

Abstracts of Aero-Medical Literature

AEROSPACE MEDICINE

1
Summary of Medical Experience in the Apollo 7 through 11 Manned Spaceflights. CHARLES A. BERRY. *Aerospace Medicine*, Vol. 41, May 1970, P. 500-519, 12 Refs.

The 3105 hours of exposing man to space flight during the Apollo program have added greatly to knowledge of man's response to space travel. The spacecraft cabin environment has been suitably maintained for the crew. The radiation environment has been benign, no solar flares occurring during the Apollo program missions. Crews have generally adapted well to weightlessness, and have learned to utilize it to their advantage. Improvements have been made in in-flight food, with the addition of moisturized packs and such items as sandwiches and dried fruit. The body weight losses, which have continued to occur during space missions, are not entirely due to body fluids loss. Work-sleep cycles have been improved somewhat by having all crew members sleep at the same time, and by having cycles more closely related to those during training period. Cardiovascular deconditioning has been identified postflight with both lower body negative pressure and 90° passive standing techniques. Microbiological studies have shown that organism transfer between crew members. Moreover, the growth of opportunist organisms appears to be favoured by these shifts. Extravehicular activities on the lunar surface during the Apollo 11 mission were conducted within expected energy costs, at an average of 1,200 BTU per hour. The liquid-cooled-garment-temperature method of energy cost estimation is the most suitable. It appears that lunar surface time can be expanded safely. The Apollo 11 quarantine was a demanding operation, conducted very successfully.

(Author's abstract)

AIRCREW MEDICAL PROBLEMS

2
Medical Wastage of Military and Civil Aircrew in Great Britain, 1963-68. G. BENNETT and P. J. O'CONNOR. *Aerospace Medicine*, Vol. 41, May 1970, P. 550-552, 1 Ref.

This paper compares the medical wastage of trained professional aviators in military and civil

flying in Great Britain for the years 1963-68. It concerns flight deck personnel who are prevented from revalidating their flying licence by reason of ill-health or death. The Board of Trade which issues flying licenses to all civilian aircrews gave the civil medical wastage, and the statistics branch of the Royal Air Force gave details concerning military aircrew. The data show that cardiovascular disease, flying accidents and psychiatric illness are the chief causes of medical wastage of aircrew. In civil aviation cardiovascular disease (90% due to coronary artery disease) is the chief cause of wastage, while in military flying, flying accidents and psychiatric wastage are expectedly higher.

(Authors' abstract)

3
Wolff-Parkinson-White Syndrome Simulating Myocardial Infarction. J. E. SMITH and C. R. HARPER. *Aerospace Medicine*, Vol. 41, March 1970, P. 328-330, 10 Refs.

During a routine company prescribed physical examination, a 50-year-old airline captain was found to have an abnormal resting electrocardiogram and a positive post exercise Master two-step test. Previous ECG's taken annually over a period of 18 years were normal. Re-examination showed a reversion to normal with a normal exercise electrocardiogram. It was decided that this case was an unusual type of Wolff-Parkinson-White Syndrome and was not related to coronary heart disease. From an analysis of the literature, and our experience with this case, it is likely that exercise electrocardiograms in the presence of Wolff-Parkinson-White type of accelerated conduction, have no diagnostic value because of the frequency of false positive tests.

(Authors' abstract)

4
Occurrence and Significance of Myocarditis in Trauma. P. J. STEVENS and K. E. UNDERWOOD GROUND. *Aerospace Medicine*, Vol. 41, July 1970, P. 776-780, 20 Refs.

The literature on isolated focal myocarditis is reviewed with regard to its incidence and potential for causing sudden collapse and death in apparently healthy individuals. Six cases of the condition among 263 pilots killed in aircraft accidents are reported, but in no case was it considered to be connected with the causes of their accidents. The

difficulties in the diagnosis and assessment of the significance of myocarditis with respect to accident causation is discussed. An incidental myocarditis was not found in 93 non-pilot aircrew killed in the same aircraft accidents. However, a control series of 61 hearts from apparently healthy males aged between 18 and 50 years, who had died from trauma in circumstances which precluded the accidents having been caused by the deceaseds' sudden incapacitation, were examined. This study indicated that the incidence of asymptomatic focal myocarditis in British males aged 18 to 50 years may be as high as 5 per cent.

(Authors' abstract)

5
In-flight Coronary Occlusions: A Short Series of Cases. F. O. HEMMING. *Aerospace Medicine*, Vol. 41, July 1970, P. 773-775, 10 Refs.

The suggestion that present medical scrutiny of aircrew is highly effective in eliminating overt coronary artery diseases is examined in the light of six cases of inflight death. The need for full autopsies on all aircrew fatalities is mentioned and the question of the Double Masters ECG is considered relevant to the F.A.A. proposals to amend Parts 61 and 67 of the Federal Aviation Regulations. The absence of a significant medical history and the existence of normal ECG records in the fatalities described raises the question of the efficacy of current screening methods. The necessity for aeromedical involvement in aircrew autopsies is stressed as is awareness of the danger of inadequate autopsies.

(Author's abstract)

6
Aeromedical Consultation Service Case Report: Post-traumatic Epilepsy. EARL A. ZIMMERMAN and TIMOTHY N. CARIS. *Aerospace Medicine*, Vol. 41, March 1970, P. 343-344, 8 Refs.

Two cases of head injury complicated by subdural hematoma were referred to the USAF School of Aerospace Medicine seventeen months and two years post-surgery for aero-medical evaluation. In one, persistent focal central spikes and, in the other, a seizure after sleep deprivation precluded return to flying. These two high-risk factors for post-traumatic epilepsy (subdural hematoma and focal spike E.E.G. abnormality) are reviewed.

(Author's abstract)

7
Motion Sickness. K. E. MONEY, *Physiological Reviews*, Vol. 50, January 1970, P. 1-39, 316 Refs.

This review article discusses motion sickness under various heads like incidence in man, signs and

symptoms, etiology, treatment and adaptation, theories of essential nature of motion sickness.

(R.K.)

8
Motion Sickness in USAF Flying Personnel. R. S. RYBACK and R. E. RUDDO. *Aerospace Medicine*, June 1970, Vol. 41, P. 672-677, 8 Refs.

Forty-nine cases summarizing the experience with motion sickness in rated personnel evaluated at the USAF School of Aerospace Medicine from 1962-1969 are reviewed. Typically, the individual referred for evaluation is a young navigator or pilot who is found to have a strong previous history of motion sickness and increased sensitivity to Coriolis stimulation. Factors present in the past history, along with laboratory examinations, help to determine whether the etiology is primarily organic or psychiatric. Laboratory examinations included audiogram, electroencephalogram, tilt table, caloric stimulation, centrifuge run, F-100 ride, and blood indices. Psychological testing was performed in 16 cases, and all patients given psychiatric interviews. The aircraft the patient was current in at the time of referral, his rating by command, rating code, flying hours, recommended disposition and final disposition are reported.

9
Potentials of the Aeromedical Evacuation System in the overall Treatment Process for the Seriously Ill Patient. J. P. McCANN and J. R. BURNETT. *Aerospace Medicine*, Vol. 41, March 1970, P. 323-328, 4 Refs.

A study of the worldwide Aeromedical Evacuation System included an evaluation of the potential of the AES in the overall treatment of the seriously ill patient. The findings relevant to this portion of the study were based on (1) analysis of specific case histories of seriously ill patients involved in various treatment plans, each of which included air evacuation operations; (2) the application of techniques to grossly calculate the relative stress on the patient imposed by various treatment and evacuation alternatives and their application to determinations of optimum treatment plans where air evacuation is available; and (3) analysis of trends and the probable influence of new developments in medical treatment, medical equipments, air transport, and the military-civilian interfaces in the exploitation of air ambulances and speciality treatment centres. A brief description of the study program and some of its findings pertinent to the topic are presented. The study, conducted by a multi-disciplined team comprised of medical, operational and engineering personnel,

included first-hand observations of the AES covering in excess of 100,000 miles of evacuation routes throughout the worldwide system and interviews with over 150 authorities.

(Authors' abstract)

10

Centrifuge as a Therapeutic Device. R. PELLIGRA and S. STEIN. *Aerospace Medicine*, Vol. 41, April 1970, P. 451-455, 4 Refs.

A bullet fragment floating freely in the ventricular system of the brain of a 63-year-old male assault victim was moved to a fixed position by exposing him to an increased acceleration environment in the NASA/Ames Research Center's Five-Degree-of-Freedom Centrifuge. The small lead fragment threatening to occlude the Aqueduct of Sylvius migrated to the posterior horn of the left lateral ventricle under the following acceleration profile:

0.39 g/second onset rate to peak 5 g maintained for 20 seconds, then increased at 0.33 g/second to 6 g for 3 seconds. Initial offset rate was 0.8 g/second, and total exposure time approximately 58 seconds.

A fresh human brain autopsy specimen, with a bullet fragment implanted in the left ventricle, was exposed to these same conditions. Gross and microscopic pathological examination revealed indentation of the ependymal lining due to the lead fragment which appeared to be wedged in the posterior horn. It was presumed that the bullet fragment in the patient's brain was being held in place by the combined effects of wedging in the posterior horn and gellosis due to disruption of the ependymal lining. Recent pneumoencephalography and tomography studies confirm that approximately 30 to 40 per cent of the body of the bullet fragment is embedded in the postero-lateral wall of the left lateral ventricle. The patient, a known diabetic with arterio-sclerotic cardiovascular disease, tolerated the procedure well and is now ambulatory with no apparent neurological deficit.

(Authors' abstract)

AIRCREW TRAINING

11

Heart Rate of Training Captains Engaged in Different Activities. S. C. BATEMAN and R. GOLDSMITH. *Aerospace Medicine*, Vol. 41, April 1970, P. 425-429, 3 Refs.

As part of a study of the work of the training captains in a civil airline, an assessment of the

differential stress of simulator, base conversion and line training was made using heart rate as an indicator.

The heart rate of twelve volunteer training captains flying four different types of aircraft in these three situations were compared with the rates both at rest and in line flying without training. To provide a base line the heart rate of twelve ordinary line captains were also observed during their normal flying duty.

The results showed that the overall mean heart rate recorded for training captains on line flying was the same as for the control group. It was also found that their heart rates in line flying, line training and simulator work are very similar and that they are all higher than resting rates. Base training rates are significantly still higher.

It was also shown that heart rate was raised by specific stressful conditions. Most commonly this was seen in take off and landing and at times when the training captain was demonstrating manoeuvres requiring a high degree of skill, or when there was some element of danger.

The heart rate also rose during activities such as numerical calculation, the diagnosis and rectification of aircraft technical faults and in rough air.

The conclusion was drawn that heart rate was a useful comparative indicator of stress and that base training was an arduous activity.

(Authors' abstract)

12

Responses of USAF Undergraduate Pilot Trainees to Indoctrination in the Spatial Orientation Trainer. P. J. DOWD and R. L. CRAMER. *Aerospace Medicine*, Vol. 41, May 1970, P. 544-549, 3 Refs.

Twenty-two students from the Air Force Undergraduate Flying Training Program "flew" a prototype spatial orientation trainer to the solution of different orientation problems. In subsequent interviews, all but one recommended incorporation of orientation training in their program. The lone dissenter had not yet begun instrument flight training.

(Authors' abstract)

BIOMEDICAL INSTRUMENTATION

13

A Method for Recording Myocardial ECG in Animals During Intense Vibration. DONALD J. SASS. *Journal of Applied Physiology*, Vol. 28, March 1970, P. 361-364, 6 Refs.

In studies of effects of whole-body vibration in cats we have been unable to record the electrocardiogram using conventional methods when the animal is vibrated with peak acceleration exceeding about ± 4 g. The present study shows, however, that the electrocardiogram can be recorded from myocardial electrodes during whole-body vibration with peak acceleration up to $+15$ g. Satisfactory electrodes consist of two No. 30 AWC enamelled copper wires sutured into the myocardium at one end of each wire with the two free ends brought out through the vascular system. Clinical quality electrocardiograms were not recorded using this method in anaesthetized cats, but tracings were produced in which the base line and R waves are distinct throughout the period of vibration. This paper describes one method for implanting the electrodes and illustrates the results with reproductions of tracings from some of the experiments.

(Author's abstract)

14

E.C.G. Telemetry Within a Small, Closed Chamber. F. C. CARPENTER, Jr. *Aerospace Medicine*, Vol. 41, April 1970, P. 402-406, 6 Refs.

This article concerns the requirements and problems of an ECG Telemetry System within a small, irregular metal chamber. Theoretical analysis of the chamber is made to provide starting point parameters for development of a successful system. Specifications for the system and results of empirical tests are given. A diversity receiving antenna system for use with two subjects in the chamber is described. Electrode-subject interface problems are discussed. Tests of high and low impedance data channel inputs, and high and low electrode impedance configurations are described. Investigation of this area was primarily for development of best telemetry system requirements; a solution to the input-subject interface problem is not offered. It is suggested that much work remains to be done in this area to improve accuracy, particularly for monitoring under worst-case conditions such as strenuous exercise.

(Author's abstract)

15

Gas Scrubber for a Small High-Pressure Chamber. R. E. THOMPSON and T. K. AKERS. *Journal of Applied Physiology*, Vol. 28, June 1970, P. 851-852, 1 Ref.

A reclamation system, and its flow characteristics for a small dual compartment high-pressure chamber is described. Pressure, up to 11 Ata, is supplied by either an air compressor or a cascade of cylinders containing helium, oxygen, etc. The gas flows from a 37.94 liter mixing tank to either or both compartments of the high-pressure chamber; it exits through a demand valve controlled through a gas line attached to the negative, or vacuum, side of the air compressor. The demand valve reduces the pressure and allows the use of fragile plexiglas canisters containing soda lime, Drierite, or charcoal to scrub the recirculating gas. After leaving the canisters, the gas is recompressed and returned to the chamber. At a pressure slightly greater than 1 Ata, the flow is 1,200 liters/hr. within the closed system. Temperature is controlled through an S-shaped copper unit containing a water jacket on one limb and heating tape on the other, it is installed between the mixing tank and the chamber and is capable of exchanging 0.972 kcal/hr.

(Authors' abstract)

ENVIRONMENTAL FACTORS

(Barometric pressure, Hypoxia, Hyperbaric Oxygen, Gravitational Stress, Thermal Stress, Sleep, etc.)

16

Accidental Decompression: A New Philosophy for the Transports of the 1970's. A PETER HOLM and T. FREEDMAN. *Aerospace Medicine*, Vol. 41, March 1970, P. 277-282, 21 Refs.

The rationale for personnel protection against accidental decompression in transport aircraft that will be operating in the 1970 decade is reviewed. Data pertinent to manned and simian tests that were conducted in conjunction with the B-70 program is presented in context with a review of the literature dealing with the effects of rapid decompression to altitudes of 45,000 feet and above. The results of these findings indicate a need for additional protection for flights in this region and questions the use of oxygen masks for contingencies above 35,000 feet. Potential alternatives which would augment aircrew protection are discussed in terms of feasibility and the physiological characteristics of the existing pilot inventory. A recommendation is made to provide flight stations with a capsule which would rapidly achieve a ground level oxygen equivalent upon decompression warning and be equipped for flydown to an altitude where demand oxygen equipment can safely be utilized.

(Authors' abstract)

17

Factors Influencing the Time of Safe Unconsciousness (TSU) for Commercial Jet Passengers Following Cabin Decompression. JAMES G. GAUME. *Aerospace Medicine*, Vol. 41, April 1970, P. 382-385, 5 Refs.

A review of the need for passenger emergency oxygen for cabin decompressions is worthy of detailed analysis from a physiological point of view. Statistical analysis of the results of past decompressions in aircraft is not sufficient to make the decision to eliminate emergency oxygen. In performing such an analysis, many physical and physiological variables must be considered. The Time of Useful Consciousness (TUC) and the time it takes to become unconscious are guidelines that have been used in the past for flight crew members. These criteria are not applicable to the passengers' situation. The analysis delineates and discusses those factors involved in determining a Time of Safe Unconsciousness (TSU) permissible for passengers after cabin decompression. Simply stated, the degree of hazard is directly proportional to the time the passenger is unconscious from lack of oxygen.

(Author's abstract).

18

Effect of Hypoxia on Airway Smooth Muscle Mechanics and Electrophysiology. N. L. STEPHENS and E. KROEGER. *Journal of Applied Physiology*, Vol. 28, May 1970, P. 630-635, 23 Refs.

The mechanism by which hypoxia impairs the contractile function of airway smooth muscle (ASM) was studied in the canine trachealis. Impairment of power production as reflected in changes in the force-velocity relationship proved to be inversely related to oxygen tension as well as dextrose concentration. Intracellular potentials were recorded to test whether depolarization block produced by hypoxia had impaired cell excitability and produced these mechanical changes. The normal resting membrane potential (RMP) of 54.2 ± 0.9 mv was, however, unaffected by hypoxia. An increase in resting tension (RP) was also observed, but only under severe hypoxia and partial substrate depletion. As the RMP was unchanged, the increase in RP could not be due to depolarization of the membrane to critical mechanical threshold levels provided the latter had not altered. Potassium depolarization titrations excluded this possibility. Since acetylcholine did not increase electrically elicited active tension, and atropine did not affect the increase in RP during hypoxia, mediation of these responses by neural elements was unlikely. The impairment

of mechanical function in power production and rise in RP or ASM are postulated to involve hypoxic inhibition of mitochondria which provide energy for the contractile process and for sequestration of calcium in intracellular stores, respectively.

(Authors' abstract)

19

Hemodynamic and Metabolic Effects of Hyperbaric Oxygenation in Myocardial Infarction. HOWARD J. KLINE and ANTHONY J. JACOBSON III. *Journal of Applied Physiology*, Vol. 28, March 1970, P. 256-263, 38 Refs.

The effects of hyperbaric oxygenation on coronary sinus flow and hemodynamic and cardiac metabolic alterations were determined in dogs breathing 100% oxygen at 3 ATA and in those breathing air at 1 ATA after production of acute myocardial infarction with shock by plastic sphere coronary embolization. Hyperbaric oxygenation (arterial PO_2 of 1,635 mm/Hg. resulted in a significant rise of the low post-embolic aortic pressure 49-62%). Cardiac output and coronary sinus flow initially increased moderately in several animals but the overall increments for the group were not significant ($P < 0.05$). There was significant elevation of systemic and coronary vascular resistance. Arterial-coronary sinus oxygen difference diminished. In animals breathing air at 1 ATA for 2 hr. after coronary embolization, there was no change or decline in the low post-embolic cardiac output, aortic pressure, arterial PO_2 , and coronary sinus flow. Postembolic myocardial "excess lactate" production diminished or disappeared in almost all animals exposed to hyperbaric oxygenation but in only one of nine animals breathing air at 1 ATA. It is concluded that delivery of oxygen to the ischemic myocardium is probably increased during hyperbaric oxygenation. The increased myocardial oxygenation might be attributable to increased coronary perfusion pressure as well as to increased arterial oxygen content.

(Authors' abstract)

20

Metabolic Changes in Man During Short Exposure to High Pressure. M. W. RADOMSKI and P. B. BENNETT. *Aerospace Medicine*, Vol. 41, March 1970, P. 309-313, 18 Refs.

The effects of compression and decompression on blood and urine chemistry in humans were assessed. Subjects were exposed to pressures up to 10 atmospheres absolute (ATA), breathing air or a 20/80 oxy-helium mixture for 1/2-1 hour periods, and 2 ATA of 100% oxygen for 1/2-hour. Samples of blood and urine were collected at depth and throughout

the decompression period. Marked decreases in the excretion of sodium and calcium were found at depth on the air dives, these changes being completely reversible on decompression. Oxy-helium and pure oxygen did not alter the normal pattern of electrolyte excretion. A significant correlation between the degree of retention of sodium and/or calcium and the total pressure of air was found. Significant increases in serum potassium and inorganic phosphorous and decreases in albumin also occurred in humans at 200 and 300 ft. of air. The alterations in electrolyte distribution in humans breathing air at pressure resemble the changes found with various anesthetic agents and implicate the narcotic properties of the nitrogen component of air.

(Authors' abstract)

21

Cardiorespiratory Responses to Exercise at a Simulated Seawater Depth of 1,000 Feet. J. SALZAND and D. C. RAUSCH. *Journal of Applied Physiology*, Vol. 28, Jan. 1970, P. 34-41, 30 Refs.

Three subjects performed work on a bicycle ergometer for 8 min. at loads of 275, 582 and 735 kpm min. with intervening rest periods several times at sea level (1 atm), once at a simulated depth of 320 ft. in sea water (10.7 atm), and once at a simulated depth of 1,000 ft. (31.3 atm), in a dry compression chamber. The gaseous environment at 31.3 atm (99.1% helium and 0.9% oxygen) was 4.4 times denser than air at 1 atm. In general, the patterns of the responses to work at 31.3 atm resembled those occurring in healthy individuals at 1 atm. In comparison to studies at sea level each work load at depth was performed with a greater $\dot{V}O_2$, unchanged or greater $\dot{V}E_{O_2}$, lower heart rate, lower respiratory rate, larger tidal volume, lower ventilatory equivalent for oxygen ($\dot{V}E/\dot{V}O_2$), and greater oxygen pulse ($\dot{V}O_2/\text{heart beat}$). Moderate hypercapnia occurred in two subjects during exercise at depth. Observed differences at depth could be attributed at least in part to the increased density of the respired medium. Other observations at a simulated depth of 320 ft. suggest that factors other than gas density contributed to the altered cardiorespiratory responses.

(Authors' abstract)

22

Effect of 2 Months' Undersea Exposure to N_2-O_2 at 2.2 Atm on Lung Function. ARON B. FISHER and ARTHUR B. DUBOIS. *Journal of Applied Physiology*, Vol. 28, Jan. 1970, P. 70-74, 7 Refs.

Four normal male aquanauts lived at 38 ft. (2.2 atmospheres absolute) and worked at 23-100 ft. of seawater for 60 days while breathing a nitrogen-

oxygen mixture (ambient P_{O_2} 150-170 mm Hg.). Compared to control studies on the surface, measurements at the start of the underwater period showed a decrease in maximal inspiratory and expiratory flow rates and an increase in pulmonary resistance during tidal breathing compatible with the increased gas density. During the 2 month underwater period, a statistically significant increase occurred in vital capacity; in addition maximal midinspiratory flow rate and maximal voluntary ventilation showed an upward trend in two subjects. Postexposure measurements of lung volumes, lung mechanical properties, and diffusing capacity indicated that neither deleterious effects nor adaptive changes in the lungs occurred from the chronic exposure involved in this study. However, the results do suggest that increased strength of the respiratory muscles developed during the underwater period secondary to exercise and physical training.

(Authors' abstract)

23

Effect of Carbon Dioxide on Oxygen Uptake During Hyperventilation in Normal Man. MONROE S. KARETZKY and STEPHEN M. CAIN. *Journal of Applied Physiology*, Vol. 28, Jan. 1970, P. 8-12, 38 Refs.

The oxygen uptake was measured in four normal subjects at two levels of hyperventilation, breathing four different CO_2 mixtures at each level. The CO_2 mixtures were breathed for 16- or 20-min. periods and the expired gas was collected continuously and measured at either 4- or 5-min. intervals. The end-tidal PCO_2 was measured during the last minute of each interval. Each level of ventilation was attained by two combinations of tidal volume and respiratory frequency. A linear relationship was found between the $\dot{V}O_2$ and end-tidal PCO_2 during voluntary hyperventilation at combinations of frequency and tidal volume studied. We concluded that the excess oxygen uptake did not necessarily represent increased metabolism of the respiratory musculature alone but, rather, resulted from a complex interaction of the increased work of breathing and the stimulation of total body $\dot{V}O_2$ by the fall in H^+ ion concentration.

(Authors' abstract)

24

Evaluation of the Sympatho-adrenals Activity in Pilots by Determination of Urinary Catecholamines During Supersonic Flight. R. DEBJADJI and L. PEROVIC. *Aerospace Medicine*, June 1970, Vol. 41, P. 677-679, 17 Refs.

Adrenaline and noradrenaline output in urine was estimated in supersonic pilots divided in the

groups, A, B and C, during the flight at different altitudes and speeds. Significantly increased excretion of adrenaline ($P < .001$) during flight is most probably due to the emotional stress of the pilots. The excreted amount of adrenaline during flying stress suggests that the pilots in group A and B reacted by the law "all or nothing". The repeated flight of the pilots in group C has shown to lead to adaptation of the sympathoadrenal system to the flying stressors.

(Authors' abstract)

25

Urinary Excretion of Vanillylmandelic and Homovanillic Acids in Mountain Climbing. J. WOLF, V. DOLEZAL and J. LUXA. *Journal of Applied Physiology*, Vol. 29, July 1970, P. 51-53, 13 Refs.

Czechoslovak members of the International Pamir Expedition to Lenin's Peak (7,134 m) were observed for changes in "circulation index" and for vanillylmandelic and homovanillic acids in urine after climbing to various elevations. The circulatory functions responded with rapidity while the organism as a whole had not yet reached optimum acclimatization. During the final ascent the circulatory system had already reached its top efficiency, and the ascent to beyond 7 km. was possible only due to maximal activation of the sympathoadrenal system at that time.

(Authors' abstract)

26

Sensory-motor Adaptation and After-effects of Exposure to Increased Gravitational Forces. MALCOLM MARTIN COHEN. *Aerospace Medicine*, Vol. 41, March 1970, P. 318-322, 13 Refs.

Eight subjects were exposed to accelerative forces of 2.0 Gz. in the Naval Air Development Center human centrifuge facility. Samples of hand-eye coordination were examined both during and after exposure.

While exposed to the 2.0 Gz. environment, subjects initially reached below, and then, above, a mirror-viewed target. When the accelerative forces were removed, transient after-effects were observed in which subjects reached still further above the target before they returned to baseline levels of accuracy. The after-effects resulted only when the subjects had an opportunity to make reaching movements while they were exposed to the increased accelerative forces. Where present, the after-effects were observed for both arms.

The data suggest that the relationship between intended motor outputs and their proprioceptive-Kinaesthetic consequences provides adequate information for rapid behavioral compensation and adaptation to altered accelerative forces. Further, vestibular and/or sensory-tonic factors are implicated in bringing about changes in the apparent elevation of targets viewed under increased accelerative forces.

(Authors' abstract)

27

Pressure Dynamics in thoracic Aorta During Linear Deceleration. PETER G. HANSON. *Journal of Applied Physiology*, Vol. 28, Jan. 1970, P. 23-27, 12 Refs.

Abrupt deceleration in the long axis of the body (Gz) may produce traumatic rupture of the aortic arch and descending thoracic aorta. In this study the relationship between thoracic aorta transmural pressure and rupture of the thoracic arterial vasculature was examined during a series of controlled decelerations. Anesthetized beagle dogs were restrained in form-fitted couches and exposed to head first impact (-Gz) over a range of 5-60 g. Thoracic aorta and intrapleural pressures were measured by chronically implanted strain-gauge pressure transducers. At impact there was a prominent, short-duration pressure spike in the aortic pressure wave. The magnitude of the pressure peak increased as a linear function of peak g force. Intrapleural pressure also increased as a function of g force. The resulting transmural pressure exhibited an oscillatory fluctuation over the period of impact such that an initial rise in transmural pressure was immediately followed by a rapid diminution. These data suggest that during -Gz impact the transient increase in aortic pressure is compensated by a subsequent rise in intrapleural pressure. Vascular ruptures which occurred in these studies were probably due to violent inertial displacement of the cardiac mass and thoracic viscera.

(Author's abstract)

28

Effect of Gravity on Positional Alcohol Nystagmus (PAN). W. J. OOSTERVELD. *Aerospace Medicine*, Vol. 41, May 1970, P. 557-560, 29 Refs.

Experiments were performed in order to evaluate the effect of gravity on positional alcohol nystagmus (PAN) in man and in rabbits. Weightlessness, evoked in a parabolic flight, abolished PAN I as well as PAN II. Higher g-values increased the speed of the slow component of PAN. In the period when PAN had disappeared higher g-values were able to provoke alcohol nystagmus up to 48 hours after the

intake of alcohol. Weightlessness during a few seconds abolished this nystabismus for a period of several minutes. The threshold value of provoke PAN seems to increase in the weightless state. Increasing gravity lowers the threshold for provoking PAN.

(Author's abstract)

29

Thermal Stress and Human Performance. M. F. ALLNUTT. *Flight Safety*, Vol. 3, February 1970, P. 7-9, 28 Refs.

This paper is concerned with decrement of human mental performance under heat stress. From the studies of workers in the field, an environmental temperature of 30.0 deg. C. (ET) or a deep body temperature of 37.5 deg. C. can be taken as a base line. The different measures applied in the study are environmental, physiological and behavioural. Situational variables which determine performance under thermal conditions can be grouped under 1. Man-lis (a) physical condition, (b) intelligence, (c) personality, (d) motivation and (e) training. 2. Task under parameters like (a) Type of task, (b) Central vs. Peripheral, (c) The difficulty level of the task, (d) Arousal level and (e) Compensation. 3. Environmental situation which can be distinguished as (a) The severity of the stress, (b) The suddenness of the application, (c) The duration of the stress and (e) The presence of other stresses.

(R.K.)

30

Heat Stress in the Cockpit of the AH-IG Hueycobra Helicopter. J. R. BRECKENRIDGE and C. A. LEVELL. *Aerospace Medicine*, June 1970, Vol. 41, P. 621-626, 8 Refs.

A "sweating" copper manikin was used to determine heat stress levels in the cockpit of an AH-IG "Hueycobra" helicopter parked in sunlight. After closing the canopy, changes in cockpit air and WBGT temperatures and manikin heat dissipation were measured. Although air temperature usually did not exceed 80°F and clouds reduced solar radiation, cockpit air temperature rose to 134°F, and cockpit WBGT exceeded 104°F in several experiments. With severe conditions, manikin heat loss rapidly fell to zero, indicating that a pilot could dissipate no heat. A relationship is suggested which indicates that a pilot would store heat at a WBGT above 80°F. Since tests show that the AH-IG ventilating system cannot maintain WBGT below 90°F in hot, sunny environments, an air conditioner is obviously required for effective pilot performance in this aircraft.

(Authors' abstract)

31

Maximal Oxygen Consumption in a Hot Environment. F. PIRNAY, R. DEROANNE, and J. M. PETIT. *Journal of Applied Physiology*, Vol. 28, May 1970, P. 642-645, 14 Refs.

Maximal oxygen consumption was measured in a hot environment ($T_a=46$ C, $T_{wb}=35$ C) by means of two experimental procedures. A group of 18 coal miners who performed exhausting exercise were tested at the beginning of exposure to the heat. No marked difference was noticed between maximal O_2 consumption under these conditions and under normal conditions ($T_a=23$ C, $T_{wb}=16$ C). A group of 8 students performed the same exhausting work after prolonged exposure to heat leading to a storage of calories. Such experimental conditions markedly reduced the work capacity, decreasing the maximal O_2 consumption by 25%. It is presumed that after prolonged thermal exposure, hyperthermia prevents the compensating circulatory adjustments to muscular exercise.

(Authors' abstract)

32

Effect of a Cooling Hood on Physiological Response to Work in a Hot Environment. ESAR-SHVARTZ. *Journal of Applied Physiology*, Vol. 29, July 1970, P. 36-39, 8 Refs.

Six healthy young men completed 2 hr. of three work-heat tests (50 C, 20% relative humidity, 5 km/hr.) in the following experimental conditions: no cooling, wearing a cooling hood, and wearing the hood and a suit covering the torso, arms and thighs. The hood and suit consisted of 11 and 40 m. of tubing, respectively, sewn into cotton cloth. Cool water was circulated through the tubes, with inlet temperatures determined by subjective comfort established at 7.5 C for the hood and 9.9 C for the hood and suit, the latter condition requiring larger flow rates. Cooling with both hood and suit markedly reduced heat strain (final mean heart rate and rectal temperature, and total weight loss were 104/beats/min., 37.4 C, and 0.99 kg., respectively). Cooling with the hood only resulted in a final mean heart rate and rectal temperature of 127 beats/min. and 37.9 C, while total weight was 1.81 kg. The hood alone reduced oral and forehead temperatures more than rectal and skin temperatures. It was concluded that cooling the head and neck is more effective and efficient than cooling other parts of the body.

(Author's abstract)

33

Influence of Age and Daily Duration of Exposure on Responses of Men to Work in Heat. A. R. LIND and P. W. HUMPHREYS. *Journal of Applied Physiology*, Vol. 28, Jan. 1970, P. 50-56, 13 Refs.

Six younger (23-31 yrs.) and six older (39-53 yrs.) men were exposed to five different climates, three of which lay in the prescriptive zone while the other two were hotter. Exposures were for 8 hr. and the total energy cost was nearly 2,000 kcal. In the three prescriptive climates, differences in the responses of the two age groups were small and consistent; rectal temperature was similar for each age group in all three climates. In the two hotter climates, rectal temperature increased above prescriptive levels in both age groups, but more so for older men. The duration of exposure hardly affected the responses of either group in the prescriptive climates, but in the hotter climates rectal temperature increased with time; again the older men exhibited a selectively greater strain. Since there was little or no difference in the strain in the two groups of men in the three coolest climates, the results lend confidence to the use of the prescriptive zone to set thermal environmental limits for everyday work.

(Authors' abstract)

34

Body Temperatures and Sweating During Thermal Transients Caused by Exercise. B. SALTIN and A. P. GAGGE. *Journal of Applied Physiology*, Vol. 28, March 1970, P. 318-327, 32 Refs.

During thermal transients caused by bicycle exercise (25-75 max VO_2) at ambient temperatures of 10°, 20° and 30°C (rh 40%), continuous observations were made of oxygen uptake, weight changes (W), skin (Ts), esophageal (Tes), rectal (Tr), and quadriceps muscle (Tm) temperatures as well as skin conductance and skin evaporation (Es). At the start of exercise, a 2-to 5-min. delay was observed before Es increased to a level effective for temperature regulation; Tm rose rapidly; the response of Tes was faster and wider than Tr. For the lower exercise levels, Ts remained essentially unchanged; for the highest level the greatest changes in Ts happened at 10°C. Changes in Tm may relate initially to sweat secretion rate rather than W. Significant linear regressions between Es and Ts, Tes and Tr occurred only during exercise. No linear combinations of these temperatures could predict Es under all conditions of rest, exercise and ambient temperatures and account for more than 65% of the data. Thermoregulatory signals from the observ-

ed body temperatures may have interacted non-linearly, or other important sources of thermal and nonthermal signals may not be represented by our temperature measurements.

(Authors' abstract)

35

Automatic Cooling in Water Cooled Space Suits. PAUL WEBB and SAMUEL. *J. Aerospace Medicine*, Vol. 41, March 1970, P. 269-277, 21 Refs.

Water cooling in space suits is a powerful means of extracting metabolic heat, so effective that a man can be overcooled even when working hard. The problem is how to control the cooling. Manual control by the subject has been used but man is a poor judge of his own thermal state and often reacts too late or too strongly. Automatic control based upon physiological changes is discussed in this paper for astronauts who might work hard during extravehicular activity while relying on water cooling to prevent heat accumulation and sweating in space suits.

(Authors' abstract)

36

Sleep Patterns of an Airline Pilot Operating Worldwide East-West Routes. ANTHONY N. NICHOLSON. *Aerospace Medicine*, June 1970, Vol. 41, P. 626-632, 21 Refs.

The sleep pattern of an airline pilot operating long haul east-west routes have been observed over a period of eighteen months. The normal sleep pattern was modified by irregular duty periods, and by adaptation to time zone change. It is considered that sleep disturbance rather than sleep deprivation is the main problem in such aircrew. The physiological significance of the sleep patterns experienced during route flying is not understood, but it would appear possible that complex adjustments of intra-sleep cycles and short periods of sleep (naps) may provide an adequate sleep pattern.

(Author's abstract)

37

Activity of the Nervous System During the Let-down, Approach and Landing: A Study of Short Duration High Workload. A. N. NICHOLSON and L. E. HILL. *Aerospace Medicine*, Vol. 41, April 1970, P. 436-446, 14 Refs.

Subjective assessment of workload and changes in the rr interval and finger tremor of the pilot have been studied during the let-down, approach and landing of a Boeing 707 aircraft. The observations have been made during thirty-four landings into international airports. Each let-down was assessed for

its overall difficulty and with reference to the various factors which influence the work pattern. The rr interval was recorded during the terminal part of the cruise and let-down and the finger tremor was recorded before take-off and within one minute of touch-down.

The physiological change in the pilot associated with an uneventful let-down was a mean rr interval between 400 and 450 msec and finger tremor between 0.3 and 0.8 msec²Hz⁻¹ at the 10 Hz frequency. During let-down in which poor control was accompanied by inadequate aids and unfavourable meteorological conditions and frequently preceded by a high workload cruise indicated by a mean rr interval less than 630 msec at top of descent) the mean rr interval at touch-down was less than 400 msec but the finger tremor at 10 Hz remained less than 0.8 msec²Hz⁻¹. In the event of an unresolved problem persisting or a fresh problem of some magnitude appearing during the approach mean rr intervals of less than 400 msec were accompanied by finger tremors between 0.8 and 1.3 msec²Hz⁻¹ at the 10 Hz frequency.

It is considered that mean rr interval around touch-down reflects the workload of the cruise, let-down, approach and landing whereas changes in finger tremor are associated with untoward events during the approach.

(Authors' abstract)

FLIGHT SAFETY

38

Physiological and Psychological Factors in "The Dark Night Takeoff Accident". L. E. BULEY and J. SPELINA. *Aerospace Medicine*, Vol. 41, May 1970, P. 553-556, 11 Refs.

The apparent displacement of the vertical which may occur when the sitting body undergoes longitudinal (linear) acceleration was first indicated as a cause of night takeoff accidents at least 25 years ago. However it has received scant attention in the training and operational contexts and relatively little at hypothetical (e.g., accident investigator) levels and in the literature. In the absence of visual pitch information a pilot under longitudinal acceleration cannot distinguish between the true vertical and the resultant of the gravity and "acceleration" vectors. Thus after takeoff an illusion of excessive pitch-up may occur and if, due to "corrective" pilot control input and/or flap retraction, the aircraft enters a shallow dive, the pilot may still experience a sensation of climb. This sequence of

events is most likely to occur following takeoff over a "textureless" area in conditions of extreme darkness but good visibility (in the meteorological sense), which may induce the pilot to forsake his attitude instrument(s) in favour of looking out. The "classical" accident occurs when the shallow dive is allowed to continue steadily to impact with the unseen land or water. Accelerations of airline aircraft, as measured just after takeoff, would produce an apparent tilt of the vertical of between 5 and 10 degrees. The twelve accidents reported in ICAO Aircraft Accident Digests covering the period 1950-65, in which pilot disorientation of this type appears to have played a primary or contributory role, are cited. Two recent accidents (Ilyushin 181D, Gander, Canada, 5 September 1967; Boeing 707-344C, Windhoek, S. W. Africa, 20 April 1968) present a similar pattern. The calculated flight paths and sequential accelerations for an accident in 1954 and for the two recent accidents are presented, and illusory angular displacements of the vertical (providing a measure of the strength of the illusion) are derived for climb and descent phases. Factors thought to contribute to pilots' susceptibility to illusion are considered. Finally, the need for an integrated multi-level prevention programme is stressed.

(Authors' abstract)

39

Human and Epidemiologic Aspects of USAF Mid-air Collisions, 1 Jan. 1959 to 31 Dec. 1968. FICTOR J. FERRARI, Jr. and ANCHARD F. ZELTER. *Aerospace Medicine*, Vol. 41, March 1970, P. 313-317, 3 Refs.

Although the USAF mid-air collision rate fell from 0.8 in 1947 to 0.16 in 1968, the consistent increase in the number of mid-air collisions per hundred thousand major accidents during this same period indicates that these remain one of the most acute problems in aviation safety. An evaluation of these accidents establishes not only their increasing relative frequency but also their lethal potential and their relation to aerospace traffic density and type of mission. The analysis of the classic example establishes man's psychophysiological inability to avoid mid-air collisions on the basis of see and be seen. Man's psychophysiological limitations remain constant. Future aerospace research and development must bridge this gap between technological advances and fixed human capabilities if mid-air collisions are to be prevented. A number of ways in which this may be done are suggested.

(Authors' abstract)

40

Safety Significance of Aircraft Accident Post Mortem Findings. P. V. SIEGEL and S. R. MOHLER. *Aerospace Medicine*, Vol. 41, July 1970, P. 808-814, 2 Refs.

A review of post mortem examination obtained in 1968 of pilot victims of general aviation aircraft accidents reveals that 51% of the pilot victims were studied by pathologists. The post mortem examination population above was taken from 687 pilot fatalities in general aviation accidents occurring within the United States in 1968. The percentage of post mortem examinations obtained in 1968 represents considerable progress in comparison to earlier years. Without an aircrew autopsy, the probable cause almost always consists of a higher proportion of conjecture than in otherwise the case. The full utility of the important data resulting from these examinations is going to depend, however, upon the addition of certain quantitative data to that in the current verbally descriptive protocol almost universally encountered. This is particularly pertinent in relation to computer assisted analytic studies of broad scale concerning post mortem findings.

(Authors' abstract)

41

Effects of Bending on the Vertebral Column During +Gz Acceleration. A. P. VUICAN and A. I. KING. *Aerospace Medicine*, Vol. 41, March 1970, P. 294-300, 9 Refs.

Fractures of vertebrae are still common during ejection from military aircraft. The majority of fractures occur between T8 and L1. Experiments were conducted on the vertical accelerator using seated human cadavers. Strain gauges were installed on the anterior and lateral aspects of the vertebral bodies in order to assess the relative importance of bending and axial compression. The existence of significant bending stresses has been established. It is shown that these high bending stresses are caused by the forward rotation of the head and torso.

Various restraint system and seat-back configurations were investigated. The results show that bending strains can be reduced by increasing shoulder strap pre-tension and by leaning the seatback rearwards.

It is suggested that future models predicting vertebral injury of the seated human subjected to caudoccephalad acceleration should take into account forward

flexion of the head and torso and the effects of external restraints.

(Authors' abstract)

42

Study of Pilots Who Have Made Multiple Ejections. S. O. SMELSEY. *Aerospace Medicine*, Vol. 41, May 1970, P. 563-566.

Through 31 December 1968 there were 116 individuals who made two or more emergency non-combat ejections from USAF aircraft. The circumstances surrounding both ejections for each individual were reviewed and analyzed. The author came to the following conclusions. Overall success rates are better on the second ejection. Receipt of an injury on the first ejection lead to a higher success rate on subsequent ejections. Thirty-five individuals in this category had a success rate on the second ejection of 97.1%. Individuals who did not receive an injury (84) had a subsequent success rate of 83.3%. In the cases reported, receipt of a vertebral fracture on the first ejection did not predispose an ejectee to additive injury on a subsequent ejection.

(Author's abstract)

43

Over Water Safety. F. DENSLEY. *Flight Safety*, Vol. 3, February 1970, P. 10-11.

With the advent of Supersonic Transport, Jumbo Jets and Air buses and with air routes over water, runways extending sea wards, there would be a higher ratio of ditching in emergency situations. The various safety measures which are of paramount importance to prevent avoidable loss of life are sound legislation, incorporation of original planning for escape drills in the initial designs for aircraft, low wing aircraft design instead of high wing configuration, thorough training of crews in escape drills, provision of adequate survival aids and properly designed life rafts in the place of inadequate life Jackets, and constant training of aircrew for preservation of life after ditching.

(R.K.)

HEARING AND VESTIBULAR FUNCTION

44

Pure-Tone Air Conduction Audiogram. VERNON C. BRAGG. *Aerospace Medicine*, Vol. 41, March 1970, P. 264-268, 1 Ref.

Although the air conduction audiogram alone does not provide sufficient information for diagnosis in hearing loss cases, it usually gives an indication as to whether the loss is conductive or sensorineural

in origin. This information is essential to the proper handling of patients, particularly those who may be exposed to intense noises. A method for interpretation of audiometric contours is given, followed by a step-by-step procedure for analyzing the pure tone audiogram. In addition, recommendations are made concerning the handling of patients whose audiograms fall outside normal limits. Utilization of these procedures within a comprehensive program of hearing testing, noise control, and education has been found to constitute a successful hearing conservation program wherever personnel work in hazardous noises. The analysis technique should also be helpful in dealing with various types of hearing losses in many situations. A chart, Key to Interpretation of the Pure Tone Air Conduction Audiogram, provides a quick reference to patient disposition.

(Auditor's abstract)

45

Laterization of Hearing Loss and Vestibular Nystagmus in Test Pilots. A. BRUNER and T. W. NORRIS. *Aerospace Medicine*, June 1970, Vol. 41, P. 684-687, 10 Refs.

Bekesy hearing thresholds, and spontaneous and caloric nystagmus were recorded in 53 healthy test pilots. Significant correlations were obtained between interaural differences in high frequency hearing thresholds and the extent to which caloric nystagmus beat more strongly in one direction than the other (Directional Preponderance, DP). The direction of spontaneous nystagmus, when present, and DP were toward the worse hearing ear for pilots exhibiting interaural threshold differences, in contrast to the more typical findings for 17 unilateral sensorineural loss patients whose DP was away from the worse hearing ear. Normal hearing patients showed no hearing-vestibular relations, while 31 acoustic trauma patients gave results similar to the pilots.

The lateralization of hearing loss and DP among high frequency hearing loss subjects appears to be a central phenomenon and may represent a normal predisposition to asymmetry which may or may not be augmented by noise.

(Authors' abstract)

46

Off-vertical Rotation: A Convenient Precise Means of Exposing the Passive Human Subject to a Rotating Linear Acceleration Vector. ASHTON GRAYBIEL and EARL F. MILLER II. *Aerospace Medicine*, Vol. 41, April 1970, P. 407-410, 12 Refs.

A rotating chair modified to permit tilting of a subject up to 20° from the upright was used to expose 100 normal men to an unusual vestibular stimulus, eliciting manifestations including the clinical picture of motion sickness. Through stepwise increases in angular velocity of the chair, subjects were rotated at 10° tilt until they experienced mild motion sickness (a predetermined endpoint) or until a terminal velocity of 25 rpm was reached. Eighty-eight men reached the predetermined endpoint; seven additional men reached it only when the tilt angle was increased to 20°; the remaining five men were shown to be highly unsusceptible. The accuracy and flexibility of the method should prove to be useful in ranking persons according to their susceptibility to motion sickness and in studying the symptomatology, including the underlying central nervous system mechanisms.

(Authors' abstract)

47

Aftereffects of Various Alcoholic Beverages on Positional Nystagmus and Coriolis Acceleration. R. S. RYBACK and P. J. DOWD. *Aerospace Medicine*, Vol. 41, April 1970, P. 429-435, 38 Refs.

The purpose of this study was to observe the aftereffects of bourbon and vodka on subjective tumbling, and positional and Coriolis nystagmus recorded by electronystagmography. Subjects were pilots, non-flying personnel, and non-flying personnel habituated to Coriolis stimulation. After baseline values were obtained, subjects imbibed their beverage of choice at 2200 hours over a 90-minute period.

Re-examination occurred the following two mornings at 0830 hours. Positional alcohol nystagmus (PAN) occurred, but the usual order of PAN I and PAN II was not observed. An increment in Coriolis nystagmus was seen, and it appears that bourbon has a stronger effect than vodka 34 hours after ingestion. The implications of the latter and other findings, such as increased subjective tumbling, unmasking, and alcohol's effect on pre-existing positional nystagmus, are discussed.

(Authors' abstract)

TOXIC HAZARDS

48

The Changing Attitudes in Toxicology. A. S. CURRY. *Aerospace Medicine*, Vol. 41, July 1970, P. 754-756, 8 Refs.

The Home Office Central Research Establishment was set up in 1966 to do research into all aspects

of Forensic Science. Part of this work is in the field of toxicology. The RAF Institute of Pathology and Tropical Medicine at Halton (AVM W P Stamm) is concerned with the pathological work involved in aircraft crashes of British aircraft and in 1966 it was decided to form a combined unit to undertake the toxicological analysis of the victims of the crashes. This combination of RAF staff with the instrumentation at Aldermaston also provided the opportunity for research in aviation toxicology to be started.

(Author's abstract)

VISUAL PROBLEMS

49

Analysis of Visual Search Activity in Skilled and Novice Helicopter Pilots. JOHN A. STERN and JAMES A. BYNUM. *Aerospace Medicine*, Vol. 41, March 1970, P. 300-305, 2 Refs.

Eye movements in both the horizontal as well as vertical plane and eye blinks were recorded in 13 skilled and 13 unskilled pilots while flying the UH-1D helicopter during a cross-country flight of approximately 50 minutes duration. Saccadic eye movements in both the horizontal and vertical plane were evaluated. The results demonstrate that skilled pilots engage in significantly more visual search activity in the horizontal plane than is true of novice pilots. Both skilled and unskilled pilots demonstrate changes in visual search activity as a function of time on task. These changes include: a decrease of searching in the horizontal plane; a decrease in searching in the vertical plane; an increase in the amount of time not engaged in search activity per unit time; and a decrease in blink rate. These results are interpreted as suggesting a decrease in visual search activity as a function of time-on-task.

(Authors' abstract)

50

Flight-Deck Vision of Professional Pilots. R. D. WATCKINS. *Aerospace Medicine*, Vol. 41, March 1970, P. 337-342, 23 Refs.

Alterations to the near visual acuity requirements for professional pilots are recommended, and the reasons for these proposed alterations are discussed. The factors which influence the power and type of lens chosen for flight-deck use by a presbyopic pilot are presented, particular reference being made to the range of distances over which the main instrument panel should appear clear rather than the single

distance usually considered. The possibilities of ophthalmic correction for the overhead panel are briefly examined and are concluded to be less satisfactory than a human factors engineering solution.

(Author's abstract)

51

Effect of Oxygen on Night Vision. H. A. PRETORIUS. *Aerospace Medicine*, Vol. 41, May 1970, P. 560-562, 6 Refs.

The rods of the retina are the receptors responsible for night vision. This function is highly sensitive to oxygen deficiency. A deterioration in night vision is perceptible with even a minimal decrease in the partial pressure of atmospheric oxygen. A group of 100 young men (average age 19.5 years), were tested on a Goldmann-Weekers Adaptometer. Threshold curves of dark adaptation, with and without the administration of oxygen, were obtained at a height of 5,000 feet above sea level. Following the administration of oxygen an average improvement in night vision of 25.9% was found.

(Author's abstract)

52

Effects of Hypoxia and Acetazolamide on Color Sensitivity Zones in the Visual Field. JOHN L. KOBRICK. *Journal of Applied Physiology*, Vol. 28, June 1970, P. 741-747, 28 Refs.

Effects of exposure to a series of hypoxic atmospheres (0, 13,000, 15,000, 17,000 ft. equivalent elevations) on the size and shape of visual fields for red, green, and blue stimulus detection were studied. Twenty-four human subjects were tested, half of whom received acetazolamide and the other half equivalent placebo tablets. Complete monocular field plots were obtained by conventional perimetry techniques for each eye at each elevation for each color at luminances of both 9.3 and 0.72 ft.-L. and for exposure durations of 0.5 and 3.5 hr. Significant effects were shown for hypoxia levels, exposure duration and stimulus luminance; furthermore, acetazolamide reduced hypoxic decrements generated in the placebo group. In general, constrictions in visual field size were directly related to hypoxic severity and exposure duration, particularly at lower stimulus luminance. Relative sensitivity losses correctly followed predictions based on the Purkinje law of color luminance detectability, in that red sensitivity was earliest and most severely affected under hypoxia.

(Author's abstract)