagnetic shoes for human orientation in a weightless environment. The electromagnetic shoes operate on a low voltage power source which may be adjusted to the individual requirements of the wearer. A micro-switch which interrupts the magnetic circuit each time the heel is raised reduces walking fatigue and increases the operational life of the batteries. An inertia switch is included in the magnetic circuit as a safety device. When the switch senses any sudden acceleration or deceleration, it shunts the potentiometer and allows additional current to flow to the electromagnet thereby increasing the holding force. (Authors' abstract)

75

Work in Cold Environments: Clothing for Cold Conditions. L. H. TURL.—*Jour. Occupational Med.*, 2 (3):123-128. March 1960.

The importance of the interrelationships of temperature, wind, humidity or water, solar radiation, and work level in the determination of requirements for the design of clothing adaptable to varying conditions of cold and levels of activity is discussed. On the basis of considerations concerning the physical processes of heat loss and insulation, it is concluded that clothing should combine features of maximum permeability to water vapor, maximum water repellency, high wind resistance, adequate ventilation, and minimum weight and stiffness.