



Abstracts of Current Aviation Medicine Literature

I ACCELERATION PHYSIOLOGY

1. The application of positive pressure breathing for improving +Gz acceleration tolerance

Investigations on +Gz acceleration tolerance were carried out in pilots using various values of positive pressure breathing (PPB) during centrifugation. The greatest improvement of +Gz tolerance—2.2 +Gz—was achieved while applying PPB = 45 mm Hg and using a counterpressure suit. PPB prolonged the time at +5Gz from 2 min 35 s under control conditions to 6 min 53 s at PPB = 45 mm Hg. The author discusses the mechanism of the increase in acceleration tolerance at PPB, stressing its protective effect on the circulatory system.

[Domaszuk J: Aviat Space Environ Med, 54(4) : 334, 1983.]

2. Combining techniques to enhance protection against high sustained accelerative forces

Five volunteer subjects were tested for acceleration tolerance under eight different experimental conditions representing relaxed and unprotected tolerance and tolerance with all possible combinations of the Anti-G suit, the M-1 manoeuvre, and supination in a PALE seat. The individual and combined effects of the various acceleration protective techniques were examined as they related to various models for acceleration protection, and the data revealed no statistically significant deviations from a simple additive model. The apparent net additivity was interpreted as resulting from a combination of additive, synergistic, and overlapping mechanism.

[Cohen M M: Aviat Space Environ Med, 54 (4) : 388, 1983.]

II APPLIED PHYSIOLOGY

3. Role of lung surfactant in cerebral decompression sickness

Five dogs have been embolized by air infusion into the venous system, then sacrificed and the pulmonary vasculature isolated by ligatures while ventilation was maintained for a further hour. In a sixth animal, the embolization was omitted. The

lungs were back-perfused with plasma from the same dog and successive aliquots of the back-flushings analysed by thin-layer chromatography (TLC), each spot being removed for Phosphorus determination. The results showed that the major lipid component was the phosphatidyl cholines, while lysophosphatidyl cholines, phosphatidyl ethanolamines, and sphingomyelins were also identified in significant quantities. A phosphorus balance for the lungs showed a significant migration of phosphatidyl cholines increasing by a factor of 10.6. This migration of surfactant is discussed as an important factor in determining whether trapped pulmonary air emboli are released into the arterial system when their surface area is reduced by pressurisation, suggesting, that recompression should not to be too rapid.

[Butler B D and Hills BA : *Aviat Space Environ Med.* 54(1) : 11, 1983.]

4. Physiological and behavioural effects of tilt-induced body fluid shifts

This paper addresses the "fluid shift theory" of space motion sickness. The primary purpose of our research was the development of procedures to assess individual differences in response to rostral body fluid shifts on earth. Experiment I examined inner ear fluid pressure changes during head-down tilt in intact human beings. Tilt produced reliable changes. Differences among subjects and between ears within the same subject were observed. Experiment II examined auditory threshold changes during tilt. Tilt elicited increased auditory thresholds, suggesting that sensory depression may result from increased inner ear fluid pressure. Additional observations on rotation magnitude estimation during head-down tilt, which indicate that rostral fluid shifts may depress semicircular canal activity, are briefly described. The results of this research suggest that the inner ear pressure and auditory threshold shift procedures could be used to assess individual differences among astronauts prior to space flight. Results from the terrestrial observations could be related to reported incidence/severity of motion sickness in space and used to evaluate the fluid shift theory of space motion sickness.

[Parker D E, Tjernstrom O, Ivarsson A, Gullledge WL and Poston RL : *Aviat Space Environ Med.* 54(5) : 402, 1983]

5. Effects of partial anti-G suit inflation thoracic volume and breathing pattern

The purpose of this study was to determine the changes in thoracic volume and pattern of breathing during partial anti-G suit (PAGS) inflation by respiratory inductive plethysmography (RIP). Nine normal subjects donned the PAGS, with bladders over legs and thighs, and rested for about 10 min in 60° head-up tilt position. The subjects breathed with closed glottis at functional residual capacity while PAGS was suddenly inflated to 140mm Hg using a calves to thighs sequence. The increase in thoracic volume, as measured from deflection of RIP baseline was 252 ml (5.D.43ml), which reflected displacement of blood from the lower extremities into the thorax. On resuming normal breathing, thoracic volume returned to baseline level. Breathing pattern was then monitored for a 15 min baseline period. PAGS was inflated, expiratory reserve volume (ERV) was measured by spirometry, and breathing pattern was monitored another 15min. ERV decreased 227ml (± 60) after PAGS inflation, which did not differ from the change in thoracic volume expected from displacement of blood into the thorax. Breathing pattern was monitored for another 15 min after PAGS was deflated. No changes took place in minute ventilation, tidal volume, frequency, inspiratory time, fractional inspiratory time and mean inspiratory flow from deflation to PAGS inflation. Thus, 1) increase in thoracic volume produced by displacement of blood from the calves and thighs is balanced by a decrease in gas volume and, 2) no changes in breathing pattern occur after partial anti-G suit inflation, probably because the pulmonary blood vessels and heart are sufficiently distensible to accept a 150 ml volume increment without leakage of fluid into pulmonary tissue.

[Charha T S, Lopez F, Jenouri G, Birch S and Sackner, MA : *Aviat Space Environ Med.* 54(4) : 324, 1983.]

III AVIATION NEURO PSYCHIATRY

6. Sharp targets are detected better against a figure and blurred targets are detected better against a background

There is growing evidence that the performance of percentual tasks is often facilitated by perceived

"figureness". Accuracy in detection and discrimination of targets is higher when the targets are presented in figural regions than when they are presented in ground regions of an image. This "figure superiority" might be a result of a functional specialisation in the visual analysis of figure; recent theories have also assumed a functional specialisation in the visual analysis of ground. If so, we might expect "ground superiority" in situations where task performance requires information available primarily through analysis of ground. We manipulated the spatial frequency of a small line segment and found that when it was sharp (i.e. the high-spatial frequency components were present) it was detected better in figural regions, but when we blurred it (only the low-to-medium spatial frequencies were present) it was detected better in ground regions. These findings support the view that figure and ground analyses involve different specialised functions.

[Wong E and Naomi Weisstein N : *J Exp Psy.* 9(2) 194, 1983.]

7. Motion Sickness : Acquisition and retention of adaptation effects compared in three motion environments

A sharp distinction should be made between symptoms of motion-sickness per se and phenomena inferred from the symptomatology, which include rates of acquisition and decay of adaptation effects. Fore-knowledge of those "derived phenomena" are valuable if it can be shown that they hold true for virtually any motion environment. Recently, we have developed a sudden-stop vestibulovisual interaction test for measuring susceptibility to motion sickness (1) The test procedure involves four successive assessments that provide not only an index of susceptibility to motion sickness but also the rates of acquisition and decay of adaptation effects. The 14 subjects participating in this test had previously served as subjects in parabolic flight experiments and seven of them had also taken part in the assessment of anti-motion-sickness remedies in a slow rotation room. The present report examines whether their rates of acquisition and decay of adaptation to stressful motion repre-

sent consistent general features of their responses across motion environments. From these comparisons, it appears that an individual's rates of acquiring and losing adaptation are quite consistent in very different situations. The pattern of results also suggests modifications of the sudden-stop vestibulovisual test that should increase its effectiveness as a motion-sickness screening procedure, both for orbital flight and for terrestrial conditions.

[Graybiel A and Lackner JR : *Aviat Space Environ Med.* 54 (4) : 307, 1983.]

8. Autonomic activity and workload during learning of a simulated aircraft carrier landing task

Heart rate, heart rate variability, and skin conductance responses were continuously recorded from six naive males during learning of a simulated

aircraft carrier landing task. There were 30 learning trials spanning more than 1h. Over trials heart rate decreased while flight performance increased indicating that heart rate is sensitive to practice effects. Independent of practice, heart rate and skin conductance amplitude always increased during the last minute of final approach to landing. The results supported the following conclusions: (a) heart rate and skin conductance amplitude are reliable indicators of short-term workload increases as typified by final approach; (b) heart rate is a reliable indicator of longer term workload decreases resulting from practice and increased mastery of the task. Results are discussed within the framework of autonomic activation theory.

[Lindholm E and Cheatham CM : *Aviat Space Environ Med.* 54 (5) : 435, 1983.]

9. Sensory conflict theory of space motion sickness : An anatomical location for the neuroconflict

Most investigators understand sensory conflict to mean a discontinuity between either visual, proprioceptive, and somatosensory input, or semi-circular canal and otolith input. Few hypotheses have attempted to define specific physiological

mechanisms linking the conflict with the sickness. Suggestions that the theory be renamed the neural mismatch theory allow for the possibility that central integrative mechanisms are involved in interpreting the significance of the sensory environment and that the conflict between visual or vestibular input systems or between separate components of the vestibular system is of secondary importance to mismatch occurring between ongoing sensory experience and long-term memory. This paper describes the role of the limbic system in integration of sensory information and long-term memory, in the expression of the symptoms of motion sickness, and the impact of anti-motion sickness drugs and stress hormones on limbic system function. The limbic system may be the neural mismatch centre of the brain.

[Kohl R L : *Aviat Space Environ Med*, 54(5) : 484, 1983.]

10. Effects of low intensity, continuous and intermittent noise on mental performance and writing pressure of children with different intelligence and personality characteristics

Mental performance (learning, reading, multiplication) and writing pressure of 66 ten-year-old school children was studied for 2 hours under three conditions: silence (25 dB; Only), continuous (51 dB; 2.25 noy) and Intermittent (55-78 dB; 2.25 noy) noise. No statistically significant main effects of noise or interaction between noise and personality characteristics were found. However children with high intelligence solved more items on a multiplication task in noise than in quiet conditions. The reverse was found for children with low intelligence, who were also more affected on the reading task. The results are discussed in terms of arousal theory.

[Johansson CR : *Ergonomics*, 26 (3) : 275, 1983.]

11. A Trimix saturation dive to 660 m Studies of cognitive performance, mood and sleep quality

This paper reports psychological observations on men during a simulated (pressure chamber) dive to 660m of sea-water (msw) using a gas mixture known as Trimix (He-O₂-N₂).

Recent studies by Bennett (1981) have suggested that this mixture allows for faster compression with less impairment in performance than the mixture traditionally used (He-O₂). Data were obtained from two divers on tests of cognitive performance namely arithmetic ability, grammatical reasoning, percentual speed, visuo-spatial manipulation and semantic processing. At maximum depth there was a severe blanket impairment of ability to perform any of the tests. However, at shallower depths the impairments were not as marked, with performance at 300 msw close to that measured at surface pressure. Subjects were also required to fill in two questionnaires, one concerned with the quality of their previous night's sleep, the other with their mood at the time. Sleep quality was disrupted throughout the dive, with one subject affected rather more than the other. Mood patterns varied less systematically, with large individual differences. Low correlations between sleep quality and performance indicate that performance decrements were due almost entirely to breathing Trimix at high pressure.

[Logie RH and Baddley AD : *Ergonomics* 26 (4) 359, 1983.]

IV. AVIATION OPHTHALMOLOGY

12. The dynamics of vertical eye movements in normal human subjects

We studied the dynamics of horizontal and vertical slow eye movements (vestibular, optokinetic, pursuit and visual-vestibular) in 10 normal human subjects. Several differences between horizontal and vertical eye movements were found. The time constant (time required for the slow-phase eye velocity to decay to 37% of the peak value) of vertical postrotatory nystagmus (PRN) was, on average, 50% as long as the time constant of horizontal PRN; the mean phase lead of per-rotatory nystagmus during low-frequency sinusoidal rotation in the vertical plane was approximately twice the mean phase lead of per-rotatory nystagmus at the same frequency in the horizontal plane. Vertical optokinetic after-nystagmus (OKAN) was minimal com-

pared to horizontal OKAN. Asymmetries in the dynamics in the dynamics of vertical eye movements were also noted. The mean time constant of PRN with upward slow phases was consistently longer than the mean time constant of PRN with downward slow phases and vertical OKAN only occurred when the optokinetic stimulus moved upward. Upward pursuit was better than downward pursuit and upward slow phases of vestibular nystagmus were poorly inhibited with fixation while downward slow phases were normally inhibited.

[Baloh RW, Richman L, Yee RD and Honrubia V : *Aviat Space Environ Med*, 54 (1) : 32, 1983]

13. Peripheral circular contours inhibit the visual orientation control system

Peripheral visual stimulation with tilted luminous frame has long been known to influence both body orientation and the apparent tilt of objects. Peripheral visual inputs along with vestibular and somesthetic components thus constitute a multichannel perceptual orientation control system. Surrounding the visual induction pattern with a luminous circle reduce the effectiveness of the visual channel to about 23% of maximum, whereas inscribing a circle within the luminous frame was without effect. This finding suggests a simple method for dealing with undesirable visual-vestibular interactions and an explanation for some instance of disorientation.

[Ebenbaltz SM and Utriv Jr JW : *Aviat Space Environ Med*, 54(4) : 343, 1983.]

V BIO ENGINEERING

14. Improved telemetric EEG monitoring in epileptic patients

A 20-channel EEG telemetry system provides EEG monitoring with standard EEG recording performance for use in epileptic patients. The EEG activities of 20 electrodes are separately amplified and transmitted employing PCM cable telemetry. A standard EEG apparatus is used, allowing montages to be freely selected and changed during recording.

[Kamp A and Allink JW : *EEG and Clinical Neurophys*, 56 : 254, 1983]

15. A comparison of limb plethysmograph systems proposed for use on the space shuttle

Comparisons of a Whitney mercury-filled doubled-stranded strain gauge with two plethysmographs proposed for Shuttle use an ultrasound and an impedance plethysmograph - were performed on 20 subjects. An occlusive thigh pressure cuff, inflated to 50 mm Hg, caused partial venous occlusion and subsequent blood pooling distal to the cuff. The average maximum volume changes observed in the Whitney/ultrasound test were 2.07% and 3.35%, respectively, and 2.12% and 2.53% for the Whitney/impedance comparison. Applying the ratio of the maximum volume changes to the gain of each test system caused the impedance and ultrasound volume change determinations to be essentially identical to the Whitney gauge. The three different limb parameters measured result in significant magnitude differences but the three systems track their respective changes identically.

[Levitan B M Montgomery LD, Bhagat PK and Zieglschmid JF : *Aviat Space Environ Med*, 54(1) : 6, 1983]

16. Cardiac function monitored by impedance cardiography during changing seatback angles and anti-G suit inflation

Impedance cardiography (IC) appears to be a promising noninvasive technique for monitoring small changes in pilot cardiovascular status during conditions simulating flight. Heart rate (HR), stroke volume (SV), cardiac output (CO), ventricular ejection time (VET), and thoracic impedance (Zo) were monitored in ten volunteers for 5 min at each of four seatback angles from vertical: 12°, 30°, 45°, and 60°. Data were also obtained at three seatback angles (12°, 30°, 60°) for 6 min each before, during, and after inflation of the standard USAF anti-G suit to 1.5 psi. Significant differences ($p < 0.05$) in HR, SV, CO, VET and Zo were observed among the four positions. Inflation of the standard anti-G suit to 1.5 psi at 1.0 + Gz did not significantly alter HR, SV, or CO; whereas, 1 min of deflation of the anti-G suit significantly altered HR, SV, CO compared to inflation values. The results suggest IC can detect

small differences in HR, SV, CO, VET, and Z_o within subjects as a function of minor changes in body position.

[Logan J.S. Veghte J.H. Frey MAB, Robillard LMJ BL and Luciani RJ *Aviat Space Environ Med.* 54(4) : 328, 1983.]

VI BIORHYTHMS

17. Effects of travel across time zone (jet-lag) on exercise capacity and performance

Eighty-one healthy male soldiers, aged 18-34, were studied for 5 d before and 5 d after an eastward deployment across six time zones to determine the effects of translocation on exercise capacity and performance. Fatigue, weakness, headache, sleepiness, irritability, and other commonly reported symptoms occurred in the majority of subjects. Most, but not all, of the symptoms were diminished or absent by the fifth day following the translocation. Cardiorespiratory function and perception of effort during both submaximal and maximal treadmill exercise were unaffected. Isometric strength of the upper torso, legs, and trunk extensor muscles also was not changed. Dynamic strength and endurance of elbow flexors declined significantly. Dynamic knee extensor strength and endurance scores exhibited a progressive decrement prior to translocation and were inconsistent suggesting that the stress of repetitive testing outweighed any jet-lag effects on performance capacity. Performance times for a 270 m sprint were increased for the first 4 d following translocation as were times for a 2.8 km run on the second and third days and for a 110 m lift and carry on the third day after deployment. Times for a 6.5 m rope climb did not change. These findings indicate that certain symptoms and physiological capacities are affected as a result of multiple time zone translocation. However, the specific mechanisms involved, the factors influencing the magnitude of any physiological alterations, and the ultimate impact of these capacity changes on actual physical performance remain to be clarified.

[Wright JE Vogel JE Vampson JB, Knapik JJ Patton JF and Daniels WL: *Aviat Space Environ Med.* 54(2) : 132, 1983.]

18. Circadian rhythm amplitude—Is it related rhythm adjustment and/or worker motivation?

The results of two studies are presented, the first from subjects undergoing an irregular schedule of sleep and wakefulness in an isolation unit, the second from nurses during their normal night duty. In the first study, for individuals during the irregular schedule, there was some evidence for an inverse relationship between the amplitude and acrophase adjustment of the circadian rhythms of deep body temperature and urinary excretion of potassium, sodium and urate. No clear relationships between these variables were found either if group data from the subjects were considered or if the amplitude of circadian rhythms during conventional hours of sleep and wakefulness was compared with acrophase adjustment on the irregular schedule. In the second study there was evidence that nurses working at night on single occasions only continued a conventional diurnal routine, even as far as possible, whereas, when a number of consecutive nights were worked, there was evidence that substantial changes in routine, even encroaching upon leisure time took place; this can be interpreted as 'commitment' on the part of frequent night workers. The possible relationship between the amplitude of circadian rhythms and 'commitment' in shift workers is considered.

[Minors DS and Waterhouse JM: *Ergonomics* 26(3) : 229, 1983.]

VII CLINICAL AVIATION MEDICINE

19. Acceleration induced ventricular tachycardia in asymptomatic men relation to mitral valve prolapse

In this study, the findings in 15 apparently healthy asymptomatic males who had short runs of ventricular tachycardia during +Gz acceleration stress are described. All had echocardiograms in an effort to screen them for possible mitral valve prolapse. The only individuals with mitral valve prolapse were aircrewmen already undergoing aeromedical evaluation for mitral valve prolapse, which included +Gz acceleration testing. The episodes of ventricular tachycardia occurred in association with very stressful +Gz exposures on a human

centrifuge. Anthropomorphic and physiologic response parameters suggest that these individuals were under unusually high stress when they had the episodes of ventricular tachycardia. The multistress environment of the advanced fighter aircraft pilot represents a summation of factors that have previously been associated with significant dysrhythmias, such as ventricular tachycardia. These results suggest that in-flight episodes of ventricular tachycardia may occur frequently in asymptomatic, apparently healthy aircrewmembers with completely normal aeromedical evaluations. If documented, ventricular tachycardia alone or mitral valve prolapse associated with significant dysrhythmias, such as ventricular tachycardia, are both currently disqualifying for continued USAF flying status. Continued investigation of ventricular dysrhythmias and mitral valve prolapse is imperative for assurance of both aeromedical safety and prevention of unnecessary medical restriction of aircrewmembers from continued flying duty.

[Whinnery J E : Aviat Space Environ Med. 54(1) : 58, 1983.]

20. Hypertension and orthostatic hypotension in applicants for flying training and aircrew

Although blood pressure standards in aircrew members have been revised periodically over the past 70 years, hypertension still remains one of the most controversial problems in aviation medicine. Improved clinical knowledge and operational experience vindicate a more liberal attitude for acceptable blood pressure levels. Applicants for flying training presenting labile hypertension may be accepted. Also, experienced, older aircrew with benign hypertension controlled by drugs without adverse reactions and without target organ disease may remain on flying status. In order to avoid compromising flight safety, long-term monitoring of flight crew for the diagnosis of hypertension together with the evaluation of anti-hypertensive drugs in aircrew is urgently required.

[Fuchs HS : Aviat Space Environ Med. 54 (1) : 65, 1983]

21. Diagnostic accuracy of exercise electrocardiography - A Review

The cardiovascular "stress test", and particularly the graded treadmill exercise test, has gained

wide acceptance as a diagnostic aid in searching for ischemic heart disease and as a prognostic indicator for those with known coronary artery disease. Controversies still exist, however, in its use in mass screening and in interpreting equivocal tests. A review of the use and value of electrocardiographic exercise testing is presented. Topics such as its use in asymptomatic individuals, the adjuvant use of clinical examination, and the examination of ancillary treadmill parameters are presented. No attempt is made to detail the very significant contributions of radionuclide scanning. The positive exercise electrocardiogram in the asymptomatic subject is discussed and guidelines for clinical management are offered.

[Johnson RL and Bungo MW : Aviat Space Environ Med. 54(2) : 150 1983.]

22. Sudden Incapacitation : USAF experiences 1970 - 80

During the period 1970-80, there were reported 146 cases of in-flight sudden incapacitation in the USAF. Of these, 62 involved pilots, 14 were navigators, and 70 were student pilots. The aetiologies of sudden incapacitation included illness without loss of consciousness, loss of consciousness, spatial disorientation, and improper M-1 manoeuvre. Each of these categories is analyzed with emphasis upon prevention, for example, not flying with symptomatic preexisting disease, continued emphasis upon spatial disorientation training, and correct performance of the M-1 manoeuvre. Based upon the data, conclusions and recommendations are suggested to minimize the risk of episodes of in-flight sudden incapacitation.

[Rayman RB and McNaughton GB : Aviat Space Environ Med. 54(2) : 161, 1983.]

23. An unusual cause of sudden incapacitation in flight : A case report

A 49 yrs old experienced Air line pilot developed grand-mal type seizures while flying on an international route. Subsequent investigations revealed that the seizures were probably caused by lead encephalopathy resulting from prolonged clandestine self medication with an indigenous ("Ayurvedic") drug for improving glucose tolerance.

Details of the case are discussed with special emphasis on its aero medical significance.

[Nayar GS: Journal of the Association of Aviation Medical Examiners 1: Suppl, 1983.]

24. An evaluation of plasma volume expanders in the treatment of decompression sickness

Each of 29 goats was instrumented with an ultrasonic flowmeter transducer around the left common carotid artery and a silastic catheter in the anterior vena. Following recovery from the surgery the goats were subjected to a dive protocol designed to elicit symptoms of decompression sickness (DCS). The goats were returned to the surface and, following a 20 min observation period, were either left untreated (controls) or treated with one of five different plasma volume expanders. The plasma volume expanders were evaluated based on their ability to decrease the severity of DCS and the number of arterial bubbles that could be counted. Analysis of the results shows that all of the five plasma volume expanders used appeared to reduce the severity of the signs of DCS and to decrease the number of arterial bubbles detected but that these tendencies were not statistically significant except for mannitol and Dextran 40. Animals that did not develop arterial bubbles tended to respond better to fluid therapy than did those that did develop bubbles.

[Morton DA, Fife WP and Gross DR: Aviat Space Environ Med. 54(3): 218, 1983.]

VIII ENVIRONMENTAL PHYSIOLOGY

25. 100% Oxygen breathing during acute heat stress: effect on sweat composition

Twelve male Indian Air Force subjects were exposed on two occasions to a simulated hot environment (DB 57°C; WB 35.5°C; RH 25) for a period of 50 min. On one occasion the subject breathed 100% oxygen at ambient atmospheric pressure. Arm sweat collected at the end of the two experiments was analysed for Na⁺, K⁺, Mg⁺⁺, Cl⁻, and lactic acid. Arm sweat Mg⁺⁺ was found to be much higher than that reported in the literature. Hyperoxia during heat stress improved arm sweating and showed significantly lower concentrations

of Mg⁺⁺, Na⁺, K⁺, and lactic acid. However, the total loss of these cations and lactic acid through the arm were not found to differ significantly for the two experiments. Based on arm sweat concentration, when the total body loss of these cations was worked out for the two runs, only whole-body Mg⁺ showed a significantly lesser loss during hyperoxia. The selective retention of Mg⁺⁺ during the hyperoxic heat run and its association in lowering the heat-induced physiological strain are discussed.

[Morton DA, Fife WP and Gross DR: Aviat Space Environ Med. 54(3): 218, 1983.]

26. Effect of cold exposure on various sites of core temperature measurements

Rectal oesophageal, auditory canal, gastrointestinal tract, and sublingual temperatures were recorded on five young Caucasian males who, in an environment of -32°C and 11 km/h wind, sat during one 90-min exposure and walked on a treadmill at 2.9 km/h during another. The clothing permitted cooling of their torsos while giving adequate protection to their extremities. Control exposures involved subjects sitting in still air at 24-27°C dressed only in thermal underwear. In the control environment all of the internal body temperatures measured gave comparable and consistent values; however, cold exposure affected the various sites differently. Oesophageal temperatures fluctuated rapidly as a result of subjects swallowing cold saliva. Sublingual temperatures were below the lower limit of a clinical thermometer, possibly because of facial cooling. Auditory canal temperatures were low, perhaps also because of facial cooling. Rectal temperatures were high as were the gastrointestinal tract temperatures, due perhaps to local heat production in response to cold stimulation. Metabolic rate increased initially in the cold and again toward the end of the cold exposure.

[Livingstone S D, Grayson J, Frim J, Allen CL and Limmer RE: J Appl Physiol Respirat Environ Exercise Physiol 54(4): 1025, 1983.]

27. Does heat acclimation lower the rate of metabolism elicited by muscular exercise?

Heat acclimation has been suggested to either

lower or have no effect on the rate of metabolism (M) elicited by muscular exercise. The purpose of the present investigation (Study I) was to examine the effect heat acclimation has on the $M(W\text{ Kg}^{-1}$ or VO_2 in $\text{ml kg}^{-1} \text{min}^{-1}$) elicited by muscular exercise. Two additional investigations were evaluated to determine if season (summer or winter) of year (Study II) and subjected gender (Study III) further influence the effect heat acclimation has on during exercise. Volunteers for Study I ($n=15$ men), II ($n=8$ men), and III ($n=10$ men and 9 women) completed standardized treadmill walks in hot (40°C , 30% rh or 49°C , 20% rh) and cool (20°C , 40%) environments immediately before and after heat acclimation. After heat acclimation, lower M was observed for Study I (-4% ; $P<0.05$), II (-2% ; NS) and III (-3% ; $p=0.06$) in a hot environment. In addition, after heat acclimation a lower M was observed for study I (-3% ; $p=0.08$), II (-5% ; $P<0.05$) and III (-6% ; $p<0.05$) in the cool environment. Season of year and subject gender did not have significant effect on these results. These data indicate that heat acclimation does lower the M elicited by exercise. The observed percent decrease was lower in the hot (-3%) than cool (-5%) test environment.

[Sawka MN, Pandolf KB, Avellini BA and Shapiro Y: *Aviat Space Environ Med* 54(1): 27, 1983.]

28. The subjective equivalence of sinusoidal and random wholebody vibration in the sitting position (an experimental study using the 'floating reference vibration' method)

An experimental technique known as the 'floating reference' method was developed to compare the subjective response of seated subjects to sinusoidal vibrations in the range 1-10 Hz with those produced by narrow-band random vibration (Gaussian distribution) centred on the same frequencies. Male and female subjects were asked to adjust the r.m.s. amplitude of each test vibration until it produced an overall sensation equivalent to that caused by a reference vibration. The frequency content and rms values of the random stimuli measured on the seat attachment plate are representative of vibration environments associated with

earth-moving machines and tractors for agricultural and forestry use.

The results have a small dispersion and show that subjects generally appear to be slightly more sensitive to random excitation than to sinusoidal (approximately 1 dB when averaged over the range 1-10Hz). This difference of sensitivity decreases at higher frequencies, but was observed in all three translational directions of fore-and-aft, lateral and vertical motion at frequencies below 6 Hz.

The equivalent sensation contours derived from these experiments relate only roughly to the weighting curves enshrined in the Standard ISO 2631, particularly for the fore-and-aft axis.

[Donati P, Grosjean A, Mistrot P and Roure L: *Ergonomics* 26(3): 251, 1983.]

IX HIGH ALTITUDE PHYSIOLOGY

29. Hypoxia : USAF Experience 1970-80

During 1970-80, 298 USAF aircrewmen were reported as having experienced in-flight hypoxia. Although none of the incidents resulted in an aircraft accident, the potential was there in that many of the reported symptoms were incapacitating to some degree. Most often, the cause of the hypoxia incident was due to cockpit cabin depressurisation or some other malfunction of the oxygen system. However, it was sometimes due to poor oxygen discipline. The authors emphasize that, with a thorough preflight inspection of the mask, hose, and connections as well as a Price check, the risk of in-flight hypoxia would be significantly reduced.

[Rayman RB and McNaughton GB: *Aviat Space Environ Med* 54(4): 357, 1983.]

30. Decompression sickness : USAF experience 1970-80

During the period 1970-80, there were 58 cases of decompression sickness in one of its forms reported in USAF aircrewmen. These cases occurred in a number of different types of aircraft in which cabin/cockpit depressurization occurred either intentionally (because of operational require-

ments) or because of mechanical malfunction. The most common manifestation of decompression sickness was bends, although some airmen experienced various degrees of neurological dysfunction. Even though none of the aircraft was lost or damaged due to crew incapacitation, the threat was clearly there. The authors briefly review decompression sickness including prevention, treatment, and aeromedical disposition.

[Rayman RB and McNaughton GB: Aviat Space Environ Med, 54(3): 258, 1983.]

X SPACE MEDICINE

31. Space motion sickness : phenomenology countermeasures, and mechanisms

A summary of the incidence of Space Motion Sickness (SMS) in 27 soviet cosmonauts who flew on missions varying from 2 - 185 d in the Salyut-6/ Soyuz vehicle complex is presented. A questionnaire indicated that 88% (24) of the cosmonauts developed some type of "illusionary sensation" while 44% (12) presented some degree of SMS. The SMS countermeasures used in flight included an antihistaminic drug, pneumatic cuffs applied to the thigh reflexion, application of lower body negative pressure, a head cap that restricted head movement while simultaneously providing force stimulus to the cervical antigravity muscles, and finally the use of an insole counterpressure device that added pressure to the sole of the foot.

[Matsnev E I, Yakovleva Y, Trasov IK, Afakseev VN, Korniloyan, LN, Matveev AD and Gorgiladze G: Aviat Space Environ Med, 54(4): 312, 1983.]

32. Correction of changes in fluid-electrolyte metabolism in manned space flights

In order to prevent and correct hypohydration and negative electrolyte balance, the effects of exercises, lower body negative pressure (LBNP) and water-salt supplements (WSS) were investigated in more than 100 test subjects during 14, 49-182-d headdown tilt test (-4°). A combined use of WSS and LBNP during regular exercises led to a distinct water and sodium retention. These changes

were mainly determined by the stimulation of the renin-angiotensin-aldosterone and antidouretic systems. After these countermeasures were tested in simulation studies, they were used by 12 cosmonauts during the 63- and 185-d space flights. The detailed analysis of the postflight examinations of the crewmembers suggests that these countermeasures may exert a beneficial effect on fluid-electrolyte balance.

[Grigoriev A I: Aviat Space Environ Med, 54(4): 318, 1983.]

