

Abstracts of Aero Medical Literature

Aircrew Medical Problems

1

Civil Aeromedical Research; Responsibilities, Aims, and Accomplishments. S. R. MOHLER—Federal Aviation Agency, Civil Aeromedical Research Inst., Oklahoma City, Oklahoma. Report No. 62-20, Oct. 1962 18p. Unclassified

Civil aeromedical research conducted by the Aviation Medical Service of the Federal Aviation Agency is concerned primarily with (1) elucidating those mental and physical attributes of civil airmen most vital to the safe operation of present and proposed civil aircraft; (2) providing the civil aviation industry, from the designer to the operator, with adequate information relative to the physiological, psychological and medical characteristics of civil aircrew members, passengers and ground support personnel; (3) determining the means by which human tissues may be protected from injury during civil aircraft accidents; and (4) developing means by which the effects of aging, drugs, fatigue, hypoxia, toxic substances, and other factors can be measured with respect to their influence on performance by civil airmen (Author's abstract)

2

Clinical Aeromedical Observations. H. A. MINNERS, S. C. WHITE, W. K. DOUGLAS, E. C. KONBLONCK, and A. GRAYBIEL.—In: Results of the second United States manned orbital space flight, May 24, 1962, p. 43-53. Washington, D. C.: National Aeronautics and Space Administration, 1962. Unclassified.

A review of the detailed medical examinations on two astronauts who experienced approximately 4 1/2 hours of weightless space flight reveals neither physical nor biochemical evidence of any detrimental effect. Specifically, no pulmonary atelectasis, cosmic ray damage, or psychiatric abnormalities were found. In spite of directed efforts to stimulate the pilot's orientation and balancing mechanism during weightless flight, no abnormal vestibular nor related gastrointestinal symptoms occurred. Post-flight special labyrinthine tests confirmed an unchanged integrity of the pilots' vestibular system. Biochemical analyses after astronaut M. Scott Carpenter's flight confirmed the occurrence of moderate diuresis. Included are representative medical and biochemical tables. If heat stress continues to be a part of space flight, adequate fluid intake during the mission is necessary for crew performance and safety (Authors' summary, modified).

3

Tuberculosis in Air Force Personnel: Is Treatment and Return to Active Duty Practi-

cal? T. M. Dees, N. M. Hensler.—Military Med., 127 (10): 822-826. OCT. 1962.

A follow-up survey of 140 patients treated for tuberculosis revealed that it was more profitable for the Air Force to treat and return to duty properly motivated patients with minimal and moderately advanced tuberculosis. This was based on the finding that 82% of the patients were still on active duty, that of the 21 patients, who had been separated only 4 were separated because of problems related to their tuberculosis, and that previous tuberculosis did not seem to affect the individual's work performance. The only significant effect of tuberculosis on the patients' careers seems to be related to length of hospitalization and to either temporary or permanent removal from flying status. Forty-seven per cent of those grounded were eventually returned to flying status and two individuals not previously on status were put on status after completion of therapy for pulmonary tuberculosis. The need is stressed for an integrated follow-up system of tuberculosis patients. (Authors' conclusions, modified)

4

Spontaneous Pneumothorax—Modified from "Gleanings." The Antiseptic 60(5): 440. May 1963.

Opinions about the best means of treating spontaneous pneumothorax differ widely. The commonest cause of spontaneous pneumothorax in young adults (usually male) is rupture of a subpleural bleb; and in discussion of "spontaneous pneumothorax" this is usually the type envisaged.

The objects of treatment are: (a) to ensure re-expansion of the lung and (b) to prevent recurrence. Usually pneumothorax, left to itself, will be reabsorbed in time and therefore rest, supplemented by aspiration of air from the pleural cavity if necessary, is the only treatment required. But, if the condition recurs, some form of pleurodesis to prevent further episodes may be necessary. The technique of pleurodesis varies from instillation of silver nitrate, iodised oil, or camphor in oil, to poufrage with iodised talc. These methods are most often successful but carry a definite, though small, morbidity. When the patient is admitted under a Surgeon's care, the commonest form of treatment is "controlled thoracotomy tube suction", although other methods like thoracotomy with stripping of the parietal pleura, are occasionally used. Klassen and Meckstroth treated 135 cases by thoracotomy and tube suction and achieved prompt re-expansion of the lung without subsequent collapse in 81% of the cases. A short stay of five days in hospital is usually sufficient for this method of treatment. Thoracotomy with resection of the subpleural blebs had to be done in 30 cases because of recurrence or because tube suction failed.

5

Obesity in Aircrew—T. J. POWELL, F. P. CARRIGAN, and M. J. STANFIELD *Aerospace Med.* 34 (1): 21-24, Jan. 1963.

The authors submit that obesity and overweight from a "standard" table have little or no relationship. The belief that overweight has a relationship to dysbarism does not seem to be borne out by some careful studies. Pathologists in describing cases of fatal dysbarism appear to have been somewhat lax in defining the term "obesity." The apparent association of obesity and fatal dysbarism does not seem to be proven but this association has been eagerly pounced upon, and forcible reduction of weight has been practiced on aircrew. The dangers of fat embolism would seem to be enhanced by a reduced, inadequate dietary regime as practiced by many individuals. The relationship of alcohol consumption and dysbarism should be investigated, these two factors may well be correlated. We most strongly suggest that pathologists define obesity for us in terms of adipose organ fat and fat infiltration of other tissues. It has not been possible for those looking at the outside of the body to produce a definition. The pathologist, with the whole body and the history of the subject, is better equipped to provide the answer. (Authors' summary)

6

Current Flying Age, Experience and Non-Jet Accidents. A. F. ZELLE, E. C. LENTZ and J. M. BURKE—*Aerospace Med.* 34 (3): 222-225 March 1963.

The study as a whole lends substantial support to all of the hypothesis advanced. By practical experience the number of accidents available for consideration is markedly less than when jet accidents are involved. For this reason the trends are not nearly as clearly established for non-jet as for jet flying. In general, however, there is a tendency for greater amounts of current flying to be associated with a lower accident rate. By far the most important current flying interval is the first 20 hours during a six-month period.

In contrast to the jet evaluations there is no tendency for the advanced age factor to be an important consideration in accident experience. To the contrary, the older pilot has a lower rate and is less dependent upon current flying for maintaining this rate. Any decision to restrict older pilots from flying reciprocating aircraft on the basis of higher accident potential should be very carefully considered as the factual information available lends little or no support to this thesis.

The transition process in non-jet aircraft is also accomplished with far less hazard than in jets. Again the older pilots appear to cope with the transition problems in these non-jet aircraft with greater success than do the younger.

Pilots in reciprocating aircraft are also able to maintain proficiency with erratically spaced periods of current flying. The older pilot is more capable of coping with this hazard than the younger.

As have previous evaluations, this one also shows the period after graduation as one associated with high accident hazard regardless of the type of aircraft involved. This is the period which requires intensive supervision and is suggested as the single most fruitful area for the prevention of large numbers of accidents.

No attempt should be made to extrapolate the present findings to other than military flying. By definition, military missions seldom have their counterparts in civilian flying and even the equipment, which in some instances is quite similar, has been modified so that direct comparison is difficult. The age spectrum of Air Force pilots is also quite different from that of most other groups. Whereas in some civilian flying pilots 40 years and over represent the average, within the Air Force this group represents a small fraction of the overall pilot population. Any decision involving policy regarding flying should be unique to the pilot population, to the equipment, and the mission to be flown. (Authors' summary)

7

Discussion on Hypertension: Management and Results. G. PICKERING, D. WHEATLEY, H. T. N. SEARS and W. EVANS—*The Practitioner* 190 (1138): 529-531, April 1961.

No evidence has been produced to indicate that there is a dividing line between normal blood pressure and hypertension. The rate of rise of blood pressure with age is the same in relatives of subjects with and without hypertension. What is inherited is not the rate of rise of pressure with age, but the tendency to high pressures at all ages. The false concept of a dividing line between normotension and hypertension has caused avoidable anxiety to patients and has been the greatest cause of mismanagement.

The objectives of treatment are: (a) reduction in blood pressure, (b) relief of symptoms, and (c) prevention of complications.

With methoserpidine there was a fall in diastolic pressure of at least 10 to 15 mm Hg after ten weeks. Polythiazide produced similar effect in 87% and in combination with reserpine greater falls. Guanethidine produced larger falls, and when combined with cyclopenthiamide had an enhanced effect.

Commonest symptoms were headache, vertigo, and dyspnoea; 87% of patients obtained relief with the various hypotensive drugs used. It is probable that relief of symptoms resulted from the blood pressure falls.

Hypotensive effects can be maintained for many years, with continued relief of symptoms. Omission of treatment, however may result in cerebrovascular accidents supervening. Weight reduction and abstinence from over indulgence either in pleasure or work, are important.

Hypertonism, as physiological state, must be differentiated from hypertension. This differentiation cannot be based on the level of blood pressure only, and the former condition does not develop into the latter. In a series studied for ten years,

the mean blood pressure of hypertonia patients was 235/120, whilst the hypertensive mean was 215/125. The rise in hypertonia is transient and influenced by nervous stimuli, and is unaccompanied by any other physical signs. In hypertension the rise is sustained, thickened brachials are common, retinal arterioles invariably contracted and E. C. G. indicates left ventricular hypertrophy.

8

Clinical Problems In Aviation Medicine—The Aging Pilot and Heart Disease. V. C. SCHULZE (Jr)—*Aerospace Med.* 34(5): 443-449. May 1963.

There has been a tenfold increase in the numbers of "over forty" flying personnel in the U. S. Air Force in the past seven years. There has also been a significant increase in the percentage of civilian airline pilots over 40 years of age. This group is important from the standpoint of numbers and flying experience. One of the greatest challenges to them as a group is the development of coronary heart disease within the next ten years. Coronary heart disease is not a disease restricted to the aged, but frequently occurs in persons in the 40-50 age group. There seems to be a certain susceptibility of given individuals to develop the disease, and these individuals may be identified with a fair degree of accuracy years before the disease becomes manifest. These identifying, or predisposing factors, include a positive family history, an elevated serum cholesterol level, obesity, lack of exercise, and heavy cigarette smoking.

There is need for a different approach to the care of older flyers. One aspect is in the extent and conduct of the annual physical examination. More time should be spent with the flyer and some health guidance should be included. Coronary heart disease susceptibles should be identified and counsel ed regarding their weight, diet, exercise, and personal habits. A serum cholesterol determination and certain electrocardiographic studies should be included as a part of the annual examination of all flyers. Finally, preventive medical principles as pertain to the development of coronary heart disease should be emphasized.

(Author's Summary)

9

Urinary Calculosis: Anomediical Implications of Current Concepts. C. L. HOLT—*Aerospace Med.* 34(5): 392-399—May 1963.

Some historical aspects of urinary calculosis were briefly noted and the need pointed out for review of current developments in several aspects of the disease. Limited epidemiologic data indicates: (1) Urinary calculosis is twice as frequent in males as in females. (2) The highest frequency in males is attained in the 5th decade. (3) There appears to be a relationship between incidence and certain climatic conditions. (4) Negroes appear to be relatively resistant to the disease. (5) Among USAF personnel, there is no clear excess of the disease in pilots.

A large proportion of cases of urinary calcu-

losis appear to have certain attributes in common which may be of etiologic significance: (1) Approximately 90 percent of cases are idiopathic in origin. (2) 93-95 percent of calculi are calcigerous in nature. (3) All calcigerous calculi have an organic matrix derived from components of the urinary colloids which are markedly elevated in calculous patients. (4) Certain fractions of the urinary colloids bind calcium *in vitro* throughout the pH range of urine. (5) Irrespective of stone location, bilateral alteration of the renal tubular connective tissue matrix has been demonstrated. (6) Recurrent calculi are as frequently located contralaterally as ipsilaterally.

In evaluating the patient presenting with urinary calculosis, a number of aspects should be considered: (1) A wide variety of potential etiologies exist. (2) Asymptomatic contralateral calculi may be present in 8-9 percent of admissions for the disease. (3) The idiopathic stone-former with active disease may be readily differentiated from all other classes by the effect of a drug and diet regimen on 24 hr. calcium excretion. (4) The intravenous calcium load test may be the most valuable aid in differentiating early hyperparathyroidism from the other calculous disease. (5) When considered as a separate group, patients with rapidly recurrent or bilateral urinary calculosis have a much increase incidence of endocrine, metabolic, degenerative and infectious disease.

The only system of medical management of demonstrated effectiveness in prevention of recurrent urinary calculosis involves rigid application of the following principles: (1) dietary calcium restriction to 150 mg. day; (2) adjunctive use of calcium sequestering agents; (3) vitamin D control; and (4) urine acidification.

Current studies of urinary calculosis indicate certain items of prognostic value: (1) An overall recurrence rate of about 9 per cent is to be expected. (2) 80-85 per cent of patients with urinary calculosis will have but 1-2 episodes in a lifetime. The remaining 15-20 per cent have bilateral or rapidly recurring diseases. (3) Surgical intervention increases the risk of recurrence. (4) Most recurrences are within 3-5 years. (5) Renal function is not measurably altered after conservative management. (Author's Summary).

10

Medical and Environmental Problems in Agricultural Aviation. C. E. BILLINGS, Jr.—*Aerospace Med.* 34(5): 406-408. May 1963.

Certain of the hazards implicit in aerial application have been described. These fall into three major categories. The first is fatigue, with which may be included the effects of noise, vibration, wind blast, high ambient temperatures, and distracting influences. It is believed that better personal equipment incorporating lightweight communications units would make the pilot's task easier and would thus help to alleviate fatigue. A second hazard category is that of toxic substances with which the pilot is continually in potential or actual contact. There is an urgent need for simple qualitative screening tests which will indicate whether appreciable absorption of these toxins

have occurred. A third category is that of information and data presentation. In each of these areas, research and development efforts are badly needed. Finally, those engaged in agricultural aviation have an unmet need for aeromedical training and guidance.

Agricultural aviation is a major factor in this country's agricultural economy. Pressures on applicators, particularly during periods of plant epidemics, are enormous. This segment of general aviation needs and deserves better support from aviation medicine than it has thus far received. It is hoped that flight surgeons and equipment manufacturers will realize the potential gains both to the industry and to themselves in the sort of research and development which has been discussed. (Author's Summary).

11

The Effects of Simulated Altitude on Penetrating Eye Injuries. J. R. DILLE, N. L. NEWTON and J. F. CULVER—*Aerospace Med.* 34 (2): 105-107, February 1963

Trapped intraocular air expansion can cause extrusion of the lens or vitreous through ocular penetrations. Reduction in barometric pressure with a predictable relative gas expansion (RGE) occurs under conditions of altitude. Therefore, air evacuation presents a potential hazard to the patient having intraocular trapped air resulting from an ocular penetration. Information obtainable from a knowledge of the flight conditions and of the clinical eye examination can be related to the hypothetical formula $V_{SL} = (RGE \times V_{AIR} \times K) - V_{PL}$ (where V_{PL} —volume primary loss of intraocular contents following initial injury). This formula should be regarded as a basis for understanding the mechanics involved, and it should serve to approximately define the extent of the hazard for individual patients. The precise prediction of V_{SL} (volume of secondary intraocular content loss) is not possible. Therefore, the best mode of transportation for individual ocular injury patients will rest heavily on clinical judgment.

Spontaneous loss of intraocular contents may occur for reasons other than expansion of trapped gas under conditions of reduced barometric pressure. This loss is usually attributable to extrinsic mechanical pressure, such as from muscle spasm. This fact suggests that great care should be used in handling the patient; also, it points to a logical use for sedation and analgesia. (Authors' Summary).

12

The Use of Newly Designated Aviators as Instructors.—J. H. JOHNSON, and J. R. BERSHIRE—*Aerospace Med.* 34 (1): 25-27 Jan. 1963.

Traditionally, Naval Flight Instructors have been pilots who have had at least one tour of duty in the Fleet. Occasionally, however, because of shortages of fleet experienced personnel, newly designated Naval Aviators have been assigned to Instructor duty. Many training personnel have

strong misgivings about its effect upon the quality of training accomplished. Beginning in 1955 and intermittently thereafter for four years some graduating aviators were "plowed back" into instructor jobs.

The department of Psychology of the U. S. Naval School of Aviation Medicine was asked to evaluate the effects of such "plowing back."

The study included students' performance, students' attitudes, training accidents and success in the fleet.

Students' Performance

The check flight of the students were conducted and graded by experienced pilots other than the students' regular instructors. The results of the study showed that there is no real difference in primary flight training success of students taught by newly designated aviators and those taught by fleet experienced instructors.

Students' Attitude

It was thought that the attitude of students towards the relatively inexperienced "plow back" instructors would not be as good as toward instructors who were older, had more rank and could teach with authority based on actual squadron experience. A study showed that there was no real difference in student attitudes because of fleet experience of their instructors.

Training Accidents

A study showed no apparent difference in accident rates. It had previously been seen however that a "plow back" instructor who had a low pre-solo grade when he went through training had a relatively higher probability of encountering a pilot-caused accident; it had also been found previously that students who had a low pre-solo grade in training were liable to more accidents in the fleet after graduation; but the suspected difference in accident rates amongst differently trained students could not be substantiated.

Success in Fleet

The performance of former "plow back" instructors who were serving their first tour in the fleet was compared with that of several groups of other pilots who were also serving their first tour. Pilots in both fighter attack squadrons and anti-submarine squadrons were evaluated. The results showed that the "plow backs" compared unfavourably with all categories. This was thought due to the fact that an initial assignment to a training type aircraft, training type missions and duties was poor preparation for later operational flying and for officer responsibility in operational squadrons.

It was also discovered that men who volunteered to "plow back" were poorer risks in later assignments than non-volunteers.

The findings suggested that, should it ever be necessary to use newly designated pilots as instructors, men should be selected for the assignment rather than be permitted to volunteer and that they should be retrained in high performance aircraft, prior to fleet assignment.

13

The Value of Indoctrination Flights in the Screening and Training of Naval Aviators. J. R. BERKSHIRE and R. AMBLER.—*Aerospace Med.* (34) (5): 420-423, May 1963

Four instructional hops were given to 196 students prior to their entry into naval air training. The purpose was to determine the effects of the flights upon subsequent student performance in training and to determine if evaluation during such flights could be used to augment existing selection procedures. The evidence was generally favourable toward the concept of indoctrination flights. Reduced attrition and enhancement of performance were demonstrated. These findings were interpreted with caution, however. The most significant results were that certain predictions and observations made by the instructors had high validity in predicting later failure and would significantly augment current selection procedures. (Author's Summary)

14

Stress Responses of Pilots Flying 6-Hour Overwater Missions in F-100 and F-104 Aircraft—V. H. MARCHBANKS, JR., H. B. HALE, and J. P. ELLIS, JR.—*Aerospace Med.* 34 (1): 17, Jan 1963.

Postflight urine and blood samples for pilots flying 6-hour overwater missions in F-100 and F-104 aircraft were employed in an attempt to appraise flying stresses. Comparison was made with a third group of pilots on an off-duty day. Urinary determinations included epinephrine, norepinephrine, corticosteroids (17-OHCS), sodium, potassium, inorganic phosphate, urea, uric acid, and creatinine. Blood determinations included free and conjugated hydrocortisone and corticosterone like fractions. Flying raised corticosteroid levels in plasma but not in urine. Levels for the F-100 group were higher than for the F-104. Urinary epinephrine and norepinephrine values for the flying groups were significantly above those for the control, values for the F-104 exceeding those for the F-100. Differences in flying groups appear to relate to aircraft characteristics, weather conditions, and flying experience. Both flying groups showed high urinary excretion of urea and uric acid, but only in the F-104 group was sodium and potassium excretion elevated. Flying induced no variation in urinary phosphate. Singly and collectively, these determinations are basic to future studies on flight stress. (Author's summary)

15

Prolonged Human Performance as a Function of the Work-Rest Cycle. O. S. ADAMS and W. D. CHILDS.—*Aerospace Med.* 34 (2): 132-138, February 1963

The purpose of this study was to investigate the feasibility of using a 4-hours-on-duty and 2-hours-off-duty schedule in the operation of advanced weapon systems. Two B-52 combat-ready crews were confined for 15 days in a simulated advanced system crew compartment and were tested with a battery of 5 performance tasks and 4 psychophysiological measures. This paper presents the results obtained on 4 of the performance tasks (arithmetic computation, pattern discrimination, probability monitoring and warning lights monitoring) and 2 of the psychophysiological measures (skin resistance level and heart rate level). It is concluded that, with the proper level of motivation, crews can work for periods of at least 15 days using a 4-on and 2-off work-rest schedule. (Author's Summary)

Flight Safety.

16

Fatal Aircraft Accidents and Disease of Aircrew. P. J. STEVENS.—*Aerospace Med.* 34(5): 450-455, May 1963.

A number of conclusions arise from the analysis of this series of cases and from our experience with pilot error or possible pilot error accidents, examples of which have been quoted.

- There is no evidence that pre-existing disease in aircrew constitutes a major problem and the abnormal conditions found are in no greater proportion than would be expected in a routine survey of non aircrew traumatic deaths of a similar age group.
- With the possible exception of coronary artery disease and fatty liver, no other conditions occur sufficiently frequently to merit consideration as being occupational in origin.
- Some conditions, uncommon though they may be in aircrew, are either potentially suddenly incapacitating, or may materially affect the efficiency of a man's performance of his tasks; these conditions can and do cause accidents.
- In many instances the discovery of significant disease or disability will be made from the pilot's medical and personal history. (Author's Conclusion)

17

Visual Deficiencies as a Cause of Aircraft Accidents. A. B. GORNEY — *Revue de médecine aeronautique* (Paris), 1 (4): 38-45, July-Aug. 1962. In English.

No evidence was demonstrated that reduced visual acuity, astigmatism, manifest hypermetropia, poor accommodation, or poor extrinsic eye muscle balance within the limits of the current Royal Air Force standards played a specific part in the causation of a group of over 200 aircraft accidents (1958-1960) especially selected because visual factors may have had some bearing on their causation. However, visual acuity of 6/12 or worse in one or both eyes was more than twice as prevalent in the two groups of pilot-error accidents (5.7% and 6.9%) than in the technical defect accidents (2.4%). This study indicated that

corrective flying spectacles cannot be issued with the assumption that they will be worn on all occasions when it is essential. Representative tables are included. (Authors' Conclusions modified).

18

Blood Group Typing for Aircraft Accident Investigation. E. R. TAYLOR—*Aerospace Med.* 34 (5) 389-391, May 1963.

344 crew members of a heavy bomber wing were blood typed, at minimum cost using available personnel and equipment for ABO, MN and CoDE types.

Reliability and internal consistency of the typing were found to be acceptable.

Final validation of the detailed blood typing awaits use in fragmented and burned remains of people upon whom types were previously determined.

Division of an aircrew population into small unique groups was sufficient to be of marked potential value in aircraft accident investigation. (Author's summary)

19

Survey of Rotary Wing Accidents—FRANK W. KIEL, and J. M. BLUMBERG, *Aerospace Med.* 34 (1): 42-47, Jan 1963.

Helicopters have developed into a useful and popular means of transportation since Breguet first flew one 55 years ago. Nowadays there are over 5,000 helicopters in service under United States registration.

As the number of aircraft has increased, fatalities have occurred, but not in direct proportion. An apparent downswing in fatalities is seen in the three services, although the Chicago air-taxi crash raised the civilian rate for 1960.

Investigation of helicopter accidents is being actively pursued by the three military services and the Civil Aeronautics Board, all of which have well-kept records. Autopsy examination of victims and toxicology tests are being used more in recent years by the services.

Of 245 helicopter accidents involving at least 1 fatality, the most common type was found to be the inflight crash to the ground (typically open land), with weather being a minor factor. Usually the aircraft was largely or totally destroyed, and there was often a fire on impact.

Mechanical failure was the leading cause of these accidents, accounting for nearly one-third. Striking an unseen obstacle (typically high tension wires or telephone wires) was the second most common cause, where the cause was determined. Disorientation due to bad weather was third in importance as a causative factor. The number of persons walking into rotors has decreased in recent years, as helicopters have become a more familiar sight. Pre-existing disease acute coronary insufficiency was responsible for only one accident.

Cardiovascular lethal injuries—ruptures of heart and aorta mainly—have been nearly as common as lethal head injury. As helmets seem to

offer protection to the head, perhaps attention should next be turned to the prevention of injury to the heart and great vessels. Burns, lacerations, and drowning still claim quite a few victims.

Future developments in the field of protecting helicopter occupants in accidents must be along the lines of safer and stronger helicopters. Ejection seats do not seem to be the answer, but an emphasis on parachute bailouts might be worthwhile. (Author's summary)

20

Helicopter Versus Fixed Wing Crash Injuries—ANTHONY A. BEZREH, *Aerospace Med.* 34(1): 11-14, Jan. 1963.

This paper compares crash injuries experienced in the U. S. Army in light slow fixed wing aircraft and helicopters.

The incidence of non fatal injuries was twice as great in rotatory wing aviators as in fixed wing aviators—suggesting that rotatory wing accidents are more likely to produce non fatal injuries than fixed wing accidents.

In the severity, type and location of injuries there was very little difference between the two types. Pure decelerative forces accounted for only 60% of all traumatic agents, of these 70% involved the spinal column. Considered separately 64% of all the fixed wing decelerative injuries, and 76% of the rotatory decelerative injuries involved the spinal column. Large vertical force caused 79% of the rotatory wing spinal and 44% of fixed wing spinal column injuries.

Post crash fire occurred only in 5.7% of all major accidents; this accounted for 63% of rotatory wing fatalities and 35% of fixed wing fatalities. Post crash fires in both types of aircraft originated when fuel from ruptured fuel cells and lines reached an ignition source. This suggests that a crash worthy fuel system should be a priority item in the design of light aircraft. Analysis of the head injuries revealed significant data. Among personnel not wearing helmets there were 144 serious head injuries and 58 fatal head injuries—occurrence of head injuries was slightly more amongst rotatory wing personnel not wearing helmets. But there were twice as many fatal head injuries amongst fixed wing personnel not wearing helmets. Among personnel who wore crash helmets there were 28 serious head injuries and 3 fatal head injuries, all the latter occurred in rotatory wing users. Of the 22 cases wherein the helmet was dislodged on impact 21 occurred amongst rotatory wing aviators. It is probable that the larger rotational accelerations in rotatory wing crashes may explain this.

Environmental Physiology.

21

ALTITUDE

Performance Tests of a Passenger Oxygen System Designed for Altitudes to 48,000 Feet. F. C. THIEDE, J. W. RAEKE and W. R. SANTISCHI *Aerospace Med.* 34 (3): 209-213, March 1963.

A testing program was carried out to qualify the oxygen system of the commercial version of

the T-39 airplane for FAA certification at altitudes up to 45,000 feet. Twenty altitude-unindoctrinated subjects were decompressed from 8000 to 35,000 feet in 10 seconds to assess the ability of naive passengers to don their oxygen masks effectively following a cabin depressurization and the performance of the oxygen system. Four additional untrained subjects were taken from ground level to 45,000 feet to evaluate steady-state performance of the passenger oxygen system up to maximum altitude, and two trained altitude-indoctrinated subjects were exposed to rapid decompression from 8000 to 45,000 feet.

Results indicated that the performance of the oxygen system was sufficient to maintain individuals free from hypoxic symptoms for at least 5 minutes following rapid decompression to 35,000 feet with respiratory adequacy also satisfactorily maintained throughout the descent from 35,000 feet to fly-back altitude at the rate of 2000 feet per minute. Untrained subjects, for the most part, seemed quite capable of donning their masks within the 30 to 40 seconds of useful consciousness time available at this altitude. The data obtained from steady-state flights to 45,000 feet and the 8000 to 45,000 foot decompression indicated that the systems provided adequate protection for subjects up to 5 minutes at the 45,000 foot T-39 altitude ceiling. The concept of a maximum of 8 mm. Hg positive pressure at 45,000 feet from a regulator supplying two passengers was validated. (Authors' summary)

22

Cardiorespiratory Functioning In-Flight. J.A. ROMAN—*Atmospace Med.* 34 (4) : 322-336. April 1963.

- 1 Systolic and diastolic blood pressures on three pilots in-flight in high performance single engine jet aircraft in the course of cross-country flights were above clinical norms, in the absence of physical exercise, linear acceleration other than 1 G, or hypoxia. The values obtained (systolic 130-200 mm. Hg, diastolic 80-140 mm. Hg) confirm isolated results obtained by other investigators previously. Because of the small number of pilots sampled, the data obtained cannot be considered as norms for a larger pilot population.
- 2 The blood pressures obtained correlate well with the pilot's estimate of the difficulty of the task at hand.
- 3 High blood pressures are frequently seen in the face of normal or near normal pulse and respiratory rates.
- 4 Heart rate, respiratory rate and blood pressure responses were highly reproducible in similar in-flight situations in the same individual. Substantial differences in response are apparent between different individuals.
- 5 Evaluation of in-flight heart rate response of a subject has meaning only when related to baseline heart rate values for that individual. It is not yet apparent whether the

same will hold true for blood pressure and respiration response to the in-flight environment.

- 6 From the data presently available, it appears that sinus tachycardia is the most common and the only significant ECG finding seen regularly in the in-flight situation. (Author's Conclusions)

23

Acute Pulmonary Oedema of Altitude: Clinical and Physiologic Observations. H. L. FRED, A. M. SCHMIDT, T. BATES, and H. H. HECHT—*Circulation*, 25(6): 929-937. June 1962.

Three separate episodes of acute pulmonary oedema are described that developed in two otherwise healthy individuals during heavy exertion at high altitudes. Detailed physical examination and laboratory studies failed to demonstrate pulmonary infection or cardiac disease. Data obtained by cardiac catheterization during one of these episodes revealed elevation of the pulmonary artery pressure and a normal left atrial pressure. This syndrome appears to be the consequence of pulmonary vascular obstruction distal to the capillary bed, presumably in the pulmonary veins. It is brought about by exposure of susceptible individuals to high altitudes, and is completely reversed by oxygen administration. (Authors' summary).

24

Blood Volume Changes in Dogs Exposed to Altitude. D. W. BADGER and N. PACE—*Physiologist*, 5(3): 101. Aug. 1962

Changes in red cell mass, plasma and total blood volumes were compared in intact and splenectomized dogs sojourning at 12,470 feet altitude. Similar measurements were made in splenectomized dogs, whose aortic and carotid chemoreceptors had been ablated (glomectomized) to prevent respiratory response to hypoxia. All groups showed increased red cell mass. The intact and splenectomized dogs reached 145% of sea level values, the latter more slowly. The glomectomized—splenectomized dogs increased to 250%, hematocrit values as high as 86% being observed. Plasma volume decreased within a few days in all groups, the intact dogs fell to 90% of sea level and returned by 60 days, the splenectomized decreased to 70% and recovered by 240 days, while the glomectomized decreased to 50% and had not recovered by 500 days. The erythropoietic response to hypoxia is slow in splenectomized dogs, although the same degree of increase in red cell mass as in intact dogs occurs eventually. On the other hand, the glomectomized—splenectomized dogs showed a far greater erythropoietic response to hypoxia than the other groups. It is apparent that the chemoreceptors are not needed for the erythropoietic response, but that the spleen may play a role in erythropoiesis. Further, in the absence of hypoxic hyperventilation mediated by the glomi, the erythropoietic response is enhanced, with or without the presence of the

spleen. Finally the early decrease in plasma volume may be accounted for, at least in part, by activation of left atrial stretch receptors by hypoxia—induced increased pulmonary venous pressure, with resultant decrease in ADH secretion. (Authors' abstract).

25

The Effect of Moderate Altitude on Exercise
C. E. BILLINGS, P. K. JOHNSON, G. N. HOOVER, and D. K. MATHEWS—Physiologist, 5(3): 107, Aug. 1962.

This report describes controlled studies in an altitude chamber at 720, 620, and 520 mm. Hg. barometric pressures (1,500, 5,500 and 10,200 feet pressure altitudes). Eleven male athletes performed mild work (4 times the resting oxygen uptake) twice at each altitude under identical conditions. The experiment was carried out under double blind precautions. Expired air samples were collected; ventilation, oxygen uptake and carbon dioxide output were determined. It was found that the excess oxygen cost of this mild work was not significantly increased at either 620 or 520 mm. Hg. compared with 720 mm. Hg. Minute ventilation during exercise, however, increased incrementally and significantly as barometric pressure was reduced. Increases in respiratory frequency at altitude may explain why no significant difference was observed in respiratory exchange ratios with increasing altitude. This study and others in the literature suggest that a "time-dose" relationship exists for aerobic muscular work performed breathing ambient air at pressure altitudes as low as 5,500 feet. (Authors' abstract).

26

Physiological and Medical Aspects of the Himalayan Scientific and Mountaineering Expedition, 1960—61. L. G. C. E. PUGH—Brit. Med. Jour. No. 5305: 621—627, Sept. 8, 1962

Physiological investigations were conducted over a period of five months in a prefabricated laboratory situated at 19,000 ft. during an attempted ascent of Mt. Makalu (27,790 ft.). At 24,400 ft. the maximum oxygen intake was found to be 1.4 litre per minute, ventilation 119 litres/minute, and heart rate 135 beats/minute. Haldane end-expiratory gas samples taken at rest at 25,700 ft. showed an average oxygen tension of 33 mm. Hg. and carbon dioxide tension of 14 mm. Hg. Arterial oxygen saturation less than 50% was observed during periods of two to three minutes' maximum exercise at 19,000 ft., the average resting value being 67%. The party appeared to acclimatize well to 19,000 ft., and card-sorting and other psychological tests revealed no evidence of mental impairment. However, all members of the party continued to lose weight. Newcomers on Mt. Makalu, after four to six weeks' acclimatization were fitter and more active than men who wintered at 19,000 ft. On Mt. Makalu cases occurred of cerebral thrombosis, pulmonary infarction, acute pulmonary oedema, pneumonia and frostbite. The ascent was made without oxygen

equipment, but oxygen was available for medical treatment. (From the author's summary).

27

Alveolar Gas Composition at 21000 to 25000 ft. (6400—7830 M). M. B. GILL, J. S. MILLEDGE, L. G. C. E. PUGH, and J. B. WEST—Jour. Physiol (London), 163 (3): 373—377, Oct. 1962.

During the recent Himalayan expedition alveolar gas samples were collected by the Haldane—Priestley technique at altitudes of 21,000 ft. (6400 m), 24,400 ft. (7400 m) and 25,700 ft. (7830 m) where the barometric pressures were 344, 300, and 288 mm. Hg. respectively. The mean alveolar carbon dioxide tensions at the three altitudes were 20.7, 15.8 and 14.3 mm. Hg. respectively; the mean alveolar oxygen tensions were 38.1, 33.7 and 32.8 mm. Hg. respectively. By plotting the alveolar gas points on an O₂, CO₂ diagram, it is shown that they lie between the lines drawn by Rahn and Otis (1949) giving the alveolar gas compositions of men acutely exposed to low pressures and of men acclimatized to high altitudes. These results are consistent with the altitude history of the subjects, and agree well with the curve predicted from data previously collected on Mount Everest. (Authors' abstract)

28

Blood PCO₂ and Brain Oxygenation at Reduced Ambient Pressure. E. C. PIERCE, C. J. LAMBERTSEN, M. I. STRONG, S. C. ALEXANDER and D. STEELE—Jour. Applied Physiol., 17(6): 899—908, Nov. 1962

Hyperventilation during breathing of 100% oxygen elevates the oxygen tension (PO₂) of alveolar gas by the same amount that it lowers its carbon dioxide tension (PCO₂). Since the development of arterial hypocapnia causes cerebral vasoconstriction, brain oxygenation is drastically decreased even while arterial oxygenation is improved by hyperventilation. Administration of 30% carbon dioxide with oxygen at an ambient pressure equivalent to that at 39,000 feet altitude prevented alkalemia and, in spite of hyperventilation, restored cerebral venous oxygenation to a level at least equivalent to that found when pure oxygen was breathed at rest at the same altitude. The respiratory minute volume during administration of carbon dioxide with oxygen was greater than when oxygen alone was breathed at reduced ambient pressure. Since neither arterial PO₂ nor cerebral venous PCO₂ values differed in these two experimental situations, the respiratory stimulation may represent the quantitative demonstration in man of a respiratory effect of carbon dioxide mediated by arterial chemoreceptor activation and unrelated to change in the level of central chemical stimulus. (Authors' abstract).

29

Pyridine Nucleotide Oxidases and Transhydrogenase in Acclimatization to High Altitude. B. REYNAFARJE—Inst. of Andean Biology and Faculty of Medicine, Lima, Peru (Contract AF 41 (657)-249): issued by School of Aero-

space Medicine, Brooks Air Force Base, Tex. (Project No. 7758, Task No. 59582). Technical Documentary Report No. SAM-TDR-62-88, Nov. 1962, iii + 6p. Unclassified

Activity of pyridine nucleotide oxidases and transhydrogenase has been examined in heart, liver, and rectus femoris muscle of guinea pigs (native of sea level) and high altitude. There was an enhanced, reduced form of diphosphopyridine nucleotide oxidase (DPNH-oxidase) and transhydrogenase activity in heart and muscle from animals adapted to high altitude. The higher activity in muscle at altitude was due solely to increase in ratio of red to white portions. Both groups showed the pigmented portion twice as active as the white one. In liver, neither the DPNH-oxidase system nor the transhydrogenase was significantly changed in their activity on a fresh-weight basis. Nevertheless, the DPNH-oxidase was higher at altitude when the activity was expressed per gram of nitrogen. The reduced form of triphosphopyridine nucleotide oxidase activity was not appreciably changed in any of the tissues. It is concluded that adaptation to high altitude is associated with apparent changes in the magnitude of the electron transport pathway. Increased activity in skeletal muscle is probably related to the tissue pigment content. (Author's Abstract)

30

Hormonal Factors in the Rat's Tolerance to Altitude. D. A. DeBIAS-Amer. Jour. Physiol., 203 (5) : 813-820, Nov. 1962.

The survival period of adrenalectomized rats, which are less tolerant than normal rats to reduced barometric pressure (equivalent to altitude of 27,800 feet), can be extended when the animals are pretreated with adequate amounts of cortisol. Pretreatment of adrenalectomized animals with somatotropin (0.5 mg./100g body wt.) did not have any significant effect on tolerance to simulated altitude but when somatotropin was administered simultaneously with a subeffective dose of cortisol, tolerance to altitude was significantly increased. Thyroidectomy did not have a beneficial effect on survival of adrenalectomized animals, but pretreatment of adrenalectomized thyroidectomized rats with 3 mg. cortisol, which is inadequate to protect the adrenalectomized animal against exposure to simulated altitude, significantly increased survival rate. A possible mechanism whereby lesser amounts of cortisol are effective in prolonging survival of thyroidectomized-adrenalectomized rats exposed to low barometric pressure may be a decrease in catabolism of the steroid in hypothyroid animals. (Author's abstract)

31

Effects of Hypoxia and Hypercapnia on Gastric Acid Secretion in Man. A. NAITOVE and S. M. TENNEY-Gastroenterology, 43(2): 181-188, Aug. 1962.

The separate and interacting effects of alveolar carbon dioxide and oxygen tensions on gastric

acid secretion were studied in normal humans exposed to a variety of gas mixtures at sea level and at high altitude (14,246 feet). Post-test meal acid secretion was, in general, directly related to alveolar carbon dioxide tension. Moreover, the amount of acid secreted at any given carbon dioxide tension was found to increase as the accompanying oxygen tension decreased. However, elevation of carbon dioxide tension was shown not to affect fasting secretion in man. It is concluded that changes in carbon dioxide and oxygen tensions can significantly modify an existing state of acid secretion, but that this cannot be universally demonstrated in all types of secretory studies. The possible role played by changes in gastric blood flow in determining the gastric secretory responses is discussed (Authors' summary).

32

Effect of Altitude on Formation of Urinary Bladder Calculi in Male Rats. A.T.K. COCKETT - Aerospace Med. 34 (2) : 108-110, February 1963.

A method for the formation of vesical calculi in male rats at simulated altitude is presented.

Weight of urinary bladder calculi formed experimentally in male rats at low barometric pressure without hypoxia (18,000 feet) is not significantly greater than calculi formed experimentally in rats at ground level.

The significance of dehydration rather than altitude in flying personnel is mentioned.

The possibility of urinary calculi as a result of extended space flight must await studies performed under altitude and prolonged weightless conditions. (Author's summary).

33

Studies on Bubbles in Human Serum Under Increased and Decreased Atmospheric Pressures. V.M. DOWNEY, T. W. WORLEY Jr., R. HACKWORTH and J.L. SHITLEY—Aerospace Med. 34 (2) : 116-118 February 1963.

These simple experiments showed that gas evolved from solution when serum was subjected to reduced atmospheric pressures less than 380mm. of mercury (equivalent to an altitude of 18,000 feet). The longer the serum remained "at altitude", the larger the bubbles became. When the serum was returned to one atmosphere, the bubbles decreased in size, but they did not disappear. When the pressure in the chamber was increased to the pressure of five atmospheres, the bubbles rapidly decreased further in size, and some were eliminated. Continued pressure at five atmospheres for a prolonged period of time finally forced all the gas back into solution.

(Authors' summary)

34

The use of Overcompression in the Treatment of Decompression Sickness. V.M. DOWNEY — *Aerospace Med.* 34 No. (1): 28-29 Jan. 1963.

The overcompression treatment for decompression sickness in aviators has been described. Overcompression has been used for many years in the treatment of the same disease in divers. It has now been used successfully in two aviators. It is the only specific treatment available for decompression sickness. Its general adoption in serious cases of decompression sickness is recommended, particularly in neurocirculatory collapse. We must continue to treat shock and correct cerebral hypoxia with oxygen inhalation, but these treatments should be considered as adjuncts to overcompression in serious cases. Mild cases will not require overcompression the usual symptomatic treatments will suffice.

(Authors Summary)

35

Convulsive Syncope Induced by the Weber Manoeuvre. R.C. DUVOISIN — *Arch Neurol.*, 7 (3): 219-216. Sept. 1962.

Responses to the Weber or Valsalva manoeuvre (straining against a closed glottis as long as possible) were observed in 200 males of military age and monitored with simultaneous electroencephalographic and electrocardiographic recordings. Sixty-one succumbed in syncopal episodes which were accompanied by a progressive slowing of the EEG culminating in extreme cases in electrical silence. Convulsive phenomena supervened on 54 occasions. These were distinctive in character and possessed features which render it difficult to view them merely as epileptic seizures triggered by anoxia. The convulsive movements and the EEG patterns resembled those described for convulsive syncope secondary to a reflex cardiac arrest, and to phenomena observed in men subjected to hypoxia in a low-pressure chamber.

(Author's summary, modified)

THERMAL STRESS

36

Factors Affecting Tolerance to Cooling of the Fingers (Abstract). C.J. EAGAN — *Physiologist* 5 (3): 133. Aug. 1962

The responses to finger cooling in 0.0°C water for 10 minutes and in air at -20° to -25° C. (with moderate air movement) for 30 minutes, or until fingers cooled to -5° C., were compared in 3 groups of subjects. The groups consisted of: six control subjects who were on the laboratory staff; four Eskimos who normally lived in northern Alaska but who had lived in a temperate climate on an ordinary mixed diet for nine months previous to the tests; six mountaineers who had undergone rigors of daily cold exposure of the extremities for 45 days in the course of an ascent of Mt. McKinley. Subjects with higher basal metabolic rates tended to maintain higher average fingers temperatures during both water and

air cooling. Physical fitness scores were in the order: mountaineers>Eskimos>controls. There was no correlation between level of physical fitness and resistance to finger cooling. The most marked differences between the groups were in the air cooling tests. The fingers of all the control subjects cooled to -5° C. before the end of the test (average 22 minutes). All of the Eskimos withstood 30 minutes of cooling. Three of the mountaineers who had not suffered cold injury lasted 30 minutes with their fingers at lower (average 15° C.), and hence more economical, temperatures than those of the Eskimos (average 22° C.). (From the author's abstract).

37

Manual Performance During Cold Exposure as a Function of Practice Level and the Thermal Conditions of Training. R. E. CLARK and C. E. JONES — *Jour. Applied Psychol.*, 46 (4): 276-280 Aug. 1962.

Three groups of 10 subjects each were given varied thermal experience (warm or cold hands) during the weeks of training on a standard manual task. The results were as follows: (a) one day of cold-hand training significantly reduced the size of a manual decrement usually associated with cold exposure, but continued cold experience did not; (b) skill level on the task per se did not interact with the cold-induced performance decrements, and (c) the thermal conditions associated with performance on the task appeared to become part of the stimulus complex eliciting correct manual responses when these thermal conditions were maintained for a large number of trials, i.e., the subjects learned not merely to perform on the task, but to perform with warm, or cold, hands specifically. (Authors' summary)

38

Effect of Severe Cold Stress on the Nitrogen Balance of Men Under Different Dietary Conditions. B. ISSEKUTZ, K. RODAH, and N. C. BIRKHEAD — *Jour. Nutrition*, 78 (2): 189-197. Oct. 1962.

Four groups of healthy young men consumed for 10-day periods at an ambient temperature of 22° C: 3,000 calories (Cal.), including 72 g. of protein (diet 1); 3,000 Cal., 4 g. of protein (diet 2); 1,500 Cal., 72 g. of protein (diet 3); and 1,500 Cal., 4 g. protein (diet 4), respectively. Diets 2 and 4 caused a marked loss, and diet 3 a moderate loss of body nitrogen. Changing to diet 1 during the follow-up period caused in every case a marked positive balance. The metabolic response to these four diets was investigated in nine nude subjects living for three to nine days at an ambient temperature of 8° C. This cold stress induced almost constant shivering and a resting metabolic rate about twice the basal metabolic rate (BMR). A negative nitrogen balance was observed with diet 1, and the nitrogen loss characteristic for diets 2, 3, and 4 at 22° C. was markedly increased at 8° C. After changing to diet 1 and a room temperature of 22° C. during the follow-up period, during which time the BMR was normal, the negative nitrogen balance persisted for four to six days, despite an 18-fold increase of the protein intake

(in case of diets 2 and 4). It is suggested that an increased activity of the thyroid or the adrenal cortex, or both, may be responsible for this after-effect of cold exposure. (Authors' summary)

39

The Effect of Work in Cool and Hot Conditions on Pulse Rate and Body Temperature. O. G. EDHOLM, J. M. ADAM, and R. H. FOX — *Ergonomics* (London), 5 (4): 545-556, Oct. 1962

Subjects performed work daily for four hours in cool conditions for two weeks, and then on one day in a hot environment. Thereafter, both groups continued the daily work, one in hot conditions, the other in cold, for a period of 12 days. The energy expenditure did not change throughout the experiment. In the cool environment, after approximately one week, post-work pulse rate and body temperature remained relatively constant, and so were the pulse rate and body temperature increments during work. On first exposure to heat, post-work body temperature and pulse rate were greater than in the cool conditions. All parameters decreased with each successive day of work in the heat, but post-work pulse rate and body temperature did not reach the levels attained in cool conditions. Post-work pulse rate and body temperature are linearly related and a correction can be made to the pulse rate by subtracting 27 beats per 1°C. for the rise of body temperature above 37°C. The value obtained is approximately equal to the post-work pulse rate observed in cool conditions. Assessing energy expenditure from post-work pulse rate or body temperature or their increments during work in the heat may be misleading, as the results depend upon the degree of acclimatization. If a correction is made for the level body temperature, an approximate measure of energy expenditure can be made irrespective of the state of acclimatization. (From the authors' summary).

40

Heat Exchanges of Men During Caloric Restriction in the Cold. P.F. IAMPINETRO and D.E. BASS — *Jour. Applied Physiol.*, 17 (6): 947-949 Nov. 1962.

The ability of men to maintain thermal balance during continuous cold exposure (14 days at 15.6°C., sedentary while nude) was assessed under four regimens of caloric intake: (a) adequate, 2,800 kcal./day; (b) moderate restriction, i.e., sufficient to maintain weight in a warm environment but without the added calories to support shivering, 2,600 kcal./day; (c) marked restriction, 600 kcal./day; and (d) complete starvation, 0 kcal./day. Respective weight losses for b, c, and d were 1.8, 8.2, 12.2% body weight. With 600 and 0 kcal./day there was an impaired ability to maintain rectal temperature; under these conditions the men exhibited rectal temperatures 0.7°C. lower than when they were on adequate or nearly adequate caloric intake. The men on complete starvation had the lowest heat production of all groups during later days in the cold; however, the data were too variable to demonstrate a close relationship between depressed core temperature

and decreased heat production. It is concluded that marked restriction of calories is associated with depressed core temperatures during prolonged cold exposure, due in part to absence of specific dynamic action. (Authors' abstract)

41

Effect of Some Pharmacologic Agents on Cold Tolerance of Dogs. C.M. BLATHEIS — *Amer. Jour. Physiol.*, 203 (5): 829-833, Nov. 1962.

Eight unanesthetized, shaved dogs were studied in 32 experiments for their thermal and metabolic responses to 90 minutes of exposure to 6°C. during peripheral vasoconstriction (Metaraminol bitartrate, 0.3 mg/kg), peripheral vasodilatation (trimethaphan camphorsulfonate, 10 mg/kg), and increased heat production (2,3-dinitrophenol (DNP), 2.5 mg/kg). In the cold, the temperatures of the metaraminol-vasoconstricted dogs fell more rapidly and lower than temperatures of controls, whereas the temperatures of the trimethaphan-vasodilated dogs decreased more slowly but also fell lower than those of controls; DNP retarded the temperature fall of these hypermetabolic dogs in the cold, but did not affect its degree. The vasodilating drug delayed the onset of shivering, whereas DNP hastened it; shivering in the vasoconstricted dogs began at a time not significantly different from that of controls. (From the author's abstracts).

42

Effect of Ventilating Air Flow on Human Water Requirements. B.E. WELCH, R.G. CUTLER, J.E. HERLOCHER, J.J. HARGREAVES, F. ULVEDAL, E.G. SHAW, G.B. SMITH, H.J. McMANN and L. BELL — *Aerospace Med.*, 34 (5): 383-388, May 1963.

These preliminary data indicate that the wearing of ventilated pressure garments, either partially-donned or fully-donned, has a marked, increasing effect on water requirements. This increase is influenced by suit inlet air temperature and by the environmental conditions surrounding the suit-man combination. Water requirements while the pressure suit was worn continuously averaged 1196 cc/man/day with an inlet air temperature of 60.6°F. The partially-donned type garment was reasonably well tolerated by the test subjects, as well as the fully-donned mode. Prolonged (3 days) continuous wear of the suits dictates the need for good ventilation and good skin hygiene. Heat loss from the body via evaporative cooling was greater than in the "shirt-sleeve" environment, but still did not assume a dominant role in maintaining thermal equilibrium. (Authors' Summary)

43

Physiological Responses of the Astronaut. E.P. MCCUTCHEON, C.A. HERRY, G.F. KELLY, R.M. RAPP and R. HACKWORTH — In: Results of the second United States manned orbital space flight, May 24, 1962, p. 54-62. Washington D. C.: National Aeronautics and Space Administration, 1962. Unclassified.

All flight responses in the MA-7 mission of M. S. Carpenter, May 24, 1962, provided an

appreciable extension to the observation of man's physiological responses to space flight (accelerations, weightlessness, artificial environment, etc.), and were considered to be within acceptable physiological ranges. Specifically, the heart-rate response to nominal exercise demonstrated a reactive cardiovascular system. An aberrant electrocardiographic (ECG) tracing recorded during re-entry possibly resulted from increased respiratory effort associated with continued speech during maximum acceleration. No disturbing body sensations were reported as a result of weightless flight. Astronaut Carpenter felt that all body functions were normal. Solid food could be successfully consumed in flight but precautions must be taken to prevent crumbling. The respiration rate sensor provided good pre-launch but minimal in-flight coverage. Because of erratic amplifier behaviour, the rectal temperature thermistor gave incorrect values for approximately 1/3 of the flight. In-flight blood pressure could not be interpreted. Included are tabulated data from clinical examination, bio-instrumentation, and subjective in-flight observations. (Author's summary modified)

GRAVITATIONAL STRESS

44

The Physiological Limitations of Performance During Acceleration. H. A. SMEDAL, T. A. ROGERS, T. D. DUANE, G. R. HOLDEN and J. R. SMITH—*Aerospace Med.* 34 (1): 48-55. Jan. 1963

We find that alveolar ventilation and arterial haemoglobin saturation are severely diminished during EBI (eye balls in) acceleration, and that the latter decrement is progressive. There is also indirect evidence that diminished venous return contributes to the progressive hypoxia and hypercapnia. The dyspnoea reported by most pilots under EBI acceleration can be accounted for in part by the hypercapnia, but the substantial deflation of the lungs is probably the chief cause of this discomfort.

In contrast, our measurements show that under EBO (eye balls out) acceleration, alveolar ventilation and arterial haemoglobin saturation are essentially normal. Furthermore, the ear pulse amplitude, blood pressure, and heart rate data all suggest that cephalic blood flow is at least as good as that during EBI acceleration and almost certainly better.

The tracking performances shown by the pilots under EBO acceleration, however do not show the clear cut superiority to be expected from the physiological advantages described above. Performance deteriorates in both acceleration vectors, and yet our physiological data suggest that only in EBI acceleration is there sufficient cerebral hypoxia to account for the deterioration. It would appear, then, that some other factor causes the decline in performance during EBO acceleration, and that its effects are fortuitously similar to the more obvious factors causing the deterioration during EBI acceleration. It is possible that during EBO acceleration, despite a generally adequate cephalic blood flow, some increase in intra-optic pressure may cause a strictly local retinal ischaemia. This will be investiga-

ted by cinephotography of the retina during acceleration. Despite the greater respiratory comfort, EBO acceleration is, nevertheless, a strange sensation even for experienced test pilots. It is likely that a subject's tracking performance suffers because a portion of his attention is inevitably channeled into concern for his restraint system and the unfamiliar sensations in this acceleration vector.

We consider that the most likely explanation of the seeming discrepancy, however, lies in the flow and accumulation of tears on the cornea during EBO acceleration. Tracking performance depends initially on the visual input, and if vision is blurred by tears, the performance will be affected just as adversely as if the visual decrement were of a more sinister etiology. This suggests that if the wavering refraction of the tears could be overcome by, for example, the pilot's wearing goggles filled with a physiologically compatible fluid of appropriate refractive index, then the major advantages of EBO acceleration would be reflected in an enhanced control facility. (Authors' Summary)

45

Atelectasis Following Acceleration: A Study of Causality. A. S. HYDE, J. PINES and I. SAITO—*Aerospace Med.* 34 (2): 150-156. Feb. 1963.

1. The effect on lung volumes (vital capacity, timed vital capacity, inspiratory capacity, expiratory reserve, tidal volume) was determined for various combinations of G_x vector, gas composition, wearing of anti-G suit, and simulation of restrictive aspects of ventilation during acceleration.

2. Following +6G_x (forward acceleration) for three minutes, severe decrease in vital capacity (-40 per cent) was found only after 100 per cent O₂ was breathed. This decrease occurred primarily because the inspiratory capacity diminished. There was no change in the post-run expiratory capacity.

3. Simulation of the accelerative force "loading" the chest and abdomen, as reproduced by lead-shot weights, did not alter lung volumes even when 100 per cent O₂ was breathed.

4. Positive pressure breathing (2 mm Hg per G) during +6G_x accelerations for three minutes while breathing 100 per cent O₂ did not prevent any of the post-run loss of vital capacity.

5. For the condition of +3.0 to +3.5 G_x (positive G) acceleration of three minutes duration, significant post-run loss of vital capacity occurred only when the anti-G suit inflation while breathing 100 per cent O₂ at +1 G_x was without effect on post-run lung volumes.

6. Loss of vital capacity following the conditions cited in 5 above occurred even when pre-run (control) and post-run vital capacities were measured with the anti-G suit inflated to 3.0 to 3.5 p.s.i.g. This infers that the post +3 G_x and 100 per cent O₂ loss was not limited to lung tissue directly compressed by inflation of the anti-G suit, but was in addition to it.

7. Suggested mechanisms which may be responsible for these phenomena are discussed. (Authors' summary).

46

Injuries During Ejection Seat Training. K. H. COOPER and F. M. G. HOLMSTROM. — *Aerospace Med.* 34(2): 139-141. Feb. 1963

Ejection seat indoctrination is a valuable training exercise. It occasionally exacts a penalty, usually in the nature of a mild to severe coccygeal injury. These injuries are generally related to unfavourable elastic characteristics of the seat cushions, to improper body position of the trainees and perhaps most important, to unusual accelerative characteristics of certain firings. Use of a firm, energy-absorbing seat cushion, careful attention to body position and use of the blowout patch and modified cartridge should serve to make ejection seat training a safe procedure. (Author's summary)

47

Response of the Rhesus Monkey to Lateral Impact. F. R. ROBINSON, R. L. LAMIN, W. M. WOLFF, and R. R. COERMANN—*Aerospace Med.* 34(1): 56-62. Jan. 1963

These experiments provide information regarding the physiological and mechanical response of well protected animate systems subjected to lateral impacts.

Rhesus monkeys were subjected to 11 laterally applied impacts ranged from 5 to 75 g with pulse durations of 70 to 27 milliseconds, respectively. Marked resonances of the head and hip occurred in the 30 millisecond pulse duration range. There appeared to be a resonance of the chest in the 10 millisecond range and either another resonance or the shifted resonance in the 30 millisecond range. The most important biological effect of the impacts was the response of the heart in the form of conduction abnormalities. The maximum response occurred immediately after the 55 g impacts. There were twice the number of abnormalities recorded from left lateral impact as compared to right lateral impacts.

Radiographs showed no skeletal fractures. Movement and/or dilatation of the heart was evident on the side receiving the impact. Routine haemogram and serum glutamic-oxalacetic transaminase values showed no change due to the impacts.

Protection provided by the individually fitted body moulds is discussed, particularly with reference to the heart. (Authors' summary)

48

Speech During Weightlessness. C. W. NIXON and C. E. WAGGONER - Aerospace Medical Division, Aerospace Medical Research Labs. (6570th), Wright-Patterson Air Force Base, Ohio (Project No. 7231, Task No. 723103). Technical Documentary Report No. MRL-TDR-62-45, May 1962. iii + 10p. Unclassified

Standard speech materials were recorded on magnetic tape by eight subjects (six Project Mer-

cury Astronauts who had previous zero-gravity experience) under 0 g, 1 g, and 2 1/2 g's during parabolic flight of KC-135 aircraft. Subjects were also queried concerning their personal reactions to speech under the altered g conditions. The recorded speech materials were evaluated by both subjective and objective methods. No differences were observed among the responses of the zero-g oriented astronauts and not significantly by altered brief periods of zero gravity. Both speakers and listeners indicate good speech intelligibility under weightlessness (From the author's summary and conclusions).

49

Psychomotor Performance Under Conditions of Weightlessness. J. E. WARD - Aerospace Medical Division, Behavioral Sciences Lab., Aerospace Medical Research Labs. (6570th), Wright Patterson Air Force Base, Ohio (Project No. 7184, Task No. 718405). Technical Documentary Report No. MRL-TDR-62-73, June 1962. iii + 7p. Unclassified

Subjects operated three different sets of switches as they were flown through 0-g trajectories in a C-131B aircraft. Push-button, toggle, and rotary switches were each paired with a master push-button switch to form the three sets used to turn an indicator light on and off. The subjects were instructed to perform the task as fast as possible by alternate actuation of the two switches of each set. Each subject also performed in straight and level flight with each set of switches for control data. Performance data, along with aircraft accelerative forces in three dimensions, were recorded on high-speed oscillograph. Small but statistically significant decrements were found in speed of operation of all three sets of switches in the 0-g environment in comparison with performance at 1 g. The toggle switch set showed the least decrement. The push-button switch set was operated most rapidly in both 1-g and 0-g conditions. (Authors abstract).

50

Survival and Growth of Organisms During Life Exposure to High Gravity. C. C. WUNDER, L. O. LUTHERER, and C. H. DOGE - *Aerospace Med.* 34(1): 5-10. Jan. 1963.

Nine different forms have been subjected by various laboratories to a chronic centrifugation. Alterations in life span and development result. These forms are the bean and wheat seedlings, fruit fly larvae, turtles, chickens, turkeys, rats, mice and hamsters. In some cases, life span decreases and growth decelerates; in other cases, growth is enhanced. The nature of the response is a function of the field intensity, the age, size, and biological and physical characteristics of the organism, as well as other environmental factors. These experiments indicate that terrestrial forms of life could live and multiply at gravitational intensities differing from that of the Earth's. However, there would undoubtedly be developmental alterations of a type which are at this time too complex to accurately predict.

(Author's summary)

RADIATION

51

Space Travel: A Suggested Method for Predicting Human Response to Ionizing Radiation. L. T. ODLAND and S. M. MICHAELSON—*Aerospace Med.* 34 (1): 62-65. Jan. 1963.

The hazards of ionizing radiation to manned space travel are reviewed. Some of the important factors in determining biological injury to ionizing radiation are discussed, and the relationship between metabolic and recovery rate is described.

It is suggested that an experiment be supported by interested agencies wherein several species of mammals are studied under identical conditions in order to define rates of accumulation and repair of injury caused by ionizing radiation as these relate to species metabolic rate. Results from the proposed study would provide information allowing more detailed planning for space exploration and military defence.

(Author's summary)

52

Depth of Penetration of Solar Protons Into the Atmosphere and Related Radiation Exposure in Supersonic Transport. H. J. SCHAEFER—*Aerospace Med.* 34 (1): 1-4. Jan. '63.

The flight profile of supersonic transport (SST) tentatively calls for a cruising altitude in the 65,000 to 80,000 feet range. At these altitudes only a few per cent of the total shielding power of the earth's atmosphere is left above the vehicle. It seems of interest to analyze the residual intensity of flare produced solar proton beams at these altitudes and the corresponding radiation exposure for pilots and passengers in such aircraft. A representative energy spectrum for a Class 3 flare event is selected and the altitude profile of tissue dose rate in a spherical tissue phantom behind 1 g./cm.² shielding is established. At 80,000 feet altitude the dose rate in the surface of the phantom equals 25 milliroentgens per hour and in the centre 13 milliroentgens per hour. Dose rates drop steeply toward lower altitudes and become insignificant in the 50,000 to 60,000 feet altitude region.

Available information at present is not sufficient to delineate exactly the latitude region within which the indicated dose rates would prevail. On the one hand, the magnetic field of the earth is known to shield low energy particles from the equatorial region. On the other hand, magnetic storms after large flares are known to neutralize this shielding effect to a large extent.

Flares of Class 3+ have occurred 41 times in 1958, 65 times in 1959, and 70 times in 1960. A minimum is to be expected in the "Years of the Quiet Sun" 1964 and 1965. While these data indicate that groundings of SST because of radiation hazards, even at times of high solar activity, will be less frequent than groundings of conventional aircraft weather conditions, it should be pointed out that the radiation hazard, contrary to weather conditions, is not of a local character, but prevails over the entire Northern and Southern polar cap region down to at least 50° latitude.

(Author's summary)

53

Alternations in Physiological Accommodation to Stress Induced by Irradiation. B. D. NEWSOME and D. J. KIMELDORF—*Aerospace Med.* 34 (3): 226-230. March 1963

Neutrons appear to be more effective in altering the cold tolerance of rats than x-rays.

Transitory changes were found early in the post-irradiation period for heart rate and body temperature response during cold exposure, but these changes could be correlated with the period of decreased cold tolerance that follows neutron exposure.

Sublethal neutron exposure caused a drop in indirect blood pressure measured in the tail artery but blood pressure returned to normal by the third day of post-irradiation.

The decreased cold tolerance after irradiation is not dependent solely on body weight.

Before an acceptable dose is set for the crew of a space vehicle more information should be accumulated on performance and ability to maintain homeostasis in humans following irradiation exposure. (Author's summary)

Respiratory Physiology

54

Oxygen Toxicity. A. B. DUBOIS—*Anesthesiology*, 23 (4): 473-477. July-Aug. 1962.

The administration of high oxygen concentration using an airtight system results in the rapid absorption of gases from closed spaces in the body. Atelectasis, accompanied by engorgement of the lungs and by right to left shunting of blood, may ensue. There is some suppression of the respiratory impulses arising from the carotid body, and hence a decreased ventilatory stimulus. This may result in an increase in arterial carbon dioxide tension if the ventilatory response to carbon dioxide is not adequate. These effects are counteracted by assisted ventilation. In normal man, there is a decrease in cardiac output when breathing oxygen, but this is abolished by atropine. When administered over a period of days, oxygen may produce chemical effects in the alveolar cells resulting in a picture of pulmonary oedema, atelectasis, pneumonia, and alveolo-capillary block. At 3 atmospheres, pure oxygen brings on convulsions owing to the chemical action of oxygen on the brain cells. The chemical effects probably are due to inhibition of cellular metabolic processes by oxidation of certain enzymes, and the presence of ionizing radiation accentuates these effects.

(From the author's summary)

55

Influence of Carbon Dioxide and Hyperventilation on Cardiac Output in Man. M. MCGREGOR, R. E. DONEVAN, and N. V. ANDERSON—*Jour. Applied Physiol.* 17 (6): 933-937. Nov. 1961.

The effect of changes in ventilation and carbon dioxide tension on cardiac output was studied in seven normal human subjects in the supine posture using a dye dilution method. Voluntary hyper-ventilation of room air with resultant hypocapnia invariably produced an increase in cardiac

output (mean, 88 ml. blood/litre increase in ventilation). Voluntary hyperventilation with maintenance of carbon dioxide tension at near normal levels resulted in a smaller increase in cardiac output (mean, 15 ml./litre). Hyperventilation produced by the inhalation of 8.4% carbon dioxide produced no change in cardiac output within the first 2 minutes but an increase thereafter. The response of the cardiac output to hyperventilation is thus largely determined by the carbon dioxide content of the inspired air. The manner which this takes place is uncertain. The higher cardiac output response at 2 minutes with hypocapnia may be partly the result of respiratory alkalosis. It might also be related to the increase in respiratory mechanical work per litre ventilation associated with the fall in carbon dioxide. The reason for the late rise of cardiac output with hypercapnia is unknown. (Authors' abstract).

56

Oxygen and Carbon Dioxide Tension as Factors in Respiration after Apnoea from Hyperventilation. K. SUGIOKA, D. A. DAVIS, M. HINTERNAOFF, R. L. MCKNIGHT, and D. C. GROSSKREUTZ — *Anesthesiology*, 25 (6, Part I): 772-782, Nov. 1962.

Dogs were lightly anaesthetized with pentobarbital and ventilated with room air, anaesthetized with ether and ventilated with a 25% oxygen mixture. Continuous recordings were made of oxygen (P_{O_2}) and carbon dioxide tensions (P_{CO_2}), blood pressure, and respiratory flow during and after hyperventilation. Hyperventilation resulted in increased arterial oxygen tension which remained consistently high while arterial carbon dioxide tension fell to very low levels. The resumption of respiration following the apnoea of hyperventilation occurred when the oxygen tension dropped to low levels and at low P_{CO_2} and seems independent of P_{CO_2} at that time. The initiation of respiration after this form of apnoea is possibly a function of the hypoxic drive from the aortic and carotid body chemoreceptors rather than an effect of carbon dioxide on the respiratory centre. Dangerous levels of hypoxia may occur during apnoea after hyperventilation with gas mixtures containing 20-25% oxygen if respiratory assistance is not given in the interval between the onset of apnoea and the resumption of respiration from whatever stimulus initiates breathing at this time. (Authors' summary, modified)

57

Alveolar CO_2 During Breath Holding and Exercise. A. B. CRAIG and S. A. BABCOCK — *Jour. Applied Physiol.*, 17 (6): 874-846 Nov. 1962.

When 12 healthy adult male subjects held their breath after breathing 100% oxygen, the partial pressure of carbon dioxide in the alveoli at the breaking point was higher when they exercised than when they were at rest. Attention was not a factor, and passive exercise did not produce a result different from rest. By repeated breath-holding experiments at different work loads it was possible to demonstrate a systematic error due to

the sampling site, the alveolar air. When this error was examined quantitatively, it was found that there is probably no difference in the carbon dioxide tension at some critical sensing site at the breaking point under the different conditions of voluntary apnoea. Our results imply that exercise may not change the sensitivity to carbon dioxide, or at least the sensitivity is not decreased. (Authors' abstracts).

58

Effect of Forward Acceleration and Negative Pressure Breathing on Pulmonary Diffusion. F. W. ZECHMAN and G. MULLER — *Jour. Applied Physiol.*, 17 (6): 909-912, Nov. 1962.

Forward acceleration decreased lung volumes, resembling negative pressure breathing (NPB). At 4 g the relaxation pressure curve is shifted downward and to the right 15 mm. Hg. Pulmonary gas exchange and diffusion capacity were measured in nine human subjects during NPB (-15 mm. Hg.) and forward acceleration (4 g). Pulmonary ventilation increased approximately 40% in each condition. The oxygen uptake increased with NPB (from 261 to 293 ml./min) and was slightly decreased or unchanged at 4 g. Carbon dioxide elimination increased in both experimental conditions. The apparent steady-state carbon monoxide diffusion was unchanged by NPB but decreased from an average control value of 21 to 12 ml./min. mm. Hg at 4 g. Since lung volumes are decreased by comparable amounts in both conditions, it is believed that the deleterious effects observed with forward acceleration are associated with the increased hydrostatic gradient from chest to back. (Authors' abstracts).

59

The Pressure-Relationships of the Intrathoracic Airway in Man. R. E. HYATT and R. E. WILCOX — *Jour. Clinical Investigation*, 42 (1): 29-30, Jan. 1963.

The gas-velocity profile in the trachea was evaluated in five conscious subjects by simultaneous direct measurement of lateral and impact tracheal pressures. The profile was found to be nearly blunt during both inspiration and expiration for flows ranging from 0.5 to 4.5 liters per second. Isovolum pressure-flow curves of the lower airway (alveolus to trachea) were obtained. From a knowledge of the tracheal velocity profile it was possible to separate the lower airway pressure drop into two components, one related to the frictional losses in the gas and one to the convective acceleration of the gas (Bernoulli effect). Failure to consider the pressure drop due to convective acceleration leads to an overestimation of expiratory frictional resistance and underestimation of inspiratory frictional resistance. (Author's summary)

60

Effect of Expiratory Flow Patterns on Lung Emptying. A. C. YOUNG, C. J. MARTIN, and W. R. PACE — *Jour. Applied Physiol.* 18(1): 47-50, Jan. 1963.

Differences in expired alveolar gas concentrations with changes in expiratory flow were studied in single-breath experiments using nitrogen and

carbon dioxide meters. High flow rates preferentially emptied lung areas having low ventilation-to-volume ratios and high ventilation-to-perfusion ratios, whereas low flow rates preferentially emptied areas of high ventilation-to-volume and low ventilation-to-perfusion ratios. Selective emptying of different lung areas by varying the expiratory flow pattern was not affected by age, or body position. A model of the lung is proposed to explain how ventilation-to-volume ratio differences can be seen at mouth level during constant slow, varying and constantly increasing or decreasing expiratory flows. (Authors' abstract)

61

Abdominal Muscle and Diaphragm Activities and Cavity Pressures in Pressure Breathing. B. BISHOP—*Jour. Applied Physiol.*, 18 (1): 37-42 Jan. 1963.

The respiratory contribution of the diaphragm and external oblique abdominal muscle has been assessed by recording from the anaesthetized cat the integrated electromyograms during continuous pressure breathing. As the intrapulmonary pressure is progressively reduced from 0 to +12 cm. H₂O, the diaphragm becomes increasingly active until it has no silent period during the respiratory cycle. Concomitantly, any respiratory activity in the abdominal muscle is completely silenced. A hyperactive diaphragm and relaxed abdominal wall can account for the constancy seen in the directly recorded intra-abdominal pressure even though the intra-thoracic pressure falls. When the animal is subjected to pressures from 0 to +14 cm. H₂O, the diaphragm is initially inhibited and the abdominal muscle becomes increasingly active. In every animal on positive pressure the abdominal muscle becomes active during expiration and in 20% of the animals it is also active during inspiration. Active expiration continues throughout the pressure breathing and is sufficient to reverse the breath-by-breath abdominal pressure variations. During negative pressure breathing, respiration is an inspiratory act and only the thorax is subjected to stress. During positive pressure breathing, respiration is an expiratory act and both the thorax and abdomen are subjected to the stress. (Author's abstract).

Neuro-Psychiatry & Psychology

62

Imagery and Sensory Deprivation, and Experimental Study.—P. H. LEIDERMAN, Harvard Univ. Medical School, Boston, Mass. (Contract AF 33 (616) — 6110); issued by Aerospace Medical Division, Biomedical Lab., Aerospace Medical Research Labs., 6570th, Wright-Patterson Air Force Base, Ohio (Project no. 7220). Technical Documentary Report No. MRL-TDR-62-28, May 1962. vii + 111 p.

The effect is evaluated of repeated exposures of the same individual to short periods of sensory deprivation and isolation. Behavioral and physiological responses were measured and their relationship to modification of visual input determined. The results suggest that physiological adaptation to isolation continues over several sessions. The presence of visual imagery in a subject appeared to be related to the individual personality, and not to the conditions of deprivation. Auditory and somesthetic imagery appeared to be related to the type of deprivation. Body movement response was negatively related to the amount of imagery. The findings point out the importance of non-imagery factors as measures of stress and the importance of assessing individual differences in imagery responses under conditions of isolation. (Author's abstract) (53 references).

63

Variability of Performance in a Vigilance Task—T. W. FAULKNER—*Jour. Applied Psychol.*, 46 (5): 325-328, Oct. 1962.

An experiment was conducted to determine the effect of signal pattern and frequency on the variability of a subject's performance in a vigilance task. Subjects were 12 male college students who watched 3 dials during 3 consecutive 27-min. periods. Real signals occurred alone in one period while two different patterns of dummy signals were added in the other two periods. It was found that dummy signals which occurred at semi-regular intervals were more effective in reducing the subject's variability than those which occurred at non-regular intervals. It was also found that variability increased with time. It is concluded that use of a semi-regular pattern of dummy signals would be one way of improving performance on a vigilance task. (Author's summary).

64

Vigilance Performance as a Function of Paired Monitoring—B.O. BERGUM and D.J. LEHR—*Jour. Applied Psychol.*, 46 (5): 341-343, Oct. 1962.

Two experiments were performed to determine the effect of pairing of observers upon individual monitoring performances. Both studies employed two groups of 20 subjects each. One group consisted of paired monitors and the other of isolated monitors. Experiment I employed a rate of 24 signals/hour. Experiment II employed 6 signals/hour. All subjects monitored a circular light display for period of 90 minutes. Neither experiment indicated an over-all facilitation of performance resulting from pairing, but both demonstrated significant relationships between performances of the members of the pairs. It was hypothesized that the degree of conversational interaction between members of the pairs might account for the observed effect. (Authors' summary)

65

Increased Occurrence of EEG Alpha during Increased Attention. T. MULHOLLAND and S. RUNNALS—*Jour Psychol.*, 54 (2): 317-330. Oct. 1962.

The occurrence of alpha rhythm in the electroencephalogram was compared during continuing attention sets and during recurring altering responses. Alpha was frequently facilitated during periods of attention sets or was little affected. On the other hand, the familiar suppressions of alpha occasioned by altering to an external signal was clearly evident. The behavioral effects of both the attention sets (on perceptual content) and altering (giving a verbal report in response to an audible signal) were definite and consistent. It is concluded that the term attention can refer to neither a qualitatively consistent behavioral nor neurophysiological entity and that the classical and familiar alpha-attention hypothesis refers to a special case, i.e. transitory altering to an external signal. (Authors' summary)

66

On Synchrony of the Alpha Rhythms. R. P. LEVINE, R. P. SMITH and G. R. HAWKES—*Aerospace Med.* 34 (4): 349-352. April 1963.

Speculations on alpha rhythm function concern their origin (whether in individual neurones or in alpha centres), their possible control of neural "tone," and their coordination of vigilance and information-handling processes. The synchrony exhibited by these rhythms is important to all such speculations, and other investigators have shown that synchrony exists to a significant degree. This study was designed to yield quantitative information on the degree of synchrony, and a new instrument, the "Vector Electroencephalograph" was used. This instrument presents, in a single pattern, the total electrical activity of the brain, referred to an equivalent central dipolar source. Patterns indicating an astonishingly high degree of synchrony throughout the brain have been obtained. During many such "alphabursts," the intra-brain phase shifts were about 5 milliseconds per second, or less. (Authors' summary)

67

The Electroencephalographic Findings in Passengers During Acrobatic Flight. D. C. McNUTT, S. N. MORRILL, A. B. HEADLEY and H. W. ADES—*Aerospace Med.* 34 (3): 218-221. March 1963.

Three groups, namely experienced, inexperienced and "clinical referrals" were studied while undergoing similar acrobatic sequence. The EEG, ECG, and moving pictures were recorded. Approximately fifty per cent of the "clinical" group were activated by this sequence, whereas only five per cent and fifteen percent of the other groups were. Unconsciousness was accompanied by high voltage slow waves. These were most frequently found during a loop manoeuvre. The spiking and other phenomena normally correlated with epilepsy were not seen in any of these records.

From these findings it is concluded that the airborne recording of the encephalogram has a definite place in the workup of aviators who have had some incident of unconsciousness. It would also be of value as a baseline, and as an aid in selection of a small group of astronauts such as prior to space flight. (Authors' summary)

Orientation & Auditory Perception

68

Accuracy of Orientation and Positioning in Homogeneous Visual Fields. J. W. MILLER and R. J. HALL—*Aerospace Med.* 34 (4): 337-341. April 1963.

The present study was undertaken to determine the accuracy with which an individual can position an object in the centre of a structureless visual field either illuminated or dark. Measurements were also made as to the ability of an observer to return an object to a remembered reference under similar conditions. It was found in general that an accuracy of adjustment of about 2.5 to 3.5 degrees can be obtained quite consistently. The stimuli were presented both randomly and non-randomly with similar responses resulting in both instances. Although several interpretations are discussed it is suggested that the responses are determined at least partially on the basis of bodily orientation rather than on a visual basis alone. The results also are discussed in terms of the relation between laboratory studies of this type and visual problems during high altitude flight and future manned orbital flight. (Authors' summary)

69

Perception of the Visual Vertical Under Reduced Gravity. L. R. HAMMER—Aerospace Medical Division Behavioral Science Lab., Aerospace Medical Research Labs. (6570th), Wright-Patterson Air Force Base, Ohio (Project No. 7184, task No. 718405), Technical Documentary Report No. MRL-TDR-62-55, May 1962 iv + 13 p.

Judgements of the vertical in an unstructured visual field were obtained in flight under four levels of gravity ranging from 0g to 1g. Reduced and zero-gravity conditions were produced in a cargo aircraft flying a parabolic trajectory. Each of 16 subjects made 6 judgements under each of the four gravity conditions. Results indicate that, although error of judgement of the vertical is not large, it does increase as the g-level decrease, from 1.8 degrees at 1g to 3.5 degrees at 0g. Conditions associated with inflight research are discussed and suggestions for future research are presented. (Author's abstract) (31 references)

70

The Horizontal-Vertical Illusion and the Relation of Spatial and Retinal Orientation — S. MORINAGA, K. NOGUCHI, and A. OHISHI—*Japanese Psychol. Res.* (Tokyo), 4 (1): 25-29 April 1962. In English.

The vertical extension of a figure appears to the observer to be longer than an equal figure extending horizontally. As a part of studies on the

inhomogeneous nature of the visual space, an attempt was made to investigate whether or not, or to what extent, the change in the relation between spatial and retinal orientations influenced the amount of illusion in the L-shaped figure and its modifications. The conditions were: (I) the figure was tilted to the right, the subject's head was held upright; (II) the head was tilted to the right (A) or to the left (B), but the figure was held upright; and (III) both figure and head were tilted to the right at the same time. The change in orientation of figures was found to affect the amount of illusion, most markedly in Condition I, less markedly in Condition II, and slightly in Condition III. It was concluded that the retinal factor is of the primary importance, though not exclusive, in producing the horizontal-illusion.

(Authors' summary)

71

The Perception of Rhythmically Repeated Linear Motion in the Horizontal Plane. E. G. WALSH—*Brit. Jour. Psychol.* (London) 53(4): 430-445. Nov. 1962.

Normal subjects were exposed to linear motion rhythmically repeated at rates to 1 to 1/9 cycle per second. With horizontal oscillations of 1/3 cycle/sec. the sensations of moving came at the turning-points of the swing. The person felt he was moving most rapidly when he was momentarily stationary. The central nervous system interprets acceleration as velocity under these circumstances. At times the first sensation of moving in one direction came while the person was travelling rapidly in the opposite way. At 1 cycle per second the sensations were in time with movements as they occurred. Threshold data indicate that the peak acceleration adequately describes the stimulus at 1/3 and 1/9 cycle per second. The findings are discussed in relation to the behaviour of the otolith organs and may have a bearing on possible explanations of motion sickness.

(Author's summary).

72

The Visual Perception of size and Distance, W. C. GOGEL—Federal Aviation Agency: Civil Aeromedical Research Institute Aeromedical Research Division; Oklahoma City Oklahoma, Report No. 62-15 July 1962 p. 19.

The perception of absolute distance has been assumed to be important in the perception of the size of objects and the depth between them. A different hypothesis is proposed. It is asserted that perceived relative size and distance are the primary psychological phenomena, with perceived absolute distance derived from the perceptual summing of perceived relative depths. In agreement with this point-of-view, it is stressed that relative rather than absolute retinal extents are the determiners of visually perceived extents. A principle called the "adjacency principle" is identified as perceptually organizing the relative retinal stimuli. This principle states that the apparent size or position of any object in the field-of-view is determined by whatever size or distance

cues occur between it and adjacent objects. Some evidence for the the adjacency principle is discussed and some consequences of the principle are considered. (Author's abstract) (63 references)

73

Eye Movements and the Optogyral Illusion. G. H. BYFORD—*Aerospace Med.* 34 (2):119-123. February 1963.

The visual sensations accompanying angular acceleration of a subject whose field of view is restricted to objects known to be rotating with him, may be divided as follows:—

A small, initial apparent displacement—usually less than 10° —of the fixation target with respect to the subject, in the same direction as the sensation of rotation. This displacement is accompanied by a movement of the eyes of a magnitude and direction which could reasonably be held to account for its presence. The sensation is almost invariably present following impulsive stimulation of the labyrinth, but is difficult to detect during low steady state accelerations.

A smoothly continuous unidirectional motion of the fixation target, of approximately the same duration and in the same direction as the sensation of rotation, about an axis coincident with that of the stimulus. No evidence was disclosed which would support a hypothesis that this visual sensation could be connected, by a cause and effect relationship, with nystagmus of the eyes. The phenomenon may be present (a) in a subject whose eye is incapable of producing nystagmus; (b) under conditions when nystagmus is absent; and (c) in subjects observing a target, the image of which cannot move with relation to the retinal receptors. (Author's Summary).

74

Differences in Autokinesis Based on Stimulation of the Left Versus the Right Eye. H. F. CROVITZ—*Perceptual and Motor Skills*, 15(3): 613-634. Dec. 1962.

The initial direction of the lateral component in autokinesis was studied, when the fovea of the left eye was stimulated, illusory movement was to the left and when the right eye was stimulated, it was to the right. A theory is presented which relates autokinesis to innervation for eye movement.

(Author's summary, modified).

75

Manipulation of Arousal and its Effects on Human Vestibular Nystagmus Induced by Caloric Irrigation and Angular Accelerations. W. E. COLLINS—*Aerospace Med.* 34 (2): 125-129. February 1963.

Investigations concerned with effects of subjective states on vestibular nystagmus were reviewed. Methods of controlling such states were discussed. Data indicate that the significant factor in human-orientation is a state of arousal, defined in terms of mental activity. Continuous, concerted attending to a task yields a brisk, long-duration nystagmus. If responses to a task re-

quire less attention with repetition, or if subjects are mentally unalert, a significant reduction in nystagmus output may occur. The effects of tasks on certain theoretical and applied vestibular problems were examined. (Author's summary)

76

Amphetamine, Arousal and Human Vestibular Nystagmus. W. E. COLLINS and R. H. POE.—*Jour. Pharmacol. and Exper. Therapeutics*, 138 (1): 120-125. Oct. 1962.

A normal clinical dosage of amphetamine (12 mg) and a placebo were administered to six rotation-naïve subjects and six rotation-experienced subjects by the "double-blind" technique. The drug produced significant increases in cardiovascular activity. However it did not affect significantly the total amount of slow-phase nystagmus induced by rotation when instructions influencing mental activity were employed. In agreement with other studies, the mentally active state resulted in greater output and longer durations of nystagmus than did the relaxed state.

(Authors' summary).

77

Studies in Habituation of Vestibular Reflexes III—a Revision. C. FERNANDEZ and R. S. SCHMIDT—*Aerospace Med.* 34 (4): 311-315. April 1963.

Habituation of nystagmus to repetitive caloric or rotatory stimulation was produced in the cat. The phenomenon, as in a negative learning process, presented the characteristic of acquisition, transfer and retention.

Total ablation of the neocortex with extensive damage to diencephalon did not interfere with acquisition of habituation but these structures may be important for retention of the response decline.

The phenomenon is apparently located in the vestibular centres, including vestibular nuclei and reticular formation of both medulla and pons. (Authors' summary).

78

The Validity of Tests of Canal Sickness in Predicting Susceptibility to Airsickness and Seasickness. R. S. KENNEDY and A. GRAY-BIEL.—Naval School of Aviation Medicine, Pensacola, Flo. (Project No. MR005. 13-6001, Subtask I, Report no. 71); and National Aeronautics and Space Administration, Washington, D. C. (NASA Order no. R-47). June 27, 1962. ii + 8p. Unclassified

Twenty-one subjects were exposed to a laboratory method for producing motion sickness (canal sickness) aboard the Slow Rotation Room. In an effort to determine the predictive ability of this method the subjects were also subjected to acrobatics in an aircraft and to heavy or moderately calm sea states. In addition, nystagmic response to caloric stimulation was observed. It was found that a positive relationship existed between performance on the Slow Rotation Room, caloric irrigation, and airsickness. This relationship also existed during heavy seas and to a lesser

extent on moderate seas. In general, it may be concluded that individual performance on the standard procedure used to produce canal sickness aboard the Slow Rotation Room is predictive of susceptibility to air and seasickness.

(Authors' abstract)

79

Ear Reference in Auditory Perception. M. P. BRYDEN—*Jour. Exper. Psychol.*, 65 (1): 130-105. Jan. 1963.

In a dichotic listening experiment, normal adult subjects identified numbers presented to the right ear more accurately than numbers presented to the left ear and preferred to report the material from the right ear first. To evaluate the effect of order of report, a further experiment was performed with 32 subjects, in which they were instructed to report each channel first equally often. When 3 or 4 digits were presented to each ear, most subjects identified material from the right ear more accurately than material from the left ear, when 5 digits were presented to each ear, this difference was not observed. The findings suggest that the auditory system is better organized for the perception of verbal material presented to the right ear. (Author's summary)

80

Acoustic Trauma—Some Investigations Concerning Industrial Noise. D. L. CHADWICK—*The Journal of Laryngology and Otology* LXXVII (6):

467-478. June 1963.

The hearing of workers in an unusually noisy environment was studied for a period of over 2 years.

The noise source was a jet-engine, running in an enclosed space and producing (1) a high-intensity overall noise and (2) isolated peaks of very high sound pressure levels.

The sound spectrum was such as to be capable of producing both chronic "noise-induced deafness" and acute "acoustic trauma".

The noise exposure was a continuous 6 hours daily.

Audiometric studies indicated a more marked initial high tone loss and a much more pronounced permanent threshold shift than in an otherwise comparable control group.

The role of past otitis media on the development of inner-ear lesions was studied.

The findings suggest that there may be critical sound pressure level and frequencies, which middle-ear lesions may protect the cochlea, but above which the effects of harmful noise become grossly accentuated.

(Author's Summary and Conclusions).

81

Hearing Conservation Programme Evaluation. R. G. WITWER, B. G. McDADE and C. G. COLE—*Aerospace Med.* 34 (5): 417-417. May 1963.

The programme has certainly "paid off" in monetary saving reduction in disability compensation cases, in the retention of valuable technicians,

and of even greater importance, in the probable prevention of permanent acoustic damage in an impressive group of personnel.

Aircraft are being received which generate more than twice the sound levels of our present engine i.e. F411 Phantoms. Hearing conservation programmes must be accelerated to keep abreast of technological advances in order to maintain the peak efficiency of personnel, and to prevent further acoustic loss.

It is further concluded from the examination of IBM computations that certain patterns may be predicted. The IBM questionnaire is submitted as enclosure (1). Concentration of effort is primarily indicated where family history is negative and all other factors indicate that a loss of auditory acuity is attributable to high noise generators. (Authors' summary)

Vision

82

Vision in Today's Aviation (La vision dan l'aviation d'aujourd'hui). A. MERCIER — In *Visual problems in aviation medicine*, p. 1-16. by A. Mercier. Oxford: Pergamon Press, 1962. In French, with English summary (p. 15-16).

High performance jet aircraft may cause marked visual problems in pilots. The pilot's psycho-physiological balance should be examined periodically in order to prevent the appearance of sensory illusions and to combat any emotional shock resulting from lonely flight in an empty sky. Verifying a 10/10 visual acuity and emmetropia at the initial examination no longer assures the pilot safety of vision in all circumstances because of space myopia which appears in an empty visual field. Eye protection against dazzle is a problem as the altitude increases. Goggles, visors, and tinted glass canopies must have at least a 75% absorption coefficient. Higher landing speed and the increasing use of helicopters give new importance to oculomotor equilibrium and stereoscopic vision. Whether aircrews constantly wear an oxygen-breathing apparatus, or fly in pressurised-cockpit planes, the oxygen supply must be carefully controlled because the first effect of anoxia is visual disturbance. Training in and control of night and twilight vision are recommended to ensure visual efficiency in flight (Author's summary, modified)

83

Space Myopia (La myopie spatiale). A. MERCIER — *Revue de médecine aeronautique* (Paris), 1 (4): 65-68, July-Aug. 1962. In French.

Accommodative spasm for near sight associated with high altitude flight in aviators in the so-called empty visual field is thought to cause space myopia. This type of myopia does not appear only during high-altitude flight but also during the visual survyance of vast sea or desert areas, snow-covered plains, or during flight between two cloud layers; in other words, every time the eye finds it impossible to focus at a distance. A proposal not to admit hypermetropic student pilots of 1 diopter

to fighter school was studied. Of 42 emmetropic, hypermetropic, or myopic subjects, the myopics were found to be less susceptible to hyperaccommodation in an empty visual field than hypermetropics. All factors affecting the mechanisms of accommodation vary according to the individual and the situation. Visual aids to combat accommodative spasm are ineffective. It is suggested that the following procedures be adopted: navigation control with flight plans regulating the altitudes and corridors of commercial air traffic, and the installation of radar on board military aircraft permitting observation of the sky without relying on distance vision.

84

The Time Course of Night and Space Myopia, G. G. Heath. Indiana Univ., Bloomington (Contract A. F. 33 (616)-6142); issued by Aerospace Medical Division, Life support systems Labse, (6570th, Wright Patterson Air Force Base, Ohio (Project no. 6301, Task No. 630103.) Technical Documentary Report no. AMRL-TDR-62-80, Aug. 1962. V + 39 p.

The refractive state of the human eye was measured over periods up to 4 hours in total darkness and in an empty, lighted visual field, using a subjective optometer, an infrared retinoscope, an infrared automatic recording optometer, and white light and infrared photography of the third Purkinje image. Under both viewing conditions, measurements showed a continuously varying relative myopia produced by accommodative changes, which tended to increase during the first 3-5 minutes and to vary unpredictably thereafter, with continuous, irregular, rapid fluctuations of as much as 0.75 diopter (D), occasional spontaneous changes of the predominant level by as much as 1 D., and slow drifts of as much as 1.5 D. over periods of several minutes. This highly dynamic accommodative activity in an empty visual field contrasts with previous concepts of a passive and relatively fixed "resting state" of accommodation under such conditions. Factors influencing this accommodative activity were also studied. (Author's abstract)

85

Visual Problems in Low-Altitude Flight (Les problèmes visuels dans le vol à basse altitude). A. MERCIER AND G. PERDRIEL. In: *Visual problems in aviation medicine*, p. 78-83. Ed. by A. Mercier. Oxford: Pergamon Press, 1962. In French, with English summary (p. 83).

Low-altitude, high-speed flight requires increased attention which produces a nervous tension. Turbulence and acceleration near the ground are factors that contribute to visual impairment. The detection of ground targets is more difficult while flying at high speed and low altitude because visual acuity depends essentially upon sensory psychomotor chronology. Meteorological conditions, the nature of the region flown

over, and the time of the flight have an effect upon target detection. Training can improve flying under these conditions. Variations of lighting inside and outside the cockpit also affect vision. At low altitudes, detection of another aircraft becomes more difficult. Heat, vibrations, twilight, or night flying also cause visual disturbances. (Authors' summary, modified).

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The Eye Movements of a Pilot During Aircraft Landing. E. L. THOMAS — *Aerospace Med.* 34 (5) 424-426. May 1963

The eye movements of one inexperienced pilot were recorded by the optical eye marker head camera, during twenty landings. The main findings with this pilot were: (1) the mean fixation time during the turn and final approach was 0.75 secs., i.e. about 13 eye movements during a 10 second period. (2) The pattern changed during the final approach so that the mean fixation time increased to 3 seconds during the last ten seconds before touch-down. During the last 5 seconds were few or no eye movements. (3) During this inactive period the line of regard remained directly ahead, moving down the runway at a fixed distance ahead of the aircraft. (4) The pattern of inaction was broken up into a flurry of rapid eye movements on two occasions by objects appearing away from the line of regard. (5) Head movements were few and slow, and (6) During the final turn prior to the landing the horizontal axis of the head tended to be maintained parallel to the horizon.

(Author's Summary)

87

Ophthalmological Problems Caused by Use of Helicopters and Apparatus for Vertical Take-Off and Landing (Les problèmes ophtalmologiques posés par l'utilisation des hélicoptères et des appareils à décollage et atterrissage verticaux). A. MERCIER AND G. PERDRIEL — in: *Visual problems in aviation medicine*, p. 89-94. Ed. by A. Mercier. Oxford: Pergamon Press, 1962. In French, with English summary (p. 93-94).

Helicopter pilots must have a perfect stereoscopic sense because they must be able to determine vertically the altitude, relief, and slope of the ground. Therefore, the correction of refractive defects, mainly myopia and myopic astigmatism, is necessary.

Piloting a helicopter requires a constant visual effort, more sustained than on any other kind of aircraft.

During certain missions, atmospheric turbulences at low altitude increase visual fatigue; sound vibrations have a similar effect.

The stroboscopic effect of the rotor blades has been responsible for some cases of photogenic epilepsy. Predisposition to this condition must be detected by means of an EEG with make-and-break photic stimulation.

Great accelerations in the speed at which the objects seems to pass by, and hovering flights at higher altitudes sometimes cause a feeling of vertigo.

Atmospheric conditions sometimes render the evaluation of distances difficult.

Take-off and landing of VTOL aircraft may raise a dense cloud of dust which impairs the outside visibility during the most critical time.

Protection of the pilot's eyes is also considered in relation to the required missions.

(Authors' summary)

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Flicker as a Helicopter Pilot Problem. L. C. JOHNSON — *Aerospace Med.* 34 (4): 306-310. April 1963.

Flicker during flight was reported as a problem for one fourth of these 102 helicopter pilots. Generally this was a minor problem and flicker was described as only annoying or distracting, but in one instance a near accident was attributed to flicker. At this stage of the helicopter pilot's career photic stimulation does not appear to be a useful device to detect those who would show abnormal EEG activity during flicker. Photic stimulation, however, did identify pilots who had subjective feelings of discomfort during the flickering light and perhaps of more importance in at least one-fourth of this sample, their degree of alertness was markedly affected during flicker.

(Author's Summary)

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The Mechanism of Dark-Adaption. M. A. BOUMAN and J. TEN DOESSCHATE — *Vision Research*, 1(5/6): 386-403. Jan. 1962.

An analysis is given of the various possible components of the dark-adaption process. A distinction is made between photochemical component (f_1), neural receptor component (f_2), spatial summation component (D), temporal summation component (T), and a quantum coincidence component (k). These various components partly reveal themselves in different ways in dark-adaption curves obtained by sensitivity measurements as a function of time for different target-sizes different target-colours, and different retinal locations. Experiments were carried out in order to study the relative contribution of each component for foveal as well as for peripheral adaptation vision. Foveal adaptation appears to be governed by the component f_1 and perhaps also f_2 . In phase I of peripheral adaptation a small D-component is added and in phase II of peripheral adaptation only the k-component is active. The behaviour of the resting potential of the human eye during dark-adaption does not bear a simple relation to any of the neural components mentioned in the present paper.

(Authors' Abstract)

90

Effect of Hyperventilation on Foveal Critical Flicker Frequency. G. W. GRANGER and H. IKEDA — *Vision Research*, 1 (3/4): 287-300. Oct. 1961.

The effect of voluntary hyperventilation on the relation between foveal critical flicker frequency (n) and retinal illumination (I) was investigated with circular test fields ranging in angular diameter from 2.5° to $2^\circ 11'$. Although the basic form of the n -log I relation was unaffected, the curves as a whole were displaced upwards along the critical frequency (n) axis to higher frequencies. The amount of the displacement increased with increasing size of field from zero, for fields below about $7'$ angular subtense, to 2-3 c.p.s. for the largest field size. The results are interpreted in terms of increased foveal interaction and are discussed in relation to recent work on spatial integration in the retina (Authors' Abstract).

91

On the Localization of Troxler's Effect in the Visual Pathway. F. J. J. CLARKE and S. J. BELCHER — *Vision Research*, 2 (Jan-April): 53-68. Jan-April 1962.

An attempt was made to establish the possible seat of Troxler's Effect in the visual pathway (after fixation of a target for a few seconds the objects in the outer visual field tend to fade out or disappear completely). Fully dark-adapted observers viewed a 4×10^{-2} cd/m² stimulus at 20° eccentricity under conditions of steady fixation, the mean time of subjective disappearance being 6.4 seconds. A consideration of quantum statistics and the kinetics of local adaptation at this low level shows that the effect cannot originate in the primary receptors. An experiment involving saccadic displacements of a faded image in the light-adapted condition yielded a frequency-of-seeing curve of Poissonian form, $n=3$. From this it is deduced that at least three of the functional units involved need to respond to enable a faded image to reappear and that the mean diameter of the unit at 20° eccentricity is 10 minutes of arc under these conditions. A study of extrafoveal acuity under equivalent conditions yielded a value of $8'$ of arc, indicating that the functional units involved are probably the same, the ganglionic units. As at least three units at a time seem to be concerned with Troxler's Effect, which suggests a pre-cortical origin. The lateral geniculate body is suggested as a probable seat of Troxler's Effect. (Authors' Abstract).

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A Phenomenon Caused by Light Flashes in the Eye Adapted to Darkness. H. P. H. KYLSTRA — *Nederlandse akademie van wetenschappen, Series C*, 65(1): 66-68. 1962. In English.

Six dark-adapted subjects saw a bright ring surrounding a central fixation light when the eye was illuminated from aside for a short time. The fact that the phenomenon is only seen after a certain period of dark adaptation suggests that the

stray light in the eye is perceived by the rods (which are absent in the fovea). The exposure time plays a great part in this phenomenon and may be explained by the difference in the time integration power between periphery and fovea.

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A Phenomenon Caused by Light Flashes in the Eye Adapted to Darkness. H. P. H. KYLSTRA — *Nederlandse akademie van wetenschappen, Proceedings, Series C*, 65 (1): 69-71. 1962. In English.

A method is described with which the angle under which an entoptic phenomenon is seen, can be measured. The ring of light that is seen by the dark adapted eye during short illumination from aside is measured in this way. The inner diameter of this ring is of the magnitude of the fovea, and thus significantly smaller than that of the greatest rod density. (Author's summary)

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A Phenomenon Caused by Light Flashes in the Eye Adapted to Darkness. H. P. H. KYLSTRA — *Nederlandse akademie van wetenschappen, Proceedings, Series C*, 65(1): 72-74. 1962. In English.

By exposing two subjects to two different sources of light, it was proven that the phenomenon of perceiving a bright ring caused by light-flashes from aside in the dark-adapted eye was not caused by the shadow of the wall of the fovea pit. In the first experiment a flash lamp illuminated the eyes from aside. In the second experiment the light source was plane of paper diffusely illuminated by a flash lamp which the subject saw via a semi transparent mirror. Both subjects saw the bright ring surround a dark centre with either method of illumination (Authors' summary modified)

95

The Effect of an After-Coming Random Pattern on the Perception of Brief Visual Stimuli. M. KINSBOURNE and E. K. WARRINGTON — *Quart. Jour. Exper. Psychol.* (London), 14(4): 223-234. Nov. 1962.

The perception of briefly exposed visual forms is shown to be masked by an after-coming random pattern stimulus of approximately equal intensity. This effect occurs only under certain well defined conditions; it is limited by the minimum stimulus exposure time in excess of threshold which overcomes masking (critical stimulus duration) as well as by the minimum interval between presentation of the two stimuli which permits evasion of the masking action (critical interval). Over the range of stimulus duration in which masking occurs, critical interval varied with stimulus duration in such a way that the interval multiplied by the stimulus duration equals a constant. Critical stimulus duration and critical interval at threshold are shown to vary little under a variety of conditions. The effect of the random pattern stimulus is limited to the part of the visual field to which it is presented. (Authors' summary)

96

Further Studies on the Masking of Brief Visual Stimuli by a Random Pattern. M. KINSBOURNE and E. K. WARRINGTON — *Quart. Jour. Exper. Psychol* (London), 14(4): 235-245 Nov. 1962.

A brief visual test stimulus may be masked by a preceding random pattern of roughly equal intensity in the same way as by a succeeding random pattern. The parameters of random pattern duration, interval between stimuli, and test stimulus duration limiting the masking effect show a regularity very similar in the two conditions. When the random pattern precedes the test stimulus, the relationship between the two may be stated as follows: Stimulus duration \times interval = a constant. Identical effects are found when the two stimuli are presented separately, one to each eye, both for random pattern preceding and succeeding the test stimulus. It is concluded that masking resulted through the same central interaction, whether produced by the preceding or succeeding random pattern. The interaction may be related to, and occur within the limits of, apparent simultaneity of rapidly successive visual stimuli. (Authors' summary).

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The perception of Light Signals: the Effect of the Number of Irrelevant Lights. A. CRAWFOOD. *Ergonomics* (London), 5(3): 417-428. July 1962.

The experiment described was carried out to find the effect of the number of irrelevant lights on the human response time to signals appearing among them. Both the signals and irrelevant lights could be made steady or flashing; this produced four conditions of coding of the signal lights from the background, e.g. flashing signal with steady background, and so on. It was found that the geometric mean response time increased to an unusually large extent, from 0.8 second with no background lights up to nearly two seconds with 21. A background of flashing lights was found to increase the response time more than a background of steady lights, whether the signal was flashing or not. The shortest response times were obtained when flashing signals were seen against a steady background, and the longest with flashing signals against a flashing background. Thus it is concluded that flashing signals should not be used in conditions where a number of them may appear together within the field of view. (Authors' summary).

98

Distraction from Flashing Lights. R. C. B. AITKEN, HELEN M. FERRES & J. L. GEDYE — *Aerospace Med.* 34(4): 302-305. April 1963.

When an aircraft displaying a flashing "anti-collision" light flies at night through cloud, the crew may be distracted by back-scatter of the light into the cockpit.

This preliminary laboratory experiment was carried out to determine which of five frequencies

of an occulting white light within the range 1.00 to 2.33 cycles/sec. would be the most acceptable while flying. It was found that subjective preference scores provided the most useful information to answer this question, and that the most acceptable frequencies were the two lowest ones, namely 1.00 and 1.33 cycles/sec. It was concluded that if this result is to be confirmed in a simulated flight situation, this frequency may also satisfy the requirements of conspicuity.

It was also shown that change in skin conductance was related to flash frequency, but that there was no significant alteration in estimates of relative duration of presentation.

An investigation of the frequency distribution of "anti-collision" lights at present on 84 civil aircraft revealed that there was a peak frequency of 1.3-1.4 cycles/sec. for red lights.

(Authors' summary).

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Relative Merits of Spatial and Alphabetic Encoding of Information for a Visual Display. K. M. NEWMAN and A. R. DAVIS. — *Jour. Engineering Psychol.*, 1(3): 102-126. July 1962.

A comparison between alphabetic and spatial encoding of information on a visual display was along a continuum of experimental conditions progressing from pure alphabetic to pure spatial encoding. Operator performance along this continuum was evaluated in terms of speed and accuracy for both search and an identification task. Statistical analysis of the time and error scores obtained showed that: (a) Partial spatial encoding leads to good performance irrespective of the two tasks. (b) When the primary task was one of rapid localization of target messages, then even fairly complex spatial codes improved response speed considerably. (c) The addition of labels identifying the spatial code on the display was of significant help for some operators. (d) The design criteria for visual displays must be based on a thorough analysis of the task (s) to be performed on the display. (Authors' summary).

100

Ambient and Cockpit Luminance Measurements. D. G. PITTS and L. R. LOPER. — *Aerospace Med.* 34(2): 145-149. February 1963.

A procedure is described for obtaining ambient and cockpit luminance measurements during operational flying. Data were taken at various altitudes during clear, cloudy and heavy overcast weather and while flying low over snow. A comparison of luminances measured at equal altitudes above a solid overcast and above snow shows remarkable similarity. Changes in cockpit and ambient luminances through a solid overcast from 7,000 to 17,000 feet are graphically presented. Polar coordinate presentation of the data illustrates ambient luminances that "surround" the aircraft at different altitudes. The data can be used in the design of laboratory experiments to determine the effects of glare on visual performance, in evaluation of future eye protective devices, and as a guide in operational flight planning. (Authors' summary)