



## Abstracts

### I AVIATION PHYSIOLOGY

#### 1 Hypoxia : USAF Experience 1970-1980

During 1970-80, 298 USAF aircrewmembers 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 course of the hypoxia incident was due to cockpit/cabin depressurization 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.

[Russell, B Rayman and Grant. B McNaughton Aviat Space Environ Med Vol 54, No 4 April, 1983 pp 357-359]

#### 2 A model for prediction of resynchronization after time-zone flights

Utilizing experimental data from three flight studies, a concept was developed which allows appraising average resynchronization for any day after arrival in a new time-zone. The course of adaptation is nonlinear and can be mathematically represented by an exponential function. The model predicts higher initial resynchronization rates when more time zones are crossed, but total time for complete resynchronization is essentially the same and, thus, independent of the number of time-zones. The equation derived from experimental data is converted into an e-function and the resulting time constants are presented as they evolved for different functions and flight directions.

[Hans M Wegmann, Karl E Klein, Bernhard Conrad, and Paul Esser Aviat Space Environ Med Vol 54, No. 6, June 1983, pp 524-527.]

#### 3 On-line Electromyographic Signal Processing system

An on-line electromyographic signal (EMG) processing system using a microcomputer is described. It allows real-time diagnostic aid, interference

electromyogram acquisition and processing, and signal base constitution. It includes a preprocessing unit, microprocessor based, with specialized routines (segmentation of motor unit action potentials (MUAP) in multiunit records, programmable sample frequency and duration recording, as well as specific multichannel operation), graphic display micro-computer with hard copy, mass storage, and force experimental setup (strain gauge connected to digital voltmeter).

The diagnostic application is performed on low contraction electromyographic needle signal in three steps: (1) automatic pattern recognition; (2) measurement of MUAP's parameters (such as duration, amplitude, number of peaks, and phases); (3) classification by means of a nearest class algorithm (the learning classes are obtained with dynamic cluster methods from pathological and normal subjects examinations). Micro-computer software, for needle and surface interference electromyogram processing, has been developed for spectral analysis and autoregressive modeling.

[Jean-Louis Coatrieux—IEEE Transactions on Biomedical Engineering, Vol BME-31, No. 2 Feb 84 pp 199-206]

#### 4 A cardiac hypothesis for the origin of EEG Alpha

Major hypotheses for the origin of EEG alpha suggest a neural basis, but omit to consider other electrical and mechanical aspects. A cardiac electro-mechanical hypothesis is proposed. This hypothesis suggests that the natural mechanical frequency of the skull-brain mass is approximately 10 Hz. This has been determined by model and direct measurement. Membrane, liquid junction, electrode, and static charges exist as nonneural sources of potential in EEG recording. These standing potentials can be modulated by pressure and movement. It is postulated that the arterial pulse shocks the brain mass into oscillation at its natural frequency modulating the nonneural potentials. The arterial pulse has a jitter as great as  $\pm 720$  electrical degrees at 10 Hz and amplitude jitter of approximately  $\pm 10$  mm Hg. Because of cardiac jitter, the differential aspect of amplification, and mixing of waves in the skull, coherence of alpha with phase of the cardiac cycle

could not be demonstrated. The cardiac electro-mechanical hypothesis may assist others in designing experiments that will establish a valid explanation for the origin of EEG alpha.

[Horace T. Castillo, Senior member, IEEE—IEEE transactions on Biomedical Engineering, Vol BME-30, No. 12 Dec 83 793-796 pp.]

#### 5 Morningness-Eveningness Preferences and Sleep-waking diary data of morning and evening types in student and worker samples

A questionnaire was distributed to 300 students and 175 workers of the same mean age to determine their morningness-eveningness preferences. Morning and evening type samples obtained from these larger populations were requested to keep logs of bed and rising time for each day of a 2 week period. In comparison to students, workers had a distribution significantly skewed towards the morningness scores. Differences were found between the expressed preferences and the sleep-waking diary data in workers, but not in students. The acquisition of a regular job seems to induce a change in sleep-wake behaviour, particularly in evening workers.

[Luciano Mecacci and Alber TO Zani Ergonomics, 1983, Vol 26, No. 12, 1147-1153.]

#### 6 Low and moderate alcohol doses, Psychomotor performance and perceived drowsiness

To investigate the role of alcohol on reaction time, performance errors and perceived drowsiness, 26 subjects were tested on a step input tracking task combined with a divided attention test. In four sessions in which varying amounts of alcohol were consumed it was found that as the mean blood alcohol concentration (BAC) rose from 0 to 0.073%, the number of errors increased significantly. Also, subjects reported being drowsy for at least 3 hours after drinking moderate amounts of alcohol (mean BAC, 0.050 to 0.073%). The results of the study are discussed in relation to alcohol induced driving impairment.

[Ali A Landauer and Peter Howat Ergonomics, 1983, Vol 26 No. 7, 647-657.]

### 7 Effects of spaced and repeated total sleep deprivation

Six young adult males were sleep deprived for 2 nights on five successive occasions at 3 week intervals. During the deprivation period they completed subjective ratings and performed on an extensive battery of tasks. Subjective measures and vigilance tasks showed substantial deprivation effects; the cognitively-demanding tasks were less affected. Where repetition of sessions resulted in changes, relative to sleep deprivation the effects were those of 'sensitization' rather than 'immunization'.

[Wilse B, Webb and C Michael Levy. *Ergonomics* 1984, Vol 27, No. 1, 45-58.]

### 8 An experimental and theoretical study of temperature regulation in the immersed dog

An experimental and theoretical study of the canine thermoregulatory system is described in order to obtain a better understanding of how the heat exchange network is employed by the canine to control brain temperature. Particular attention is paid to the nasal heat exchange system.

Dynamic information about the thermoregulatory system was obtained from a series of experimental studies. The dog was immersed in a warm water bath (40°C) and irrigated nasally with a stream of cool water of constant flow rate. The temperature of this water was forced to vary in a sinusoidal fashion about a mean temperature of 15°C with an amplitude of 3°C. The frequency at which the temperature oscillated was varied from 0.00836 to 0.167 rad/s. Frequency analysis techniques indicated that a second-order transfer function adequately represents the experimental response of the central head thermistor. The variation in temperature of other body regions was not large enough to distinguish the response from signal noise.

A mathematical model was developed which is based upon the model developed by Stolwijk and Hardy for temperature regulation in man. Major modification include the following: (1) a heat exchange system is added to represent the nasal cooling system in the dog, (2) compartment sizes are

modified, (3) the number of head compartments increased, and (4) the equations describing blood flow rates to the various compartments are modified. The frequency response of the head thermistor was well represented by the model with an average error of 1.2 dB between the experimental and theoretical magnitudes and 12° between the experimental and theoretical phases.

[JN Petersen and RC Saugrave—*IEEE transactions on Medical Engineering*, Vol BME-30, No. 9 Sep 83, pp 580-600.]

## II ACCELERATION PHYSIOLOGY

### 9 Medical standards for experimental human use in acceleration stress research

Acceleration research is necessary to ensure optimum protection for individuals flying high performance fighter aircraft. Human volunteers exposed to high sustained +Gz stress must be carefully screened to assure that no one is at increased risk for G-induced trauma. Rigorous medical standards for qualifying research subjects must be established and followed. Careful documentation of G-related symptoms and physiologic disturbances enhance the safety aspects of human experimentation. No severe or lifethreatening incidents have occurred. A number of symptoms resulting from +Gz exposure have been documented with loss of consciousness being the most frequently documented symptom. The most frequent medical reason for disqualifying an individual volunteer from participation in the acceleration program was because of irregularities noted on spinal x-rays. The current medical standards and clinical diagnostic testing used to screen volunteer subjects at the USAF School of Aerospace Medicine are reviewed along with the symptoms which have resulted over a three year period of high sustained +Gz stress exposure.

[James E Whinnery, Ph D, MD and Kent K Gillingham, MD Ph D Aviat. Space Environ Med Vol 54, No. 3, March 1983 pp 241-245.]

### 10 Effects of strength training on G tolerance

The G tolerance of pilots flying modern, high performance fighter aircraft is crucial. Therefore

methods to increase G tolerance are of vital importance. In this study, G tolerance was studied in a human centrifuge using simulated aerial combat manoeuvres (ACM)—consisting of 15-s periods of 4.5 and 7 G until exhaustion—before and after 11 weeks of muscle strength training. The ACM-time in 11 fighter pilots was increased after this training by 39%. Gains were observed in knee extensor muscle strength during slow contractions by 17% and in anaerobic power by 14%. Aerobic performance and various muscle histochemical indices, as assessed from muscle biopsy samples obtained from m. vastus lateralis, were unchanged. Neuromuscular adaptation seems to be responsible for the increased muscle strength, as well as for the improved performance of the M-1 straining manoeuvre. This might explain the enhanced G tolerance.

[PA Tesch, Ph D, H Hjort, MD, and Ul Balldin, MD, Ph D Aviat Space Environ Med Vol 54, No. 8, August, 1983, pp 691-695.]

### 11 Neurophysiological effects of -X impact acceleration

In 19 experiments, eight unanesthetized Rhesus monkeys, with torsos restrained in a seated position, and with head and neck free to move, were subjected to peak sled accelerations in the -X direction ranging from 42 m/s<sup>2</sup> to 963 m/s<sup>2</sup>. Recordings of cortical somatosensory evoked potentials were made using recording electrodes surgically implanted over the somatosensory cortex. Electrical pulse stimuli were delivered at a rate of 5 Hz through spinal electrodes located at L1-L2. Evoked potentials were recorded prior to impact, through the impact event, and subsequent to impact, then subjected to quantitative analysis procedures which included normalized cross-correlation and exponential regression.

[Marc S Weiss, Ph D, and Michael D Berger, Ph D Aviat Space Environ Med Vol 54, No. 11, November 1983 pp 1023-1027.]

### 12 Diaphragmatic rupture during G-Manoeuvres in a T33 jet trainer

A 26 years old white male, radar operator, participated in a flight in a U.S. Air Force T33 jet trainer.

The patient experienced nausea and vomiting followed by several episodes of retching during manoeuvres of positive acceleration. Upon landing, he noted severe epigastric pain and shortness of breath. After 3 h of persistent symptoms, he presented to the base hospital's emergency department where he was diagnosed as having diaphragmatic herniation of abdominal viscera into the left hemithorax. At laparotomy, a large traumatic paraesophageal tear was discovered. The abdominal viscera were reduced and the defect repaired. The postoperative course was uncomplicated. The pathophysiology of blunt, nonpenetrating diaphragmatic herniation is discussed. Another mechanism for diaphragmatic rupture resulting from the forces of vomiting and acceleration is proposed.

[Peter A Maningas MD, Marc A Di Julio MD and Steven C Dronen MD Aviat Space Environ Med Vol 54, No. 11, November 1983, pp 1037-1038.]

### 13 Role of impact velocity and chest compression in thoracic injury

Impact velocity and chest compression are important factors in traumatic injury; however, there is no functional relationship to assess impact severity. A blunt thoracic impact of constant velocity (5-22 m/s) and prescribed contact displacement (3-46mm) was delivered to 123 anesthetized rabbits. Myocardial and major vascular injury increased from contusion to rupture with cardiac tamponade and sudden death as either impact velocity or chest compression was independently increased. A theoretical relationship was found for impact severity:  $IS = VC/1-C$ , where V and C are impact velocity and normalized chest compression. Based on the frequency of critical/fatal injury, probit analysis gave  $IS = 6.4$  m/s as an estimate of the ED<sub>50</sub> response in the experimental model.

[David C Viano and Yeng-Kin Lau Aviat Space Environ Med Vol 54 No. 1 January 1983 pp 16-21.]

### 14 A task difficulty—G stress experiment

This paper describes a study of methods to design manual tracking tasks. These tasks are to be used to help investigate performance changes as

humans are subjected to G acceleration stress. The design of the tasks had to meet two criteria. First, the tasks were required to differ from one another in terms of subjective difficulty (as well as showing a performance change empirically). Secondly, each task had to be sensitive enough to show performance changes in a stress/non-stress environment. The tasks used were of a sum of sines design approach which occurs commonly in manual control theory. The type of environmental stress considered in this study was a +Gz acceleration to which aircraft pilots are exposed during flight manoeuvres. The experiment was conducted on the Dynamic Environmental Simulator (D.E.S.) a three degree of freedom human centrifuge located at the Air Force Aerospace Medical Research Laboratory at Wright Patterson Air Force Base, Ohio.

[DW Repperger, DB Rogers, JW Frazier and KE Hudson  
*Ergonomics*, 1984, Vol 27, No. 2, 161-176.]

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

Impedance cardiography (IC) appears to be a promising non-invasive 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 ( $Z_0$ ) were monitored in ten volunteers for 5 min at each of four seatback angles from vertical: 12°, 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  $Z_0$  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 effect small differences in HR, SV, CO, VET, and  $Z_0$  within subjects as a function of minor changes in body position.

[JS Logan, JH Veghte, MAB Frey, LMJ Robillard, BL Mann, and RJ Luciani *Aviat Space Environ Med* Vol 54, No. 4, April, 1983 pp 328-333.]

#### 16 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 counter-pressure suit. PPB prolonged the time of +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.

[Jozef Domaazuk *Aviat Space Environ Med* Vol 54, No. 4, April, 1983 pp 334-337.]

#### 17 Combining techniques to enhance protection against high sustained acceleration 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 maneuver, and supination in a PALE seat. The individual and combined effects of the various acceleration protection techniques were examined as they related to various models for acceleration protection, and the results revealed no statistically significant deviation from a simple additive model. The apparent non-additivity was interpreted as resulting from a combination of additive, synergistic, and overlapping mechanisms.

[Malcolm M Cohen *Aviat Space Environ Med* Vol 54, No. 4, April, 1983 pp 338-342.]

### III ENVIRONMENTAL PHYSIOLOGY

#### 18 Effect of sleep deprivation on self-selected workload

Psychophysical methods have been used successfully to establish maximal acceptable loads (MAL) in industrial repetitive lifting tasks, and it is known that physical tasks remain relatively unaffected by sleep deprivation, whereas cognitive tasks may be significantly degraded. Since the psychophysical

method is essentially a physical task yet has a cognitive element (in that subjects are required continuously to reassess their decisions concerning MAL based upon their perceptions of the load weight), it was not known whether MAL would remain unchanged or be degraded by sleep deprivation.

Consequently, two groups of soldiers (a sleep-deprived and control group) were studied over a 3 week period. After 5 training days, a weekend and 2 baseline days, the sleep-deprived group were partially sleep deprived for 3 days and then totally sleep deprived for 2 days, whilst the control group were allowed 4 hours uninterrupted sleep daily. There followed 1 day during which the subjects were allowed to sleep as they felt necessary, and 2 days of recovery measurements.

There was no statistically significant difference in MAL between the two groups, nor in the pattern of load adjustment adopted by the subjects. It is concluded that the assessment of MAL, using psychophysical methods, is uninfluenced by sleep deprivation.

[S J Legg and DR Haslam—Ergonomic 1984, Vol 27, No. 4, 369-396.]

#### 19 Performance and sensory aspects of work environment : a review

Many people are occupationally exposed to cool or cold environments in which human performance and comfort may be affected. Research results on manual function and other performance measures together with certain subjective effects relevant to work in moderate cold are reviewed. The considerable individual differences in reactions to work in the cold are highlighted and the difficulties in establishing relationships between physiological measures of cooling, performance and sensory reactions are discussed. It is suggested that an integration of these three aspects is a necessary basis for understanding man's reaction to work in the cold and for improving equipment, training and work routines.

[A Enander Ergonomics, 1984, Vol 27, No. 4, 365-378.]

#### 20 Noise : Effect and Aftereffect

The effects and aftereffects of noise on human performance and affective state were investigated in two experiments. In the first, 48 undergraduate university students completed five paper-and-pencil performance tests in noisy (85 dBA) and/or quiet (45 dBA) environment. In the second experiment, 24 students completed two mood and four environmentrating scale under the same conditions as in experiment-1. There were statistically reliable noise effects and aftereffects on the subjects affective ratings but none on their performance.

[Valerie J Gawron, Ergonomics, 1984 Vol 27, No. 1, 5-18.]

#### 21 100% 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 normal atmospheric air while on the other occasion he breathed 100% oxygen at ambient atmospheric pressure. Arm sweat collected at the end of the two experiments was analysed for Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>++</sup>, Cl<sup>-</sup>, and lactic acid. Arm sweat Mg<sup>++</sup> was found to be much higher than that reported in the literature. Hyperoxia during heat stress improved arms sweating and showed significantly lower concentrations of Mg<sup>++</sup>, Na<sup>+</sup>, K<sup>+</sup>, 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<sup>++</sup> showed a significantly lesser loss during hyperoxia. The selective retention of Mg<sup>++</sup> during the hyperoxic heat run and its association in lowering the heat-induced physiological strain are discussed.

[S M Iyer, M B Dikshit, P K Banerjee, and S Suryanarayana Aviat Space Eviron Med Vol 1 54, No 3, March, 1983 PP 232-235.]

## 22 Results of our 15-year study into the biological effects of microwave exposure

The results obtained during 15 years of clinical and experimental examinations of biological microwave exposure effects are briefly surveyed. Some important results are reported. Based on their experience, the authors present their attitudes concerning harmful microwave effects on living matter. They consider that microwave effects, either direct or indirect, are the result of hyperthermia. Exposure of living body to irradiation intensities not causing thermal effects do not induce important pathological alterations in the irradiated organisms. Also, it has been pointed out that the term "injury" is more suitable than the term "microwave sickness" where harmful effects of microwaves to the living organism are concerned. According to the authors, the term "microwave sickness" is not acceptable as a synonym for professional diseases of persons working with sources of microwave energy, since it refers to the complex of insufficiently defined symptoms of uncertain etiology.

[Zoran Djordjevic, Aleksandar Kolak, Vidoge Djokovic, Petronije Ristic and Zdravko Kalecevic Aviat Space Environ Med Vol 54, No 6, June, 1983, PP 539-542.]

## 23 Effects of travel across time zones (jet-lag) on exercise capacity and performance

Eighty-one healthy male soldiers, aged 18-24, 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 transaction. 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 270m sprint were increased for the first 4d following translocation as were times for 2.8 km. run on the second and third days and for a 110m lift and carry on the third day after deployment. Time for a 6.5m rope climb did not change. These findings indicate that certain symptoms and physiological capacities are effected 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.

[J.E. Wright, J.A. Vogel, J.B. Sampson, J.J. Knapik, Patton and W.L. Daniels Aviat Space Environ Med Vol 62, No. 2 February 1991 PP 132-137]

## 24 Radiation protection during space flight

The problem of ensuring space flight safety arises from conditions inherent to space flight and outer space and from the existing weight limitations of spacecraft. In estimating radiation hazard during space flights, three natural sources are considered: the Earth's radiation belt, solar radiation, and galactic radiation. This survey describes the major sources of radiation hazard in outer space with emphasis on those source parameters directly related to shielding manned spacecraft. Then, the current status of the safety criteria used in the shielding calculations is discussed. The rest of the survey is devoted to the rationale for spacecraft radiation shielding calculations. The recently completed long-term space flights indicate the reliability of the radiation safety measures used for the near-Earth space exploration. While planning long-term interplanetary flights, it is necessary to solve a number of complicated technological problems related to radiation protection of the crew.

[By E.E. Kovalev. Radiation protection during space flight. Space Environ Med Supp 1 54 (12) : 516-523; 1983]

#### IV AVIATION PSYCHIATRY

##### 25 Lightness constancy through a veiling luminance

Observers were asked to select samples from a Munsell chart to match the lightness of seven identified surfaces in an outdoor scene they were shown. A separate group that was given the same task but viewed the same scene covered with a veiling luminance equal in intensity to the highest luminance in the scene selected almost the same matches. The same lightness constancy results were obtained using an abstract laboratory display to rule out memory color. These results challenge ratio and contrast theories because a veiling luminance, by adding a constant luminance to every point in the image, dramatically alters luminance ratios. Lightness constancy was not obtained, however, when these three-dimensional real-world-type displays were replaced by a flat, Mondrian-type display consisting of surface grays from white to black, whether or not colored regions were present in the display; lightness matches were consistent with ratio predictions both with and without the veil.

[Alan L. Gilchrist, Alan Jacobsen. *Journal of Experimental Psychology: Human Perception and Performance* 1983, Vol. 9, No. 6, 936-945.]

##### 26 Personality profiles of pilots

Samples of Air Force fighter pilots, trainee commercial pilots, and males drawn from the general community completed the Edwards personality Preference Schedule (EPPS). Four significant effects were found for individual sub-scales: three (Achievement, Affiliation, and Nurturance) identifying airforce fighter pilots. Commercial pilot trainees scored significantly less than the community samples on Succorance and Nurturance. The data suggest that the EPPS consists of several related personality dimensions. One of these, "sociability", discriminated fighter pilots from the general community.

[Aviat, Space Environ, Med, Vol. 54, No. October 1963, PP 940-943.]

##### 27 Analysis of a perceptual skill

Four experiments were conducted with a trajectory-intersection (video game) task to identify the information-processing mechanisms responsible for performance differences associated with initial ability and practice. We concluded that proficiency differences associated with initial ability are largely attributable to differences in the revision of processing operations and, to a lesser extent, to differences in the effectiveness of some component operations. Practice-related proficiency differences were less associated with component revision differences, and there was no evidence that the performance improvement caused by practice was accompanied by an increase in the effectiveness of individual components.

[Timothy A. Salthouse and Kenneth Prill. *Journal of Experimental Psychology: Human Perception and Performance* 1983, Vol. 9, No. 4, 607-621.]

#### V AVIATION ENT

##### 28 Endoscopy of the Maxillary Sinus

A new, simple and inexpensive technique of endoscopy of the maxillary sinus is presented. With the technique the expensive modern optical systems for maxillary antrum endoscopy are replaced by a common otoscope and a trocar specially designed to fit into the lumen of the otoscope. They are introduced into the maxillary sinus through the canine fossa. After removal of the trocar the otoscope remains in the sinus and endoscopy of all the maxillary sinus can be performed very early and quickly. The present technique is a simple, quick, reliable and inexpensive procedure which gives full information about the maxillary sinus and its contents.

[Leonidas Papangelov; *Acta Otolaryngol* 96: 163-166, 1983]

##### 29 Electronystagmography outside the Hospital using a pocket sized electrocardiograph

It is the desire of the neurotologic clinician to record routinely the nystagmus of patients with vestibular disorder but it is troublesome to have it done



frequently. We tried to have patients record their own nystagmus using portable electrocardiograph. It is pocket size, and can be operated easily at any time and any place by laymen and often provides beneficial information. It has been recognised that the records with the portable electrocardiograph bear close resemblance to the records obtained with the ordinary electronystagmograph. According to the experience in twenty cases of dizzy patients using this recording system, it was concluded that the equipment is useful not only for the diagnosis of dizzy patients, but also for evaluating the effect of drugs and for recommending changes in the mode of living for some patients.

[Ieamu Watanabe and Motohisa Ikida. *Acta Otolaryngol.* suppl 393 : 49-57, 1983.]

### 30 Effects of noise on signal detection

Twelve subjects were tested twice in visual vigilance tasks which lasted 40 min. Employing a two category confidence rating scale they detected increments in light level from displays of five lights. The display was flashed on simultaneously for 0.5s every 3.5s. The subjects performed the task on different days under two conditions of continuous white noise: 'quiet' (70 dB) and 'noise' (100 dB). Half of the subjects had the noise treatment in the order of 'quiet-noise' and half in the reverse order. No effects of noise either upon the overall performance or upon the vigilance decrement were observed. For the risky criterion results showed mainly that during a run under the two conditions the percentage of correct and false responses decreased,  $d'$  remained unchanged and  $B$  partly increased as a function of time. For the cautious criterion only  $B$  increased during a run under the two conditions. The results were interpreted in terms of arousal theory.

[Stanisa Milosevic *Ergonomics*, 1983, vol 26, No. 10, 939-946]

## VI AVIATION OPHTHALMOLOGY

### 31 Effects of hypoxia on the luminance threshold for target detection

A technique is described for determining luminance thresholds for detection of realistic target

objects which is suitable for use in simulators or environmental chambers. Data obtained by this technique during a 10-d exposure to high altitude indicate impairment of target detection in direct relation to target viewing distance, absolute target size and length of hypoxia exposure. In general, impairments reached their maximum during the second day of exposure and recovered gradually thereafter. No differences among individual observers were noted. Implications of the results are discussed.

[John Kobriak, *Aviat Space Environ Med* Vol 54, No. 2, February 1983, pp 112-115.]

### 32 Visual discrimination, Categorical identification, and Categorical rating in brief displays of curved lines: Implications for discrete encoding processes

Visual discrimination, categorical identification and categorical rating measurements were made on sets of curved-line stimuli drawn from a theoretically uniform continuum with curvature parameter  $s$ . In Experiment 1, discriminability of pairs of curved lines separated by a constant distance on the scale was measured at successive points along the scale. Curved lines were presented four at a time in a 100 msec display, which was followed by a random-dot mask. Discrimination performance was found to vary nonsmoothly with  $s$ . In Experiment 2, a categorical identification task was performed in which subjects labeled the curved-line stimuli of Experiment 1 straight, just curved, and more than just curved. From these data, a theoretical discrimination performance was computed that was closely congruent to the discrimination performance of Experiment 1. In Experiment 3, three different categorical rating scales with two, three, and four intervals were tested and each was shown to be less effective than the categorical identification scale for predicting discrimination performance. Mean ratings were, however, highly linear with  $s$ , suggesting that the curved-line continuum was psychometrically uniform. Experiment 4 provided further evidence for the uniformity of the curved-line continuum by measuring conventional acuity for curvature. Two rather than four curved lines were presented in each display; duration was increased to 2 sec; and the poststimulus mask was omitted. Acuity was found to vary

linearly with  $s$ . It was concluded that under conditions in which attention is distributed over a number of elements in the field and in which viewing and effective visual processing time are restricted, performance in discriminating curved-line stimuli may be determined by relatively coarse, discrete visual process.

[David H Foster, *Journal of Experimental Psychology: Human perception and performance* 1983, Vol 9, No. 5, 785-806.]

### 33 Cluster analysis of visual cortical responses evoked by moving lines\*

The cortical evoked responses to a bar of light (line) moving in 8 different directions across the visual field of 6 unanaesthetized, immobilized cats were compared in 18 experimental sessions. The shape of the response is unique for each direction. This is particularly apparent during the first 350 msec of the response. Cluster analysis of the evoked potentials reveals that the recognition of the direction of the moving line is probably less distinct when the line moves in a downward direction. This finding is more pronounced in the left hemisphere. The results of the cluster analysis indicate that the technique may be useful tool in the analysis and classification of large number of evoked potentials. Furthermore, such clustering may eventually reveal some of the physiological mechanisms that contribute to the shape of the evoked response.

[Stanislav Reinis, Jack P Landolt and Davids. Weiss *Electroencephalography and clinical Neurophysiology*, 1984, 59: 195-203.]

### 34 Normalization of binocular VERs after early onset visual deprivation in man

Visually evoked responses (VERs) were elicited by a reversing checkerboard target from a patient who suffered early onset bilateral deprivation of form vision as a result of a high refractive error, large amplitude strabismus, and congenital nystagmus. Monocular and binocular steady-state VERs were abnormal in amplitude and wave form even when a correction for the patient's large refractive error

(compound hyperopic astigmatism) was worn. Although monocular VERs could not be normalized, a normal wave form and amplitude were restored to the binocular VER by the addition of horizontal prisms to the patient's ophthalmic prescription. The initially degraded binocular VER gradually acquired a normal morphology and amplitude as the magnitude of compensating base-out prisms in the patient's habitual ophthalmic prescription was systematically increased. The relationship between the binocular VER amplitude and the correcting prisms derived by the method described in this paper was subsequently used to arrive at a practical clinical solution for the patient's unusual and debilitating visual symptoms. This electrophysiological evaluation of binocular function at the cortical level proved to be a very useful diagnostic procedure with prognostic value; standard clinical procedures were ineffective in elaborating the patient's sensory and oculomotor disorders. The theoretical and practical implications of managing patients with a history of early on set visual deprivation are discussed.

[John V Lovasik, *Electroencephalography and clinical Neurophysiology*, 1984, 59: 21-28.]

## VII AVIATION PATHOLOGY

### 35 Fatal gliding accidents in the united kingdom : 1960-1980

For many years, the Department of aviation and forensic Pathology of the RAF Institute of Pathology and Tropical Medicine has assisted in the medical investigation of fatal military and civil aircraft accidents, both in the U.K. and overseas. These included 33 glider accidents involving 39 deaths over the period 1960-1980. They do not include all the fatal gliding accidents in the U.K. because there is no mandatory obligation to call in the department, but probably represent over 50%. The department is primarily interested in the nature of fatal injuries, the performance of safety equipment and the presence or absence of pre-existing medical factors which might have affected or caused the accident. It also makes recommendations intended to improve flight safety, and is often involved in the discussions between the British

Gliding Association, the Civil Aviation Authority, and the other organizations involved.

[JNC Cooke, M D, A J C Balfour MA, MB, and K E A Underwood Ground, D P H Aviat Space Environ Med. Vol 54 No. 11 November 1983. PP 1028-1030].

### 36 Applications of gas chromatographic head space analyses to aviation accident toxicology

The use of head space sampling in conjunction with gas chromatography has proved a useful technique for analyzing aviation accident post mortem material for ethanol, carbon monoxide, and volatile contaminants. An account of the experience of the technique to date at the Royal Air Force Institute of pathology and Tropical Medicine is given, and the problems and advantages associated with the method are discussed.

[Mayes, R N Applications of gas chromatographic head space analysis to aviation accident toxicology. Aviat. Space Environ. Med. 55(1) : 82-84; 1984.

## VIII ERGONOMICS

### 37 Time pressure, training and decision effectiveness

An experiment was carried out in order to evaluate the effects of time pressure and of training on the utilization of compensatory multi-attribute (MAU) decision processes. Sixty subjects made buying decisions with and without training in the process or compensatory MAU decision-making. This was repeated with and without time pressure. It was found that training resulted in more effective decision making only under the 'no time pressure' condition. Under time pressure the training did not improve the quality of decision making at all, and the effectiveness of the decisions was significantly lower than under no time pressure. It was concluded that specific training methods should be designed to help decision makers improve their decisions under time pressure.

[Dan Zakay and Stuart Wooler Ergonomics, 1984, Vol 27, No 23 273-284.]

### 38 Factors affecting the speed of acquisition of tabulated information from visual displays

The task studied was that of reading tabulated information following a change in the locus of fixation. Tasks of this type are involved in using telephone directories, in looking from documents to a screen in conversational use of VDUS and in reading entries in tables presented on a display. Subjects fixated a marked point on a VDU, and then looked across to an entry in a table of three dimensions. This was read out, and the overall reaction time recorded. This was found not to vary with the vertical position of the entry in the table for viewing distances of 570, 885 and 1140mm. The horizontal angular separation was varied both within the display and by means of viewing distance. Reaction times increased with separation from the initial fixation point and the target for a given viewing distance. Changes in angular separation due to viewing distance had little effect. Eye movement recordings showed that the latency of eye movements was constant, but that the latency of response following a displacement of fixation varied in the same way as the overall reaction time.

[MT Swanston and CE Walley, Ergonomics 1984, Vol 27, No 3, 321-330.]

### 39 Software ergonomics: Effects of computer application design parameters on operator task performance and health

Evidence is reviewed that the operating characteristics of computer application systems, in addition to physical characteristics of display units (CRTs), are the cause of many observed effects on operator health and task effectiveness. These effects are hypothesized to occur through changes in task structure, and the man-machine redivision of labour. The results when computer application systems are introduced into work settings. First, the association between task dimensions and models of operator performance effectiveness and well-being are reviewed. Second, application system design parameters that affect task structure are identified. Then, empirical evidence supporting this three-part causal linkage between application system parameters to task characteristics

to operator effectiveness and health—is presented. The findings suggest that by improving dialogue quality, taking advantage of two-way communication to reduce uncertainty, using smaller and less integrated systems and matching system performance to operator needs, a job can be created that is likely to improve both operator well-being and effectiveness.

[Jon A Turmor and Robert A Karasek, : *Ergonomics*, 27(6): 663, 1984.]

#### 40 Head and Neck Injuries in Canadian Forces Ejections

This paper reviews the head and neck injuries experienced by Canadian Forces Aircrew who ejected while wearing the DH 41-2 helmet during the period from 1 Jan. 1972 through 31 July 1982. Pre and post-ejection factors, including a review of helmet performance, are presented.

[KW Rowe, Brooks CJ: *Head and neck injuries in Canadian Forces ejections Aviat Space Environ Med*, 55(4): 313-5, 1984.]

#### 41 Analysis of a PLL system as analog processor in CW Doppler Flowmeters

In this paper a phase-locked loop (PLL) system is analyzed in order to evaluate its performance for estimating the average frequency of an input spectrum made up by  $N$  discrete components allocated in a frequency interval  $B$ . The system was studied first in the simplified case that the phase comparator has a linear characteristic. Next, a computer-aided simulation of the PLL system was performed taking into account the nonlinear characteristic of the phase comparator, assuming that the input spectral components have mutual random phase in interval and amplitudes with a distribution either uniform or obtained from a particular parabolic velocity profiles.

The obtained results show that the estimate given by a PLL system differs from the true average frequency value for a negligible percent error. It is also shown that the PLL estimate is generally better than the zero-crossing detector estimate.

[M Bramanti and E Marchesini - *IEEE Transactions on Bio-Medical Engineering*, Vol BME-30 No 9 September 1983 pp 564-569]

#### 42 Vertical impact evaluation of the F/FE-111 crew restraint configuration. Headrest position, and upper extremity bracing technique

An experiment to assess the influence of changes in restraint harness configuration, fore-aft headrest position, and upper extremity bracing technique on human response to impact was conducted using the AFAMARL Vertical Deceleration Tower. A total of 201 tests were performed with volunteer subjects in 11 test conditions to evaluate 3 restraint harnesses 3 arm bracing conditions, and 4 seat adjustment configurations. The test fixture, restraint harness, and subject were instrumented to obtain pertinent objective data during each experiment. Measured parameters included acceleration of the impact carriage and test seat, velocity of the carriage, loads reacted at the seat, loads measured at the restraint harness attachment points, triaxial translational accelerations at the head and chest of the subject, and body segment displacements. The mean peak carriage acceleration for the 161 experimental level tests was 10.5 G (S.D.=0.18) and the mean carriage velocity change was 7.89 m/s (S.D.=0.05). Resultant head and chest accelerations were increased in a proposed, modified F/FB-111 restraint system compared to the operational F/FB-111 restraint system. These findings contributed to the decision not to implement the proposed modification. Also, the arms crossed bracing position for F/FB 111 ejectionees preparing for landing impact of the crew module was associated with higher seat loads than the arms extended position. With the arms extended and braced on the anterior thighs or knees, loads are transmitted through the extremities to the footrest thereby reducing loading of the vertebral column. Operational use of the arms extended position prior to anticipated vertical impact accelerations may be helpful in reducing the vertebral fracture rate associated with these mechanical force environments.

[Bernard F. Heraron, M D, M M S, James W. Brinkley, BS, and James H Raddin, Jr M D S M. *Aviat Space Environ Med* Vol 54 No11 November 1983 pp 977-987].

#### IX CLINICAL MEDICINE

#### 43 Coronary bypass surgery: Military Aviation Medicine perspective.

Close examination of medical and surgical literature shows that significant proportions of patients

undergoing coronary artery bypass surgery do not achieve an angina-free state; of those who do, a large proportion will relapse over the ensuing 4-6 years. It is apparent from the literature that coronary bypass surgery does not reverse the underlying processes of atherosclerosis. Therefore, aviators who have undergone this surgery are at increased risk for angina and other unpredictable coronary events and should not be favourably considered for continued military flying duties.

[David J Wehrly, M D *Aviat Space Environ Med* Vol 54, No. 11 November 1983, pp 1043-1046.]

#### 44 The measurement of risk indicators for coronary heart disease in air traffic control officers: A screening study in a healthy population

We describe an attempt to improve the predictive value of the routine annual medical examination of Air Traffic Control Officers by extending its scope. In addition to the four well-recognised coronary heart disease risk indicators-age, smoking habit, family history of coronary heart disease, and systolic blood pressure-we measured plasma fibrinogen, serum total and high-density lipoprotein cholesterol. Relative risk of coronary heart disease was assessed for each subject using a multiple logistic equation, and then compared with a large matched control. There were no statistical differences between the risk factors in the two groups. The factors measured do not support the view that air traffic control produces an increased risk of coronary heart disease. However, the gradient of rise within the air traffic control population should be evaluated in those at highest risk.

[Victor B Maxwell, John H Crump and Jeff Thorp.]

#### 45 Environmentally induced cholinergic urticaria and anaphylaxis

Although urticaria is generally an uncomfortable condition, it is usually considered to be relatively benign. Recent evidence indicates that numerous environmental stimuli can initiate cholinergic urticaria, and severe systemic manifestations may be associated with the onset of the urticaria. Exercise-induced anaphylaxis is specific life-threatening

reaction that has been documented to occur very unpredictably in susceptible individuals with cholinergic urticaria. The occurrence of severe hypotension, syncope, or laryngeal edema poses specific limitations to optimum performance should it occur in individuals employed in critical occupations. Although treatment with appropriate medications is generally effective in control of symptoms, these medications frequently have side effects not tolerable in high-risk situations. Four cases of U.S. Air Force aircrewmembers referred to the USAF School of Aerospace Medicine for aeromedical evaluation illustrate the spectrum of problems that can be associated with cholinergic urticaria. Exercise history should always be carefully evaluated in individuals who present with urticaria.

[James E Whinnery, Ph. D., M D and George K Anderson, M D *Aviat Space Environ Med* Vol 54, No 6, June, 1983, PP 551-553.]

#### 46 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 +G<sub>z</sub> acceleration stress testing are described. All had echocardiograms in an effort to screen them for possible mitral valve prolapse. The only individuals with mitral valve prolapse were two aircrewmembers already undergoing aeromedical evaluation for mitral valve prolapse, which included +G<sub>z</sub> acceleration stress testing. The episodes of ventricular tachycardia occurred in association with very stressful +G<sub>z</sub> exposures on a human centrifuge. Anthropomorphic and physiologic response parameters suggest that these individuals were under unusually high stress when they had the episode 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 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.

[James E. Whinnery Aviat. Space Environ Med Vol 54, No 1, January 1983 PP 58-64.]

#### 47 Automated high-speed analysis of Holter tapes with microcomputers

We have developed an automated Holter scanning system based on two microcomputers. One is a preprocessor that detects QRS complexes and measures the QRS durations using computations of first and second derivatives. This microcomputer interfaces to a second microcomputer that does arrhythmia analysis, logging, and reporting using R-R intervals and QRS durations. This system can process Holter tapes at 60 times real time and produce printed summaries and 24 h trend plots of several variables including heart rate and PVC count.

[Mark L. Ahlstrom, Member, IEEE, and Willis J. Tompkins, Senior Member, IEEE—IEEE Transactions on Biomedical Engineering, Vol BME-30, No 10, Oct 83 PP 651-657.]

#### 48 Continuous Thermal Measurement of Cardiac output

A thermal-dilution technique for the continuous measurement of cardiac output has been developed. It employs pulmonary-artery sensing of low-level periodic thermal signals generated in the right ventricle of the heart. A resistive element in a modified Swan Ganz catheter is energized with a periodic electrical waveform. The resulting thermal signal is diluted by blood flow and attenuated by mixing within the heart. Sensed by a thermistor in the pulmonary artery, the thermal signal is processed by a microprocessor-based instrument using a suitable mathematical model. With multiple signal frequencies, separate estimates of the flow-dependant and mixing-dependant attenuation components become possible, allowing continuous monitoring of cardiac output. This technique works well in anesthetized, mechanically ventilated animals,

even with average power levels as low as 4 W and corresponding temperature increases of a few hundredths of a degree centigrade. Based on measurements of pulmonary artery thermal noise spectra in humans, we infer that similar performance levels should be attainable with mechanically ventilated human subjects. However, noise spectra from spontaneously breathing critically ill patients suggest that signal-to-noise ratios would be less than satisfactory in that group unless increased signal power is allowed or improved algorithms are developed.

[James H. Philip, member, IEEE, Michael C. Long, Michael D. Quinn, member, IEEE and Ronald S. NoWhower, Member, IEEE PP 393-400]

#### 49 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 operation 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.

[Heinz S. Fuchs Aviat. Space Environ. Med. Vol. 54, No. 1, January 1983 pp 65-68.]

#### 50 Measurement of scoliosis by orthopaedic surgeons and radiologists

Minimum medical standards for USAF flying personnel have been compiled in Air Force Regulation 160-43. This regulation specified the maximum allowable amount of scoliosis, but does not specify who should read the X-ray film to determine, using the Cobb method, the degree of curvature in scoliotic individuals. In the present study, an X-ray of an

individual with mild scoliosis was sent to departments of radiology and orthopedics at major US Armed Forces Medical Centres. Although the mean estimated degree of curvature was the same for both the orthopedists and the radiologists, the variance in the radiologists replies was considerably higher than normally expected. It is, therefore, recommended that scoliosis films of individuals being screened for flying duties should be reviewed by a qualified orthopedic surgeon.

[Morgan S. Wilson, John Stookwell and Mitzi G. Leedy. *Aviat. Space Environ. Med.* Vol. 54, No. 1, January 1983, pp. 60-71.]

### 51 The diagnostic accuracy of Exercise electrocardiography - A Review

The cardiovascular "Stress test", and particularly the graded treadmill exercise test, has gained wide acceptance 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.

Robert L. Johnson and Michael W. Bungo. *Aviat. Space Environ. Med.* Vol. 54, No. 2, February 1983, pp. 150-157.

### 52 Sudden incapacitations : USAF Experience

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 etiologies of sudden incapacitation included illness without loss of consciousness, loss of consciousness, spatial disorientation, and improper M-1 maneuver. Each of these categories is analysed with emphasis upon prevention, for example not flying with symptomatic pre-existing disease, continued emphasis upon spatial disorientation training, and correct performance of

the M-1 maneuver. Based upon the data, conclusions and recommendations are suggested to minimize the risk of episodes of in-flight sudden incapacitation.

Russell B. Rayman and Grant B. McNaughten. *Aviat. Space Environ. Med.* Vol. 54, No. 2, February 1983, pp. 161-164.

### 53 Minimal coronary artery disease and continuation of flying status

Prior to 1976, any degree of coronary artery disease, including intimal roughening, was disqualifying for flying status in the United States Air Force. A consideration to continue flying duties for aviators with minimal coronary disease must recognize that the disease is progressive, with known lesions worsening, and new lesions forming in areas previously free from disease. However, the five year mortality for subjects with equal to or less than 30% lesions (2% mortality) is less than the mortality for apparently healthy males of similar age who have not had their coronary anatomy defined by angiography. However, the mortality rate for 30% lesions is three times greater than for individuals with known normal coronary arteriograms.

The USAF School of Aerospace Medicine (USAFSAM) instituted a minimal coronary artery disease study group in 1976. This study group returned aviators to flying status if no single lesion was not greater than 30% and the aggregate (sum) of lesions was not greater than 50%. Subjects with symptoms of ischemia, ECG and/or angiographic evidence of myocardial damage, serious arrhythmias, left ventricular dysfunction, or any degree of left main coronary disease were all excluded from this study group. A total of 12 aviators have now been returned to flying status with minimal disease. Of the 12, 5 have been recatheterized at a mean interval of 30 months, and 2 have been disqualified due to disease progression. The other 3 subjects have shown no progression. No cardiac events have occurred in any of the 13 subjects.

A Separate natural history study of 15 asymptomatic USAF subjects with 30 to 50% lesions has been accomplished. These 15 subjects have been found to be free of events at a mean followup of  $55 \pm 26$  months. An additional USAFSAM review

has ascertained the natural history of lesions less than 30% in individuals drawn from the USAFSAM catheterization file from prior years. Of 31 patients with lesions less than 30%, 25 have been followed up for a mean period  $62 \pm 23$  months.

[George M McGranahan, Jr, MD, James R Hickman, Jr, MD, Gregory S Uhl, MD, Michael A Montgomery, MD, and John H Triebwusser, MD, Aviat Space Environ Med Vol 64, No. 6, June 1983 pp 548-550.]

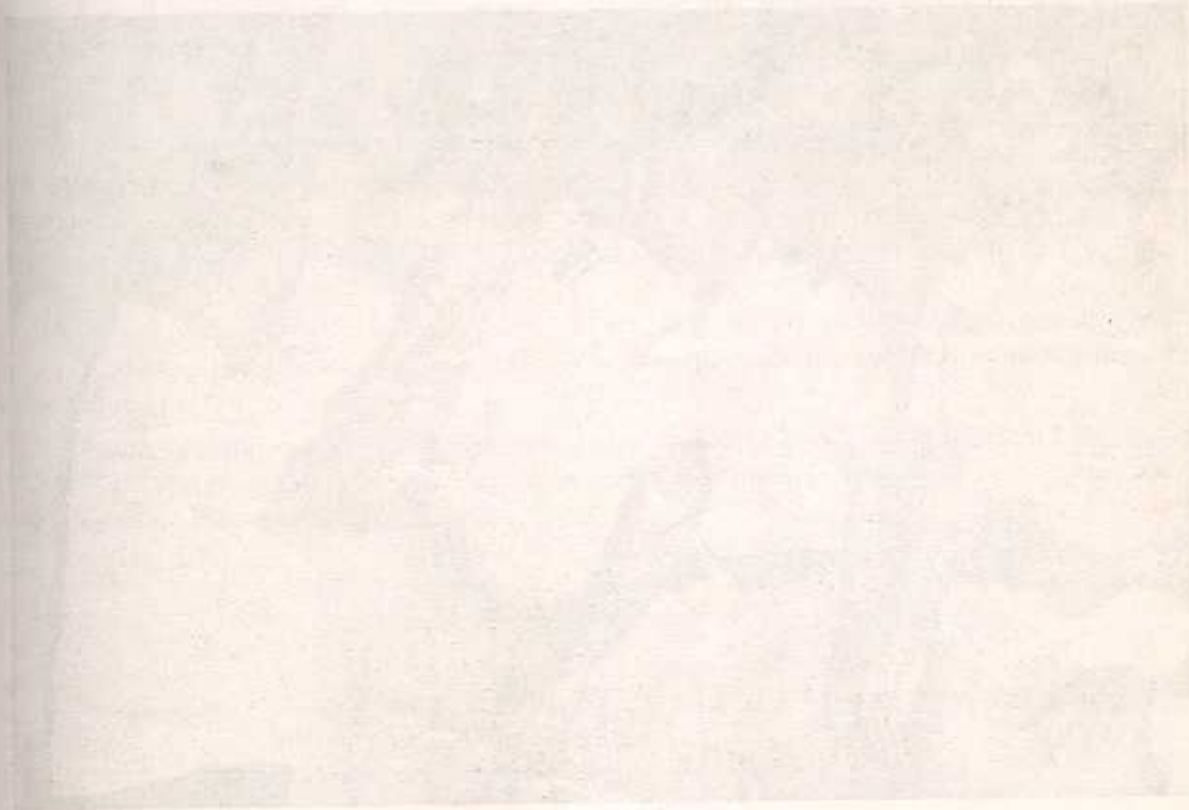
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AVIATION MEDICINE VOLUME 28 NUMBER 2 1984

SOCIETY NEWS

FAREWELL TO AIR MARSHAL MUIK RAY



An Medical Staff (MS) (AD) President of our Air Medical Society retired on 7 Aug 82 after 36 years of meritorious service. He joined the AF in Aug 1948 and held posts as Squadron Medical Officer for many years. He has evinced a special interest in the aviation problem and did much to modernize the "human factors in flight safety". In recognition of his contributions to the AF and the Air Force, he was awarded the AFM with VSM in Jan 1979 and later with VSM.

