

adjustment task on the USAFSAM Spatial Orientation Trainer. High percentages in blood ethanol levels were found in some individuals 8 hrs after ingestion of alcohol and "fatigue" was reported in spite of 7 hr of sleep.

3. **Involuntary Head movements and helmet motions during Centrifuge runs with up to + 6 G_z**; *Aerospace Med.* (K. H. E. KROEMER and KENNETH W. KENNEDY) Vol 44 June 1973; Page 639 - 644; Ref. 4.

Open-loop centrifuge runs reaching +6G_z were performed with 13 subjects wearing the foam padded standard HGU-2A/P helmet. Weights up to 20 oz were attached at top and sides. During the centrifuge runs, each subject attempted to maintain his gaze at a target directly in front of him. Hence, no voluntary motion of the head should have occurred. Position of the head, of the helmet, and of a helmet-attached reticle were recorded photographically at each G-level. From the photographs data on actual displacements of head, helmet and reticle were extracted and subjected to a computer-aided analysis.

Involuntary angular head movements as well as rotational displacements of the helmet on the head are discussed in this paper in terms of pitch, roll and yaw. Also described are linear changes in the vertical height of the subjects' eyes and of the reticle. Yaw and roll were found to be small and unstructured. Fore-and-down head and helmet pitch, and depression of eye and reticle were about proportional to the amount of + G_z stress.

4. **Effect of Prolonged Bedrest and + G_z Acceleration upon peripheral visual response time**; HAINES RF; *Aerospace Med.* Vol. 44; April, 1973 Page 425 - 432; Ref. 45

Cardiovascular deconditioning - dehydration-

and other physiological changes which occur as a result of prolonged exposure to the zero-g space environment raise some questions about the applicability of much previous research which has shown that spacecraft re-entry accelerations pose no appreciable physiological or performance problems for the astronauts. The present paper deals with whether or not peripheral visual response time changes during +G_z acceleration after 14 days of bedrest. Eighteen test lights, placed 10° arc apart along the horizontal meridian of the subject's field of view, were presented in a random sequence. The subject was instructed to press a button as soon as a light appeared. This testing occurred periodically during bedrest and continuously during centrifugation testing. The results indicated that: (1) mean response time was significantly longer (p) 0.01 to stimuli imaged in the far periphery than to stimuli imaged closer to the line of sight during + G_z acceleration. (2) mean response time at each stimuli position tends to be longer at plateau g than during the pre-acceleration baseline period for that run by an amount which ranged from about 20 to 120 msec, (3) mean response time tends to lengthen as g level is increased, and (4) under these testing conditions peripheral visual response time during + G_z acceleration within approximately 40 seconds of blackout does not provide a reliable indicator that blackout is going to occur. The bedrest response time data showed that the distribution of RTs across the horizontal retinal meridian remarkably constant within subjects from day to day during the bedrest and recovery periods. These findings are discussed in relation to previous studies and to the design and placement of aerospace vehicle cockpit instruments.

AIRCREW MEDICAL EVALUTION

1. **Functional Aging: Present Status of Assessments regarding Airline Pilot Retirement** - MOHLER S. R.; *Aerospace Med.* Vol 44; September 1973; Page 1062 - 1066; 12 Ref.

Gerontologic research progress to the present time concerning the biological age of a given human has proceeded relatively slowly. Reports by gerontologists and persons actively engaged in research on aging reveal that almost no significant progress has been made in the past 10 years from the standpoint of application. In part, this is due to a generally diminished emphasis in research support of gerontology on the topic of "functional" age. Since no significant new gerontological information exists at present beyond that which justified the original institution of a mandatory retirement age for air transport pilots over age 60, no basis currently exists for modifying the present regulation.

- 6. Monocular Pilots - A followup study -**
 MAYER HB and LANE JC *Aerospace Med.*,
 Vol 44 ; September 1973; Page 1070 - 1074 ;
 4 Ref.

A prospective survey was made of 203 pilots applicants with defective or absent vision in one eye and 408 matched controls. The monocular pilots, achievement in securing and retaining licences, acquiring endorsement on different aircraft types and accumulating flying hours, was equal to or better than that of the controls. There is a possibility, which cannot be entirely rejected, that the monocular pilots were involved in more hazardous events than the controls.

ENVIRONMENT PHYSIOLOGY

- 7. Human performance at Elevated Environment temperatures ;** W. F. GREYER ; Page 747 - 755 ; Ref. 48 *Aerospace Med.*, Vol. 44 July 1973.

A review of research on human performance at elevated temperatures is presented. The findings are analyzed in terms of five categories of performance measurements: (1) time estimation (2) reaction time, (3) vigilance and monitoring (4) tracking and

(5) cognitive and other skilled tasks. Time estimation studies, requiring subjects to count or tap at specified rates, generally show increased speed of response with elevation of internal body temperature. Most studies of simple reaction time have also resulted in increased speed as either body or environment temperatures are experimentally increased. Presumably both of these effects are a reflection of increased speed of neural conduction. Improvements in performance have also been found in measurements of vigilance, with optimum performance appearing at an Effective Temperature (E.T) of about 80° F. For all other performance functions there appears to be a plateau, with only minor effects, up to an ET of about 85° F. As environmental temperatures exceed this value there are generally increasing performance decrements. This plateau up to 85° F ET appears to coincide very closely with the range over which the human body can compensate physiologically to elevated environmental temperatures.

- 8. Heat acclimatization while wearing vapour-barrier clothing** *Aerospace Med.*, Vol. 44; June 1973; Page 609-612; Ref. 21

Acclimatization to a hot, humid environment was studied in nine men who performed work at an air temperature of 37° C while wearing vapour-barrier suits for 6 successive days. Heart rate, rectal and skin temperatures, sweat rate, and oxygen consumption were recorded. The results showed only partial acclimatization, which was indicated by decreases in heart rate and in rectal and skin temperatures of 16 beats/min 0.5° C and 0.6° C respectively from the first to the sixth exposures. Sweat rate increased 25 percent, oxygen consumption decreased 13 percent, and resting rectal temperatures decreased by 0.3° C. These changes made possible an increase of 13 min in tolerance time. Since the evaporation of sweat was minimal, due to the vapour-barrier suits, acclimatization was attributed to the lowering of resting body temperature and to the decrease in heat production.

- 9 **Thermal comfort; New directions and standards** - ROULES FH Jr and NAVINS, RG
Aerospace Med.; Vol. 44 July 73 Page 730-738. Ref. 17.

In order to determine the range of temperatures at which sedentary humans report feeling comfortable, 1,600 young adults were exposed in groups of 10 - five men and five women to 20 dry bulb temperatures ranging from 60 degrees to 98 degree F (19 degrees to 28 degrees C) in 2 degrees F (1.1 degrees C) increments at each of eight relative humidities 15% to 85% in 10% increments. The results showed that during the first part of the 3 hours exposure, the men were warmer than the women and that humidity is more important in determining how men feel than how women feel. For further research in the thermal environment a Model comfort envelope (MCE) consisting of 15 temperature-humidity conditions is proposed and its development, validation, and relationship to the new ASHRAE standards are discussed. The results are presented of a clothing study and a investigation involving elderly subjects in which the MCE was used.

- 10 **Tolerance to Heat following Cold stress**
SHVARTZ E; and MAGAZANIK A
Aerospace Med.; Vol. 44; July 73; Page 725 - 729
Ref. 11

Four men dressed in shorts performed moderate work at an ambient temperature of 50 degree C and 21% relative humidity, with and without previous exposure to 7 degrees C for 30 min. Metabolism, evaporation, heart rate and rectal and skin temperature were recorded at a temperature environment of 24.5 degree C, and every 15 min in the heat and cold. Exposure to cold resulted in an increase in metabolism and in rectal temperature and a decrease in skin temperature of 40%, 0.3 degrees C and 8.5 degree C respectively. The transfer from cold to heat resulted in an initial rapid rate of heat storage and in a decrease in evaporation

and conductance values as compared with no precooling, so that despite the removal of 91W/2m of body heat content in the cold, subsequent work in the heat was not improved. The main reason for the failure of precooling to improve reactions to heat in this study seemed to be related to the increase in rectal temperature in the cold.

HIGH ALTITUDE PHYSIOLOGY

- 11 **Nutrition systems for pressure suits**
HUNER CS; et al; *Aerospace Med.* Vol. 44; Aug.; 73 Page 905 - 909; 5 Ref.

Nutrition systems were successfully developed in the Apollo programme astronauts wearing pressure suits during emergency decompression situations and during lunar surface explorations. These nutrition systems consisted of unique dispensers water, flavoured beverages, nutrient-fortified beverages, and intermediate moisture food bars. The emergency decompression system dispensed the nutrition from outside by interfacing with a suit helmet penetration port. The lunar exploration system utilised dispensers stowed within the interior layers of pressure suit. These systems could be adapted for provision of nutrients in other situations requiring the use of pressure suits.

- 12 **Cobalt compounds for the control of hypoxia stress**; BRAHMACHARI HD and S JOSEPH; *Aerospace Med.* Vol. 44; June 1973; Page 636 - 638 Ref. 5

Cobalt chloride, cobaltodihistidine and Rencovite tablets were administered orally, on a daily dose equivalent to 2 mg. cobalt per rat and the polycythemic response of the treated animals to hypoxia exposure equivalent to an altitude of 27,500 ft for 40 days was compared with normal controls. The amounts of cobalt retained by the body tissues of the treated animals were also determined. The comparative efficiency of Rencovite tablets and cobaltodihistidine in relieving the hypoxia stress, as evidence by their

lowering of the degree of polycythemic response, was determined. Cobalt from all these compounds was effective in producing considerable polycythemic in normal rats, while exposure to hypoxia alone produced the same effect. The pretreated rats on exposure to hypoxia showed a decrease in the level of the R. B. C's from the already raised level. Polycythemic response to hypoxia was least on simultaneous administration of cobaltodihistidine and hypoxia stress, and the bone retention of cobalt was highest with this compound.

HUMAN ENGINEERING

13. **Intellectual performance during prolonged exposure to noise and mild hypoxia** - PIERSON WR.; *Aerospace Med*; Vol. 44 July 1973 Page 723-724 Ref. 12

The purpose of this study was to investigate the effects of 6.5 hr exposure to 85 dB(A) turboprop aircraft noise and an 8,000 ft simulated altitude on intellectual judgements common to aircrew tasks. No significant effects were noted in the ability to recall analogous situations and solutions, the ability to decode series of symbols into meaningful groups, or the ability to perform appropriate sequential psychomotor tasks. There was no apparent synergistic effect on these same variables.

14. **Interactive effects of intense noise and low-level vibration on tracking performance and response time** - STANLEY, C. HARRIS; and HENRY C SOMMER; *Aerospace Med* Vol. 44; September 1973; Page 1013-1016; 7 Ref

Studies conducted in our laboratory on the combined effects of noise and vibration on tracking performance have yielded both additive and subtractive effects. One reason for the difference in results may be the difference in the intensity levels of the noise used. Subtractive effects were obtained in a recent study using 100 dB while additive effects were obtained in another study using 110 dB noise. However, there were additional differences between the studies, other than noise level, that could have accounted for the results. The pur-

pose of the present study was to determine whether the intensity differences in noise level can account for the results. Approximately the same procedures were used in the present study with 100 dB noise as were used previously in a study where a subtractive effect was obtained with 100 dB noise. The performance of 12 subjects was measured during two conditions of noise, 60 dB and 110 dB and two conditions in which these noise exposures were combined with 0.10 g (vertical) vibration at 6 Hz. Noise produced a detrimental effect on tracking task performance and the effect was additive to the adverse effect produced by vibration when both noise and vibration were presented simultaneously. These results, along with the results of the previous experiments, demonstrate that as noise level is increased from 100 to 110 dB the combined effect of noise and vibration changes from subtractive to additive.

15. **Stress and strain in student helicopter pilots** - BILLINGS CE; RJ GERKE; RC CHASE and JJ Eggspuehler; *Aerospace Med*. Vol. 44 September 1973; Page 1031-1035; Ref. 27

The heart rates of nine volunteer subjects were studied during 223 hrs of primary helicopter flight training. Segments of heart rate data representing 3,952 replications of five standard training manoeuvres were selected for analysis, together with 645 segments while the helicopter was on the ground before during and after flight instruction periods. Heart rates after flights were generally higher than before the same flights. Heart rates, on the ground tended to increase over 20.25 hours of flight instruction. This trend towards increases the heart rates was also observed during dual flights, whether the instructors or students were flying. During solo flights, in contrast, heart rates tended to decrease in most students. Student heart rates were highest during flight checks in eight of nine subjects. We conclude that these data are indicative of a moderate and sequentially increasing level of psychological stress in students undergoing dual

flight instruction in helicopters. The exception to the sequential trend was solo flying. These trends may be a reflection of stress induced by the evaluatory of the flight instructors,

- 16 Physiological and operational state of a group of aeroplane pilots under the conditions of stressing and tracking tests**
Strassers H; G BRILLING; K P KLINGER and MULLER - LIMMROTH; *Aerospace Med.* Vol. 44; Sept. 73; Page 1040-1047; 15 Ref.

A test set-up is described with which a picture of the operational and physiological state of a group of pilots during about 2 hrs was obtained. The results recorded for tracking performance with fixed and also adaptive, selfadjusting degrees of difficulty, together with the simultaneous recording of the heart rate, sinus arrhythmia, and acoustically evoked potentials, were compared with the figures obtained from a control group. Through the combination of the parameters measured it could be demonstrated that the group of pilots had an above-average level of performance in the tracking tests as well as a high capacity for prolonged mental concentration. A relatively small acute alcohol effect, which cannot be separated from the natural effects of training by means of the operational data, is clearly shown in the parameter of evoked potentials that describes information processing by the CNS. It is suggested that this procedure may be used for aptitude diagnoses since it permits both performance and loading criteria to be determined.

HYPERBARIC MEDICINE

- 17. Massive surgical Air embolism treated with brief recompression six atmosphere followed by hyperbaric oxygen; ERIC KINDWALL; *Aerospace Med.* Vol 44; June 1973; Page 653-666; Ref. 16**

A case of massive air embolism stemming from open heart surgery is described, Twenty-

two minutes elapsed before cardio-pulmonary bypass could be reestablished. The patient reached the hyperbaric chamber 3hr. 17min. after embolization occurred. Only a brief 9min. at 6 ata was used, followed by treatment with low pressure oxygen requiring a total chamber stay at 5 hours 13 minutes. The patient was discharged from the hospital with only minimal neurologic residua. The practical advantages of this brief treatment schedule versus the standard 38 hours table are discussed. Pre-embolic heparinization probably played a major role in survival. The author feels that initial brief exposure to 6 ata followed by hyperbaric oxygen is superior in treatment of air embolism to the longer 38 hours schedule.

- 18 Hyperbaric Oxygen and Alveolar Surfactants: BECKMAN, DL and RT HOULIHAN, *Aerospace Med.* Vol. 44 April, 1973; Page 433 - 424; 12 Ref.**

Gross lung damage was previously found in rats exposed to mechanical head injury similar to that which occurs during exposure of rats to oxygen at high pressure (OHP). The pulmonary effects from this CNS injury and OHP exposure were blocked by sympatholytic and antiepinephrine agents. In monkeys CNS injury altered the alveolar surfactant, in the absence of any immediate gross lung damage. Surfactant changes were also produced by electrical stimulation of the pulmonary sympathetics in monkeys and cat. The present experiments were performed in order to determine whether OHP also could alter the alveolar surfactants before the occurrence of any gross lung damage. The results indicate that while rats exposed to minimal, OHP have both altered surfactants and gross lung damage, that cats had altered surfactants without the attendant gross lung damage; lung weight/body weight ratios were normal in the cat. In addition to the species differences, our results suggest that at least part of the toxicity of OHP on the lungs is a result of a centrally mediated sympathetic influence on the alveolar surfactants.