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Brown, R.H. & F.E. Guedry 1951 INFLUENCE OF VISUAL STIMULATION ON HABITUATION TO ROTATION. J. General Psychol. 45:151-161  
See also (USN School of Aviation Med., Pensacola, Fla.) Joint Proj. Rept. No. 11, Jan. 10, 1950. ASTIA AD 72417.

ABSTRACT: One indication of habituation to rotation is a systematic decrement in the duration of post-rotational apparent motion of visual objects with repeated rotation. However, the success of some investigators in obtaining habituation where others have failed with rotation series of comparable length indicates that some conditions are more favorable for its occurrence than others. The hypothesis is advanced that habituation is a function of the extent of visual stimulation present to reinforce still fixation. The general plan is to compare three groups of individuals which have different opportunities for fixating a target light during series of 20 rotation periods to determine whether the groups differ in the extent and rate of habituation. Stimuli for still fixation are varied from no illumination to full room illumination following rotation on occasional trials. Whereas one group of 12 subjects with little opportunity for reinforcement of still fixation exhibit significant amounts of habituation: (1) Individuals subjected to a series of rotations in the dark do not exhibit habituation to rotation within the limits of this experiment. (2) Individuals provided with a faint object to fixate during and after rotation and subjected to a series of these rotations exhibit habituation. (3) Individuals who observe a faint fixation object throughout every trial with a brief illumination of the visual environment interposed during the post-rotation period of nystagmus on occasional trials exhibit a rapid rate and relatively great amount of habituation. (4) The results support the hypothesis that habituation is a function of the extent of visual stimulation present to reinforce still fixation.

590

Brown, R. H. 1955 VELOCITY DISCRIMINATION AND THE INTENSITY-TIME RELATION. J. Opt. Soc. Amer. 45:189-192.

ABSTRACT: The visual discrimination of velocity is considered in terms of an observer's response to its direction at different speeds. The hypothesis is advanced that the direct perception of motion in a middle range of speeds involves a single sensory event dependent on the intensity-time relation. To test this hypothesis, four subjects discriminated velocity at different speeds for each of eight durations of exposure. The minimal luminance required for correct judgments of direction was measured by the method of limits.

The data indicate that velocity discrimination occurs at intermediate speeds when the energy of the stimulating flash is constant ( $I t = C$ ). The reciprocity relation does not hold for exposures longer than a critical duration on 0.1 sec. The luminance of the flash tends to be the sole limiting factor on velocity discriminations at longer durations of exposure ( $I = K$ ). Implications of these results are discussed with reference to other experiments.

591

Brown, R. H. 1961 VISUAL SENSITIVITY TO DIFFERENCES IN VELOCITY  
Psychol. Bull. 58(2):89-103, March 1961.

ABSTRACT: An analysis of data available in the literature on thresholds for visual sensitivity to differences in velocity is presented. A consideration of angular speed leads to the conclusion that it is the basic unit of measurement involved in studies of differential threshold. Stimulus conditions and methodology used in measuring the threshold in ten major studies are carefully considered. The differential thresholds are then plotted as a function of angular speed. Sensitivity is calculated and expressed in terms of the ratio of the threshold to the speed. This Weber ratio for velocity is applied to tracking and other predictive behavior. (Tufts)

592

Brown, W.L. 1959 PRIMATES IN SPACE.  
In Bioastronautics, Advances in Research.  
(USAF School of Aviation Medicine, Randolph Field, Texas) March 1959

593

Brown, W. R. J. 1949 EYE MOVEMENTS AND THE VARIATION OF VISUAL ACUITY WITH  
TEST OBJECT ORIENTATION.  
J. Opt. Soc. Amer. 39:1057

ABSTRACT: A possible explanation is given for the phenomenon of higher visual acuity as measured with a parallel line test object when the lines are vertical or horizontal than when the lines are at forty-five degrees. This explanation is based on a dynamic theory of visual acuity. The difficulties in explaining the effect by astigmatism of the observers, the structure of the retina, or by continuously driven small oscillations of the eye are discussed. An explanation of the effect is provided by assuming that the eye acts as a sphere held in orientation by two pairs of elastic muscles and that its movements are damped by viscous friction. This hypothesis explains the phenomenon if the average time between the involuntary "jumps" of the eye, which initiate the vibrations, is greater than the time required for the oscillations to decay to forty percent of their initial value. Since the average time between jumps is relatively long (0.5 - 0.6 sec.) the hypothesis seems reasonable. Therefore, the observed variation of visual acuity with angle appears to substantiate the dynamic theory of visual acuity.

594

Browne, B.C. and E.C. Bullard 1940 COMPARISON OF THE ACCELERATION  
DUE TO GRAVITY AT THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, AND  
BUREAU OF STANDARDS, WASHINGTON, D.C.  
Royal Society of London, Proceedings, Series A, 175:110-117

595

Browne, M.K. 1956 PHYSIOLOGICAL ASPECTS OF A MULTI-GRADIENT ANTI-G VALVE  
(RAF Inst. of Av. Med., Farnborough) FPRC No. 991

ABSTRACT: Many workers, British and American, have shown that man's tolerance to positive g is subject to side individual variations. These are still present when anti-g equipment is used. It seemed possible, therefore, that in some subjects increased g tolerance might be obtained with new equipment.

596

Browne, M.K. 1957 ACCELERATIONS IN SPACE MEDICINE.  
Spaceflight (London), 1(4): 139-142. July 1957

ABSTRACT: The physical aspects of acceleration as well as the physiological effects of positive, negative, and transverse g are discussed. The two extremes of acceleration involved in space flight are also discussed. The first is encountered in take-off and ascent where high peak accelerations occur. The second involves the weightless state created in space or coasting freely in an orbit around the earth. The known physiological consequences of these two extremes are described as they relate to the g/time patterns in the first situation and to eating and drinking, the otoliths, and muscular movements in the weightless state. Angular acceleration is also discussed with regard to its physiological effects and rocket design. These main acceleratory problems affecting man in his conquest of space do not present an insurmountable barrier. It appears that other medical problems and those of design will be the factors delaying the take-off of the first space traveler. The limits of human tolerance with regard to intensity and duration of acceleration and the position of the body axes are tabulated.

597

Browne, M.K. 1957 METHOD OF THRESHOLD DETERMINATION IN THE HUMAN  
CENTRIFUGE. (RAF Royal Institute of Aviation Medicine, Farnborough)  
FPRC 1029, Dec. 1957. ASTIA AD 209 986.

ABSTRACT: A method of threshold determination is described which utilizes visual blackout as the end point. Thresholds can be varied at will by the use of suitable filters. The method is capable of precise specification and is easily performed. A plea is made for the use of rates of application having a linear g/t relation. These, when of low value, allow cardiac compensation during the rise and obviate the use of repeated plateau runs with their concomitant fatigue.

598

Browne, M. K. 1957 THRESHOLD DETERMINATION TECHNIQUE IN THE HUMAN CENTRIFUGE. (RAF Instit. of Aviat. Med., Farnborough, Eng.) FPRC Memo. 75.

599

Browne, M.K. and J.T. Fitzsimons 1957 ALTERATIONS IN THRESHOLD WITH VARYING RATES OF APPLICATION OF POSITIVE ACCELERATION. (RAF Inst. Av. Med., Farnborough). FPRC Memo 80, Mar. 1957.

600

Browne, M.K., & J.T. Fitzsimons 1957 ELECTROCARDIOGRAPHIC CHANGES DURING POSITIVE ACCELERATION WITH A NOTE ON VECTOR-CARDIOGRAPHY (RAF, Institute of Aviation Medicine, Farnborough) FPRC 1009, June 1957. ASTIA AD 141 045.

ABSTRACT: In the human centrifuge 53 subjects have carried out 366 fully instrumented runs under positive accelerations of 3-5 g. The results were analysed for pulse rates, pulse rate intervals, and changes in the electrical axis. Some vector-cardiograms were also recorded.

No abnormal rhythms have been found and the only abnormal pattern was in a subject who lost consciousness at 4 g. Differences in cardiovascular response to g were found between experienced and inexperienced subjects, these were maximal at low g values and disappeared as the g level increased. Unconsciousness causes muscle artefacts in the limb leads and T-wave changes which, however, require cautious interpretation.

Analysis of the electrical axis has been carried out. There are definite trends under g but these are overshadowed by the effect of respiration. Positional changes are complex and cannot be dissociated from respiration. Vector-cardiograms were easily carried out and gave reproducible results but were of little value in studying the heart during positive acceleration.

601

Browne, M. K., & J. T. Fitzsimons 1957 ELECTROCARDIOGRAPHIC CHANGES DURING POSITIVE ACCELERATION, WITH A NOTE ON VECTOR-CARDIOGRAPHY. (RAF, Institute of Aviation Medicine, Farnborough) FPRC Rept. 1009; ASTIA AD-141 045  
Also Brit. Heart J. 21(1):23-30. January 1959.

ABSTRACT: In the human centrifuge 53 subjects have carried out 366 fully instrumented runs under positive accelerations of 3-5 g. The results were analyzed for pulse rates, pulse rate intervals, and changes in the electrical axis. Some vector-cardiograms were also recorded. No abnormal rhythms have been found and

the only abnormal pattern was in a subject who lost consciousness at 4 g. Differences in cardiovascular response to g were found between experienced and inexperienced subjects, these were maximal at low g values and disappeared as the g level increased. Unconsciousness caused muscle artefacts in the limb leads and T-wave changes which, however, require cautious interpretation. Analysis of the electrical axis has been carried out. There are definite trends under g but these are overshadowed by the effect of respiration. Positional changes are complex and cannot be dissociated from respiration. Vector-cardiograms were easily carried out and gave reproducible results but were of little value in studying the heart during positive acceleration. (AUTHOR)

602

Browne, M.K. 1958 STRESS SUMMATION IN FLIGHT. III. EFFECT OF BREATHING PURE OXYGEN AT ATMOSPHERIC PRESSURE ON TOLERANCE TO ACCELERATION. (RAF, Institute of Aviation Medicine, Farnborough) FPRC 1043, April 1958. ASTIA AD 201 164.

ABSTRACT: The effect of breathing pure oxygen at atmospheric pressure on the blackout threshold was measured using a method involving dark adaptation. Respiratory rates and pulse rates were also measured during the course of the experiments.

Breathing pure oxygen did not significantly alter the resting pulse rate or respiratory rate, nor was the effect of g modified by oxygen. The respiratory rate increased during g by 24-28%.

The threshold was raised by 0.5 g after 10 minutes breathing oxygen but had returned to base line levels after 20 minutes. A theory to account for these line levels after 20 minutes. A theory to account for these changes is discussed in terms of the mechanism of blackout under the present experimental conditions. (Author)

603

Browne, M.K. & J.T. Fitzsimons 1958 STRESS SUMMATION IN FLIGHT: THE EFFECT OF HEAT ON TOLERANCE TO ACCELERATION. (Inst. of Aviation Med., Royal Air Force, Farnborough) FPRC 1045 v.

ABSTRACT:

1. The influence of insulin hypoglycaemia on tolerance to acceleration has been studied in six subjects. The end point was central light loss with the dark adapted eye.
2. Hypoglycaemia in the pre-reaction phase is associated with a mean fall in threshold of 0.6 g.
3. During the reaction the threshold rises above the control value. The mean rise is 0.5 g above the control and 1.1 g above the pre-reaction threshold.
4. The possible mechanisms of these changes are discussed.

604

Browne, M.K. & J.T. Fitzsimons 1958 STRESS SUMMATION IN FLIGHT:  
THE EFFECT OF ALCOHOL ON TOLERANCE TO ACCELERATION.  
(RAF, Institute of Aviation Medicine, Farnborough) FPRC 1046 vi.

605

Browne, M. K. & J. T. Fitzsimons 1958 STRESS SUMMATION IN FLIGHT III.  
Effect of Breathing Pure Oxygen at Atmospheric Pressure on Tolerance to  
Acceleration.  
(RAF Inst. Av. Med, Farnborough). FPRC 1043. ASTIA AD 201 164

The effect of breathing pure oxygen at atmospheric pressure on the blackout threshold was measured using a method involving dark adaptation. Respiratory rates & pulse rates were also measured during the course of the experiments. Breathing pure O<sub>2</sub> did not significantly alter the resting pulse rate or respiratory rate nor was the effect of g modified by O<sub>2</sub>. The respiratory rate increased during g by 24-28%. The threshold was raised by 0.5 after 10 minutes breathing O<sub>2</sub> but had returned to base line levels after 20 min. A theory to account for these changes is discussed in terms of the mechanism of blackout under the present experimental conditions. (Author)

606

Browne, M.K. 1958 STRESS SUMMATION IN FLIGHT. IV. THE EFFECT OF  
HYPERGLYCAEMIA ON TOLERANCE TO ACCELERATION.  
(RAF, Institute of Aviation Medicine, Farnborough) FPRC 1041  
March 1958. ASTIA AD 209 985

ABSTRACT: The influence of a raised blood sugar on g tolerance has been studied. Hyperglycaemia was produced by the ingestion of 100g glucose in 250 ml. of water, which raised the blood sugar level by about 50%.

There is a large subject variation in response (from minus 0.05g to +0.65g) the mean being an increase of 0.2g in blackout threshold, which is not statistically significant. It is therefore unlikely that the g protection afforded by a meal is due to an increase in blood sugar level. (Author)

607

Browne, M. K. 1958 STRESS SUMMATION IN FLIGHT. V. THE EFFECT OF INSULIN  
HYPOGLYCAEMIA ON TOLERANCE TO ACCELERATION. (RAF, Institute of Aviation  
Medicine, Farnborough) Rept. FPRC-1044; ASTIA AD-201 168

ABSTRACT: The influence of insulin hypoglycaemia on tolerance to acceleration has been studied in six subjects. The end point was central light loss with the dark adapted eye. Hypoglycaemia in the pre-reaction phase is associated with a mean fall in threshold of 0.6 g. During the reaction the threshold rises above the control value. The mean rise is 0.5 g above the control and 1.1 g above the pre-reaction threshold. The possible mechanisms of these changes are discussed.  
(AUTHOR)

608

Browne, M.K. 1958 STRESS SUMMATION IN FLIGHT. VII. EFFECT OF THE DEGREE OF FILLING OF THE STOMACH ON TOLERANCE TO ACCELERATION. (RAF, Institute of Aviation Medicine, Farnborough) FPRC 1057, Sept. 1958. ASTIA AD 216 281.

ABSTRACT: Distension of the stomach by ingestion of water produces an increase in g tolerance of 0.7 g, the range being 0.3-1.2 g.

There is a significant linear relationship between the quantity of water ingested and the rise in threshold.

Intra-abdominal pressure increases linearly with g and shows an increase with water ingestion. This increase is inadequate to explain the rise in threshold produced.

609

Browne, M. K. 1959 THE EFFECT OF INSULIN HYPOGLYCAEMIA ON TOLERANCE TO POSITIVE ACCELERATION. Scot. Med. J. 4:438-445, August 1959.

SUMMARY: The influence of insulin hypoglycaemia on tolerance to acceleration has been studied in six subjects. The end point was central light loss with the dark adapted eye.

Hypoglycaemia in the pre-reaction phase is associated with a mean fall in threshold of 0.6g.

During the reaction the threshold rises above this control value. The mean rise is 0.5g above the control and 1.1g above the pre-reaction threshold.

The possible mechanism of these changes is discussed in relation to spontaneously occurring hypoglycaemia.

610

Browne, M. K., & J. T. Fitzsimons 1959 ELECTROCARDIOGRAPHIC CHANGES DURING POSITIVE ACCELERATION. British Heart J. 21:23-30

SUMMARY: Electrocardiographic changes under positive accelerative forces have been studied in the human centrifuge.

During g the pulse rate increases. Subjects who are not used to riding on the centrifuge show greater increases in rate at 3 g compared with experienced subjects. At higher g this difference disappears. The reasons for this are discussed.

No characteristic cardiographic abnormalities were observed and the evidence for ventricular strain is very slender.

Analysis of the electrical axis showed changes under g, but these were little different in magnitude from the changes occurring during respiration. In three subjects no correlation between electrical and anatomical axes was found. (Author)

611

Browne, M.K. & P. Howard 1959 SOME OBSERVATIONS ON THE E.E.G. DURING CENTRIFUGAL ACCELERATION. (Paper, International E.E.G. Congress, Marseilles, 1959)

612

Browne, R. C. 1954 DISORIENTATION IN FLIGHT. (RAF Institute of Aviation Medicine, Farnborough) Report no. FPRC 862; Jan. 1954 ASTIA AD-39 216.

ABSTRACT: Consideration is given to a number of the causes of disorientation which lie on the boundary line of physiology and psychology. The solution of this problem of disorientation was considered to require a combination of indoctrination, training, and clear display of attitude in aircraft.

613

Brubaker, R.E. 1945 AIR BLAST INJURY, CASES Bull U.S. Army Med. Dept. pp. 110-114.

614

Bruggink, G. M., J. Carroll, & W. R. Knowles 1960 CRASH INJURY EVALUATION: U. S. ARMY AC-1 DE HAVILLAND CARIBOU, FT. RUCKER, ALABAMA, 21 JANUARY 1960. (Aviation Crash Injury Research, Phoenix, Arizona) AvCIR-14-PV-121; TREC Tech. Rept. 60-62, October 1960

SUMMARY: The crash injury evaluation of the U. S. Army AC-1 SH "Caribou" disclosed several desirable crash safety features including a limit landing gear strength which permits a vertical rate of descent of 14 feet per second; the location of the fuel cells outboard of the engine nacelles; troop seat belt anchorages which are directly secured to basic aircraft structure.

The evaluation also revealed a number of crash safety deficiencies in the crew and troop seats, litter installation, number and location of emergency exits in the main cabin, and the related Military Specification. (Author)

615

Bruggink, G. M. 1961 IMPACT SURVIVAL IN AIR TRANSPORT ACCIDENTS.  
(Aviation Crash Injury Research, Phoenix, Arizona) AvDIR-8CSS-129,  
29 January 1961

ABSTRACT: Three air transport accidents are analyzed to determine the effects of occupant restraint and occupant environment on impact survival. The results of this study indicate that the current occupant protection criteria do not fully utilize the apparent crash resistance of modern fuselage structure. (Author)

616

Bruggink, G. M., D. J. Schneider & L. E. Spencer 1961 CRASH INJURY INVESTIGATION: U.S. ARMY HU 1A BELL IROQUOIS HELICOPTER ACCIDENT, FORT CARSON, COLORADO, 10 AUGUST 1961. (Aviation Crash Injury Research, Phoenix, Arizona) AvCIR 61 13; TREC Tech. Rept. 62 10, September 1961. ASTIA AD 274 905L.

ABSTRACT: Report is made of crash injury investigation involving a U.S. Army HU 1A aircraft to determine cause of fatalities and extent of aircraft damage. Wreckage was examined at the crash site, photographs obtained, and reconstruction of the approximate kinematics of the crash sequence made. Although the accident was considered nonsurvivable with respect to impact conditions and resulting cabin/cockpit destruction, the investigation revealed a significant trend in the failures of the cast structures in the crew and passenger restraint systems. It was recommended that the use of cast structures in occupant restraint systems be discontinued. (Author)

617

Bruggink, G. M. & D. J. Schneider 1961 LIMITS OF SEAT-BELT PROTECTION DURING CRASH DECELERATIONS.  
Rev. Med. Aero (Paris) 2:204-209, Dec. 1961

618

Bruggink, G. M., and Daniel J. Schneider 1961  
LIMITS OF SEAT BELT PROTECTION DURING CRASH DECELERATIONS  
(Aviation Crash Injury Research, Phoenix, Arizona)  
Rept. no. AvCIR 61-8. TREC TR:61-115 September  
ASTIA AD 265 868L

ABSTRACT: The protective limits of aircraft seat-belt protection, as discussed in the available literature, are compared with recent crash injury experience. To insure maximum survivability under the most adverse conditions, the strength of a seat-belt restraint system should be based on the threshold between the injurious and fatal limits of seat-belt restraint. The study indicates that an aircraft seat-belt restraint with an energy absorbing capability of 25 G's (occupant weight, 200 pounds) for a duration of at least .2 second may form a realistic compromise between the ideal and the practicable strength of such a system. (Author)

Bruggink, G. M. & D. J. Schneider 1963 LIMITS OF SEAT-BELT PROTECTION DURING CRASH DECELERATIONS.  
Industr. Med. Surg. 32:33-37, Jan. 1963

620

Bruggink, G. M. 1962 FORCED LANDING TECHNIQUES IN GENERAL AVIATION TYPE AIRCRAFT. (Paper, 7th Annual Business Aircraft Safety Seminar, San Francisco, Calif., 3-4 April 1962)

621

Bruggink, G. M. 1962 CRASH INJURY RESEARCH AND ITS APPLICATION TO ARMY AIRCRAFT. (Paper, presented in the Principles of Aviation Medicine and Aeromedical Evacuation Course at the Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Texas, June 11-15, 1962)  
(Aviation Crash Injury Research, Phoenix, Arizona) AvCIR 62-8, June 1962

ABSTRACT: This report contains a brief review of the background, the development, and the activities of Aviation Crash Injury Research, especially with respect to Army aviation.

622

Bruner, J. M. 1955 SEASICKNESS IN A DESTROYER ESCORT SQUADRON.  
U.S. Armed Forces Med. J. 6(1):469-490.

SUMMARY: Data obtained from a questionnaire answered by 699 men aboard an escort squadron revealed that about 13 percent of the men were habitually seasick, while 40 percent were never seasick. It appears that increasing sea experience is associated with a decrease in incidence of chronic seasickness. Most of the affected subjects had had a history of air or car sickness.

The increased tendency for the malady to appear aboard smaller vessels may be due to their short length and small moment of inertia.

The potential value of drug therapy is not realized in the naval activity examined. Drawing upon previous reports and upon observations within the Squadron, the natural history of motion sickness is discussed. It is believed that military seasickness is an important problem, rather neglected at the practical level. The problem is open to attack through improved application of existing knowledge and therapeutic agents.

623

Bryan, G.L., N.D. Warren, R.C. Wilson, N.E. Willmorth, & D. Svenson 1949  
PSYCHOLOGICAL STUDIES ON THE HUMAN CENTRIFUGE: LX. THE EFFECT OF INCREASED  
POSITIVE RADIAL ACCELERATION UPON THE ABILITY TO MANIPULATE TOGGLE SWITCHES.  
Rep. Psychol. Lab. Univ. Southern, Calif., 1951, No. 5

ABSTRACT: 30 male subjects were exposed to 1, 2.5, and 4.0 G of positive radial acceleration on the human centrifuge during which their reactions in operating toggle switches were tested. Toggle switches were located at the level of the subjects' shoulder, and above, below, right, and left of this reference point. Each switch was operated up, down, right, or left. Two time measures were taken: Reaction Time was the time between onset of the signal and release of the starting key, and Movement Time was the interval from release of the reaction key to completion of toggle switch operation. It was found that increase in G force increased both Reaction Time and Movement Time. The effects differed for the different switch positions and switch motions.

624

Brunner, H.J. 1943 LABYRINTH IN AVIATION.  
J. Aviation Med. 14:132-150, June 1943

ABSTRACT: In flying, the labyrinth may be stimulated by (2) rotating motions of the airplane, (b) inclination, and (c) straight-away acceleration and deceleration in either horizontal or vertical phases or through a combination of both directions. These stimuli upon the labyrinth produce sensations and reflexes. It was found through experiments that the function of the normal labyrinth is of little help to the aviator.

625

Bryan, G. L. 1950 AN INVESTIGATION OF CERTAIN AFTER EFFECTS OF PROLONGED EXPOSURE TO POSITIVE RADIAL ACCELERATION. (Paper presented at 30th annual meeting of the Western Psychological Assoc., 27-29 April 1950, Santa Barbara, Calif.)

ABSTRACT: An investigation of relatively long-lasting after-effects of prolonged exposure to moderate g intensities. A test battery was constructed on the basis of interviews with flight personnel. This battery was administered to a control group (1.5g) and an experimental group (3 g) immediately before and after rotation.

Results: No significant differences, attributable to g, between groups or between prior- and post-exposure scores. (Am. Psychologist, 5(9):465, Sept. 1950)

626

Bryan, G. L., R. C. Wilson, et al. 1951 PSYCHOLOGICAL RESEARCH ON THE HUMAN CENTRIFUGE. (Dept. of Psychology, Univ. of Southern Calif., Los Angeles) Contract N6ori77, Task Order III; ASTIA AD-159 432

CONTENTS:

Stick force estimation;  
Maximum pull;  
Spatial orientation;  
Maximum forces upon elevator and aileron controls;  
Perceptual speed;  
Simple reaction time;  
Discrimination reaction time;  
Pupillary reflex;  
Speed and accuracy of target striking;  
After-effects of radial acceleration;  
Toggle switch manipulation;  
Adjustive reactions

627

Bryan, G.L. 1952 THE EFFECTS OF INCREASED POSITIVE RADIAL ACCELERATION ON MANIPULATING TOGGLE SWITCHES. (Ph.D. Dissertation, The University of Southern California, 1952)

628

Bryan, G. L., R. C. Wilson, N. E. Willmorth, D. W. Svenson, G. A. Green, & N. D. Warren June 1952 THE EFFECTS OF INCREASED POSITIVE RADIAL ACCELERATION ON REACHING AND MANIPULATING TOGGLE SWITCHES. (Psychological Laboratory, University of Southern Calif.) Conts. No. N6ori 77 Task Order 3, Rept. No. 5.

ABSTRACT: Healthy young male students were employed as subjects in an attempt to determine their ability to react to, reach and manipulate toggle switches mounted in five locations before them, using either hand, under conditions of three g-levels and four directions of switch action. The following general conclusions were reached: (a) both Reaction Time and Movement Time are lengthened as additional g-forces are imposed. (b) the time taken to react to, and to reach a switch varies with its location, and with the amount of g imposed. (c) in general, the results from the analysis of the direction of Switch Action variable are insignificant, but there are tendencies that indicate that: (1) forehand movements are quicker than backhand movements in the right-left directions. (2) outward movements are quicker than inward movements on the Top and Bottom Switch Locations. (3) in terms of Reaction Time, the Down Switch Action is shortest. (e) the time required to react to, reach, and manipulate toggle switches is roughly equal for either hand.

629

Bryson, A.E., W.F. Denham, F.J. Carroll and K. Mikami, 1961 DETERMINATION OF THE LIFT OR DRAG PROGRAM THAT MINIMIZES RE-ENTRY HEATING WITH ACCELERATION OR RANGE CONSTRAINTS USING A STEEPEST DESCENT COMPUTATION PROCEDURE. (Paper presented at IAS 29th annual meeting, 23-25 Jan 1961, New York), Paper no. 61-6

ABSTRACT: This procedure has been used to determine the  $\alpha$  program that minimizes total heating for a representative hypersonic glider injected into a low satellite orbit at 26,000 ft. sec-1, subjected to the constraint that the vehicle travel once around the earth; to determine  $\alpha$  programs that minimize total heating for a representative hypersonic glider entering the earth's atmosphere at 35,000 ft. sec-1, subject to a pilot acceleration tolerance constraint; and to determine drag modulation programs that minimize total heating for a representative non-lifting vehicle entering the earth's atmosphere at 35,000 ft. sec-1 subject to a pilot acceleration tolerance constraint.

630

Buchheim, R. W. 1957 A DISCUSSION OF SPACE FLIGHT.  
(Rand Corp., Santa Monica, Calif.) Contract No. AF18(600)-1600, Rept. No. S-53-1; ASTIA AD-151 526; 2 May 1957, rev. 23 July 1957

631

Buchheim, R. W. 1957 A DISCUSSION OF THE RAND SPACE FLIGHT PROGRAM  
(The RAND Corporation, Santa Monica, Calif.) S-59, July 29, 1957  
ASTIA AD 133 038

ABSTRACT: A collection of five papers on the RAND space-flight program presented to the Air Force Scientific Advisory Board of Advanced Weapons Technology and Environment. Such topics are discussed as the Lunar Instrument Carriers, experiments on the moon from the moon's surface, an interplanetary system experiments with interplanetary instrument carriers, and Soviet space-flight activities.

632

Buchheim, R. W. 1957 OUTLINE OF A STUDY OF MANNED SPACE FLIGHT  
(The RAND Corporation, Santa Monica, Calif.)  
RM-2005, Sept. 27, 1957, ASTIA AD 144 296.

ABSTRACT: An outline of a study program for manned space flight. The program is presented in terms of the characteristic phases of any space-flight mission, from primary propulsion to the final recovery phase, and of the nature of early manned space-flight missions. The author discusses the problems affecting the human component of a space-flight system, the various considerations influencing vehicle design and operation, the required ground facilities and operations, and the problem of space-flight terminology. A listing of specific study topics for a research program is included.

633

Buchheim, R.W., & H.A. Lieske      1958      LUNAR FLIGHT DYNAMICS  
(The Rand Corporation, Santa Monica, Calif.) P-1453, Aug. 6, 1958.  
ASTIA AD 244 721

ABSTRACT: This paper presents a brief survey of the general subject of lunar flight with particular reference to flight trajectories, including discussion of the general nature of the trajectory problem, classes of trajectories, initial conditions, and sensitivities to initial conditions. The associated subjects of orientation control and launching requirements are also introduced.

634

Buchheim, R. W.    et. al.    1958    SOME ASPECTS OF ASTRONAUTICS  
(The RAND Corporation, Santa Monica, Calif.) P-1442, July 23, 1958.

ABSTRACT: A discussion of some aspects of astronautics, including space environment, basic laws of celestial mechanics, orbital elements, perturbations and precision, lunar and interplanetary flights, and experimentation in space.

635

Buchheim, R. W.    1958    LUNAR FLIGHT  
(Rand Corp., Santa Monica, Calif.) Rept. No. P-1248; 7 Jan. 1958

ABSTRACT: A summary outline of a lecture on the basic mechanics of lunar flight to be presented to a class on Space Technology held at UCLA Extension. The study of lunar flight is presented in a discussion of factors relating to: 1) the earth-moon system; 2) qualitative characteristics of motion in earth-moon space; 3) types of lunar flights; and 4) flight requirements.

636

Buchheim, R. W.    1958    TYPES OF SPACE FLIGHTS  
(Rand Corp., Santa Monica, Calif.)  
Rept. No. P-1428; 24 Feb. 1958

637

Buchheim, R. W., & H. A. Lieske 1958 LUNAR FLIGHT DYNAMICS.  
(Rand Corp., Santa Monica, Calif.) Rept. No. P-1453; ASTIA AD-244 721

ABSTRACT: A brief survey of the general subject of lunar flight is presented with particular reference to flight trajectories, including discussion of the general nature of the trajectory problem, classes of trajectories, initial conditions, and sensitivities to initial conditions. The associated subjects of orientation control and launching requirements are also introduced.

638

Buchheim, R. W. and RAND Corp. Staff 1959 SPACE HANDBOOK: ASTRONAUTICS  
AND ITS APPLICATIONS  
(New York, N. Y., Random House, 1959).

ABSTRACT: Chapter 15 entitled "Environment of Manned Systems" includes a short section on weightlessness.

639

Buchanan, D. W. 1959 TRIALS WITH AN EMERGENCY BARRIER TYPE S. 1 FOR USE  
WITH "SCIMITAR" AIRCRAFT.  
(Royal Aircraft Establishment, Farnborough) June 1959  
Tech note n. Naval 37

640

Buchner, F., H. W. Altmann et al 1948 SPECIAL PATHOLOGY. PART I.  
(Office of Military Government for Germany, Field Information Agencies  
Technical, Wiesbaden). ASTIA ATI 107 089.

641

Buckhout, R. 1962 A BIBLIOGRAPHY ON AIRCREW PROFICIENCY MEASUREMENT  
(6570th Aerospace Medical Research Labs, Wright-Patterson Air Force Base,  
Ohio) Technical Documentary Report No. MRL-TDR-62-49, May 1962.

ABSTRACT: Reports on aircrew proficiency measurement are compiled in the interest of research on the problem of assessing the performance of combat aircrew members. Particular emphasis has been placed on material related to the potential use of groundbased flight simulators as sophisticated, objective

642

Buckhout 1962 A WORKING BIBLIOGRAPHY ON THE EFFECTS OF MOTION ON HUMAN PERFORMANCE (Aerospace Medical Division, 6570th Aerospace Medical Research Lab., Wright-Patterson AFB, Ohio) Rept. No. MRL-TDR-62-77, July 1962. ASTIA AD 287 530

ABSTRACT: In this bibliography a list of reports is compiled from a number of disciplines which bear on the problem of motion and its effects on human performance. Psychophysiological reports in the area of spatial orientation, perception, and receptor mechanisms provide background on the human organism in relation to motion stimuli. The effects of aerospace vehicle motion are represented by a compilation of studies of performance under acceleration, vibration and buffeting, tumbling, and weightlessness. Finally reports on training and motion simulation, equipment and methodology, and general analyses of the whole problem area are presented.

643

Buddenhagen, T. F. & M. P. Wolpin 1961 A STUDY OF VISUAL SIMULATION TECHNIQUES FOR ASTRONAUTICAL FLIGHT TRAINING (Wright Air Development Division, Wright-Patterson AFB, Ohio) WADD TR 60-756 March 1961

ABSTRACT: A study was made of the engineering requirements for visual simulation in astronautical flight training and of the basic techniques available to accomplish such simulation. An evaluation of the potentialities of the various techniques led to the choice of closed circuit television as an image transfer technique. A preliminary design concept using this technique was formulated to determine the areas in which development work will be required prior to the design of a complete simulator. This report includes a compilation of applicable techniques, a determination of the probable visual environment of space, and an investigation of a method to predict the perceptual fidelity achieved by various simulation techniques as an aid in optimizing the training value of a simulator.

644

Buechner, Franz, H. W. Altmann, W. Giese et al 1948 SPECIAL PATHOLOGY - PART I (Spezielle Pathologie, Teil 1). FIAT Review of German Sciences 1939-1946. ASTIA ATI 197 089

ABSTRACT: Military Government of the British, French and US Zones of Germany by means of their respective FIATs (Field Information Agency, Technical) present this volume of the "FIAT Review of German Science" in the hope that it will assist in informing international science of research done in Germany through the war years. It is believed this and its companion volumes will present a complete and concise account of the investigations and advances of a fundamental scientific nature made by German scientists in the fields of biology, chemistry, mathematics, medicine, physics and sciences of the earth during the period May 1939 to May 1946.

645

Buechner, F., H.W. Altmann, W. Buengeler et al. 1948 GENERAL PATHOLOGY (PART II). (Allgemeine Pathologie Teil III). FIAT Review of German Sciences 193901946. ASTIA ATI 54 661.

ABSTRACT: A condensed review is presented of scientific advances made by the Germans during 1939 to 1946 in the field of general medical pathology, with special reference to the pathology of tumors and malformations, and the general pathology of environment. In addition, various inflammatory processes and endocrinal pathology are discussed. An author and subject index is appended.

646

Buettner, K. 1951 BIOCLIMATOLOGY OF MANNED ROCKET FLIGHT. In Marburger, G. P., ed., Space Medicine (Urbana, Illinois: University of Illinois Press, 1951) Chapter 6

647

Buettner, K. J. K., & H. Haber 1952 THE AEROPAUSE  
Science 115(2998):656-657, June 13, 1952

ABSTRACT: "Aeropause" is a term designating that atmospheric region in which space-equivalent conditions are being approached with respect to physiological and mechanical effects (between altitudes of 20 and 200 km). Such a functional concept should likewise be applied to zones within the aeropause. Among the functions in question are the following: boiling of body fluids sustaining combustion of fuel, supply of diffuse daylight, and thermal interaction with the craft. The solution of the problems that arise in navigating through these zones requires the co-operation between meteorologists, geophysicists, astronomers, radiobiologists, physiologists, flight surgeons, bioclimatologists, and human engineers. (Literatuuroverzicht (Over Ruimtevaartgeneeskunke) (Space Medicine Bibliography) (Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, den Haag, Netherlands) Rept. No. TDCK-16903; ASTIA AD-227 817

648

Buettner, K. J. K. 1959 SPACE MEDICINE OF THE NEXT DECADE AS VIEWED BY AN ENVIRONMENT PHYSICIST.  
U. S. Armed Forces Med. J. 10(4):416-426

ABSTRACT: The author predicts the state of the art ten years hence with respect to man's environment in space flight. This environment will be a capsule protecting him from outer atmosphere or the lack of it, cosmic missiles and rays, and heat and cold, and providing him with a frame to cope with high G and no G. Besides providing food, water, air, and waste disposal, the capsule has to function as an observatory, as a communication center and, probably, as a control center for the ship.

649

Bugrov, B. G., O. G. Gorlov, A. V. Petrov, A. D. Serov, Ye. M. Yogov, & V. I. Yakovlev 1958 PRELIMINARY RESULTS OF SCIENTIFIC INVESTIGATIONS CARRIED OUT WITH THE AID OF THE FIRST SOVIET ARTIFICIAL EARTH SATELLITES AND ROCKETS. PART III. MEDICO-BIOLOGICAL INVESTIGATIONS WITH ROCKETS. Sbornik Statei (USSR)

Report includes: Galkin, A. M., O. G. Gorlov, A. R. Kotova, I. I. Iosov, A. V. Petrov, A. F. Serov, V. N. Chernov, & V. I. Yakovlev, Investigations of the Vital Activity of Animals During Flights in Hermetically-Sealed Cabins to an Altitude of 212 Kilometers.

ABSTRACT: The aims of this work were to determine: (1) the effectiveness of using a pressure suit for sustaining life in the case of dehermetization of the cabin under conditions following an extended (up to one hour) stay at 110-k, altitudes, (2) the possibility of releasing the cabin by means of a catapult with velocities of more than 100 m/sec at altitudes of 80-90 km, (3) the character and degree of the effects of specific factors of flight on a living organism while in the upper atmosphere. Subjects were 12 dogs, weighing four to five kilograms. Six of them flew twice. To study the direct effect of flights upon the subjects during the entire time from rocket launch to animal landing, automatically recorded were maximum and minimum blood pressure, pulse rate, respiratory rate, and body temperature. For studying the more remote aftereffects of flights, particularly to determine their effect on the hemopoietic system and heart activity, pre- and post-flight tests consisted of EKGs and clinical blood analyses. Essential conclusions were: maskless pressure suits ensured safe flight, and catapulting and parachute systems ensured safe recovery of the animal; failure of certain registration systems occurred as a function of strong vibrational in the initial moment of launching; it was not possible to note any regular pattern in the arterial pressure change during the free-fall period-arterial pressure rose in some cases and dropped in others; pulse-rate variations observed during active flight seem to be determined by individual nervous-system characteristics of each animal; in a number of cases changes in cardiovascular and respiratory function were accompanied by passive-defensive (urination-defecation) reactions; there were no notable differences between pre- and post-flight blood analyses; the results of the ESR index variation prevented well-founded conclusions as yet from the relatively limited material; no changes in the animals' general, skin, or hair pigmentation which might be related to cosmic radiation could be found; six to seven months' postflight observations revealed no notable changes in the behavior of the animals; the need for improved registration apparatus was made clear.

650

Bugrov, B. G. A. V. Petrov, Ye. M. Yugov, O. C. Gurlov, A. D. Serov, & V. I. Yakovlev 1958 INVESTIGATIONS OF THE VITAL ACTIVITY OF ANIMALS DURING FLIGHTS IN A NON-HERMETICALLY SEALED ROCKET CABIN TO AN ALTITUDE OF 110 KILOMETERS. In Sbornik Statey No. 1

651

Bugrov, B. G., et al. 1958 ISSLEDOVANIYA ZHIZNEDEIATEL'NOSTI ZHIVOTNYKH PRI POLETAKH V NEGERMETICHESKOI KABINE RAKET DO VYSOTY 110 KM. (STUDIES ON VITAL FUNCTIONS IN ANIMALS DURING FLIGHT IN NON-HERMETIC CABINS IN ROCKETS UP TO 110 KM) In Preliminary Results of Scientific Researches on the First Soviet Artificial Earth Satellites and Rockets, Articles XIth, Section of I G Y Program (Rockets and Satellites), No. 1 (Moscow, Academy of Sciences, 1958) pp. 130-149

652

Bührlen, L. 1937 VERSUCHE ÜBER DIE BEDEUTUNG DER RICHTUNG BEIM EINWIRKEN VON KLIHKKRÄFTEN AUF DEN MENSCHLICHEN KORPER. (Experiments On The Significance Of Direction In The Effect Of Centrifugal Force On The Human Body). Luftfahrtmed., 1: 307-325, 1937

ABSTRACT: Centrifugal force experiments were performed on persons in the sitting and recumbent positions at the Aviation Institute in Berlin. The centrifugal force was measured by optic record of the convolutions to within a small percentage. In the sitting position (centrifugal force direction: vertical) the same symptoms were noted as those seen in aviation. Prolonged acceleration beyond 5 g. produced visual disturbance. In the recumbent position (centrifugal force direction: horizontal chest-to-back) up to 10 g. no significant disturbances other than slight respiratory constriction were noted. Beyond 10 g. respiration was markedly affected, and at 15 g. became almost impossible. At 14-15 g. also visual disturbances developed although the brain and consciousness were not affected. To obtain information of practical value it is suggested that practical experiments in planes with adjustable seats be attempted. (J. Aviation Med. 8(3): 150-151).

653

Bulmer, M.G., & C.I. Howarth 1957 A MODEL OF NON-RANDOMNESS IN THRESHOLD EXPERIMENTS. (RAF, Institute of Aviation Medicine, Farnborough) FPRC 974(a). June 1957. ASTIA AD 209 987

ABSTRACT: A model is put forward which accounts quantitatively for the tendency of responses to be repeated in visual threshold experiments. It is supposed that the subject's threshold changes between each response. After saying "Yes", the threshold is lowered by an amount proportional to the distance of the threshold from a lower limiting threshold,  $T_L$ , thus making the subject more likely to say "Yes" the next time; after saying "No", the threshold is raised by an amount proportional to its distance from an upper limiting threshold,  $T_U$ . Predictions from this model agree well with experimental results reported elsewhere.

654

Buning, H. 1961 FLIGHT SIMULATION OF ORBITAL AND REENTRY VEHICLES  
PART III. AERODYNAMICS INFORMATION REQUIRED FOR SIX DEGREES OF FREEDOM  
SIMULATION. (Aeronautical Systems Division, Air Force Systems Command,  
Wright-Patterson AFB, Ohio) ASD TR 61-171 (III). Dec. 1961.  
ASTIA AD 282 995

ABSTRACT: A survey of the aerodynamic information required for a simulator for a glide reentry vehicle is presented. Various phases of the flight are considered: hypersonic reentry, hypersonic-supersonic glide, and supersonic-transonic-subsonic approach and landing. Accuracy requirements and origin of aerodynamic information are briefly discussed. Aerodynamic parameters are defined, and the dependence of aerodynamic coefficients on these parameters is outlined. Special emphasis is placed on a technique for generating functions of two or three independent variables and some sample calculations are presented.

655

Burgess, B.F. 1955 EFFECTS OF G-FORCES ON AIRCRAFT OXYGEN SYSTEMS; FINAL REPORT  
ON EVALUATION OF  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR12, Sept. 1, 1955

ABSTRACT: A mockup of the F9F oxygen system was subjected to acceleration stress patterns varying in magnitude and direction. The direction of stress was varied through the three axes of the installation and up to 15 G. The oxygen equipment remained on the centrifuge for 4 months. The oxygen regulator continued to perform satisfactorily.

656

Burgess, B. F., J. L. Brown, & R. M. Herrick 1955 THE EFFECT OF HYPOXIA ON  
HUMAN TOLERANCE TO ACCELERATION (Naval Air Development Ctr., Johnsville, Pa.)  
Project NM 001 100 320, 31 Dec. 1955

ABSTRACT: Preliminary investigations on the centrifuge gondola evacuations have been conducted to test the mechanical capabilities of the vacuum system to simulate various altitudes.

657

Burgess, B. F., & H. N. Hunter 1955 THE G-PROTECTION PROVIDED BY THE FULL  
PRESSURE HALF SUIT. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-  
5511, 23 Sept. 1955

658

Burgess, B.F. & H.N. Hunter 1955 TEST AND DEVELOPMENT OF ANTI-BLACKOUT EQUIPMENT  
(Naval Air Development Ctr., Johnsville, Pa.) Project NM 001 100 310;  
TED ADC AE-5201, 31 Dec. 1955

ABSTRACT: A study of G tolerances has been made on trained centrifuge subjects wearing various types of anti-G suits. (1) An experimental full-pressure half suit, due to severe discomfort, was found to limit the protection to no more than that provided by the standard Z-2 suit plus straining. (2) An integrated anti-blackout suit (basically a Z-2 suit with built-in parachute and restraint harness) was evaluated and found to be very comfortable and to provide the same protection as the standard Z-2 suit.

659

Burgess, B. F., B. D. Polis, & C. F. Gell 1955 A STUDY OF ANATOMICAL DISTORTIONS, FLUID TRANSLOCATION, AND ELECTROLYTE CHANGES IN ANIMALS UNDER ACCELERATION STRESS, UTILIZING SPECTROPHOTOMETRIC, RADIOBIOLOGIC, AND QUICK FREEZE TECHNIQUES. PHASES II AND III. (Naval Air Development Ctr., Johnsville, Pa.) Project NM 001 100 312; 31 Dec. 1955

ABSTRACT: It has been shown that brain and muscle tissue of rats lose potassium and gain sodium due to the stress of acceleration. It was also shown that the muscle and brain tissue electrolytes were affected in opposite directions when the animals were subjected to acceleration stress patterns.

660

Burgess, B.F. 1956 INTEGRATED ANTI-BLACKOUT SUIT  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR15, Feb. 6, 1956

ABSTRACT: In a total of 75 runs on the centrifuge, 4 subjects were used to evaluate the characteristics of the integrated anti-blackout suit. G protection with the suit ranged from 0.7 to 1.8 G with a mean protection of 1.1 G. The MA-1 parachute/safety harness integration did not interfere with, or reduce, the efficiency of these features. All subjects wearing this suit during the test found it more comfortable than the standard Z-2 suit with the parachute harness worn over the suit.

661

Burgess, B. F. 1957 SOME PHYSIOLOGICAL AND PATHOLOGICAL EFFECTS OF ACCELERATION STRESS (A symposium sponsored by the Office of Naval Research as part of its decennial year. (March 1957) pp. 98-108)

ABSTRACT: Current emphasis in effects of acceleration upon speed and maneuverability have increased the significance of the effects of gravitational forces. Comprehensive studies of the five most frequently encountered acceleration patterns have been conducted at this laboratory. These five types of G forces are: (1) positive (head to foot), (2) negative (foot to head), (3) transverse (chest to back), (4) fluctuating positive, and (5) cyclic (alternating positive and negative).

Animal studies have provided information from which it is possible to extrapolate and predict the maximum human tolerance and the ultimate rupture points for the various mechanical systems of the body.

Data obtained from both human and animal experimentation have added much to our knowledge of the sequence of physiological events which ultimately terminate in either disorientation or unconsciousness of the subject exposed to acceleration stress. From the information obtained on the centrifuge, we are able to estimate intelligently the physiological limits of acceleration stress to which man can be exposed without producing permanent damage. (Literatuuroverzicht Ruimtevaartgeneeskunde) (Space Medicine Bibliography) (Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, den Haag, Netherlands) Rept. No. TDCK-16903; ASTIA AD-227 817; Feb. 1959.

662

Burgess, B. F. 1958 TEST AND EVALUATION OF U.S. AIR FORCE EXPERIMENTAL CUT-AWAY TYPE ANTI-BLACKOUT SUITS, DESIGNATED MA-1  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR51 April 30, 1958

ABSTRACT: The Air Force MA-1 suit and the standard Navy Z-3 suit were compared through tests conducted on the human centrifuge. Six experienced centrifuge subjects were exposed to acceleration stress while seated in a mocked-up cockpit seat with lap belt and shoulder harness. Each series of runs began at the 2.5 G level and subsequent runs were increased by 0.25 G increments until the end point was reached. The runs were 40 seconds in duration with peak G maintained for 15 seconds or until the subject noted peripheral light loss and stopped the run himself. It was concluded that there is no significant difference between the G protection provided by the Air Force MA-1 suit and the Z-3 suit. In general, the subjects found the Z-3 suit more comfortable while under acceleration. The major complaint against the MA-1 suit was that the larger abdominal bladder tended to produce slight nausea due to pressure in the "pit of the stomach". Because of this factor and the fact that both suits provided equal G protection it was concluded that the Z-3 suit was the more desirable of the two suits.

663

Burgess, B. F., Jr. 1958 THE EFFECT OF HYPOXIA ON TOLERANCE TO POSITIVE ACCELERATION  
J. of Aviation Medicine 29(10):754-757, October 1958

ABSTRACT: Low oxygen partial pressures caused centrifuge subjects to show a decreased tolerance to acceleration stress. Not all subjects however, were equally affected by the induced hypoxia. The general symptoms of hypoxia in conjunction with acceleration stress are very characteristic and, although they are more pronounced, are similar to those produced in the low pressure chamber. The data emphasize the hazard to which a pilot subjects himself when he fails to use supplemental oxygen under conditions producing a relatively mild hypoxia state. (Author)

664

Burgess, B.F., Jr. 1958 THE EFFECT OF HYPOXIA ON TOLERANCE TO POSITIVE ACCELERATION. (U.S. Naval Air Development Center, Aviation Medical Acceleration Lab., Johnsville, Pa.) NADC-MA-5804, 12 March 1958. ASTIA AD-209 174

ABSTRACT: Low oxygen partial pressures caused centrifuge subjects to show a decreased tolerance to acceleration stress. Not all subjects however, were equally affected by the induced hypoxia. The general symptoms of hypoxia in conjunction with acceleration stress are very characteristic and, although they are more pronounced, are very similar to those produced in the low pressure chamber. The data emphasizes the hazard to which a pilot subjects himself when he fails to use supplemental oxygen under conditions producing a relatively mild hypoxic state. (Author)

665

Burgess, B.F., Jr. 1959 THE EFFECT OF TEMPERATURE ON TOLERANCE TO POSITIVE ACCELERATION. (Presented on April 27, 1959 at the 30th annual meeting of the Aero Medical Association, Los Angeles, Calif.)

ABSTRACT: With the advent of space flight, the problems associated with the physiological effects of extreme temperatures may become a critical factor relating to pilot performance under conditions of high acceleration. In order to determine the effects of high environmental temperatures on G tolerance, six trained centrifuge subjects were exposed to positive acceleration in the heated gondola of the Johnsville centrifuge. Seven thermocouples were located at strategic places over the body surface in order to obtain an accurate recording of skin temperature. Although humidity was not controlled, it was recorded during all centrifuge runs. The environmental temperatures studied to date range from 75° F. to 115° F. where a decrement in G tolerance of ½G has been obtained at the upper temperature range. Further studies will be made at higher temperatures approaching conditions of heat exhaustion.

666

Burgess, B.F., Jr. 1959 THE EFFECT OF TEMPERATURE ON TOLERANCE TO POSITIVE ACCELERATION. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5905, 26 May 1959. ASTIA AD 218 957.

ABSTRACT: Six trained centrifuge subjects received positive acceleration in an environmental temperature that ranged from 75° to 160° F. The relative humidity, which was not controlled, ranged from 55% at the lowest temperature to 90% at the highest temperature. The results obtained from this investigation were not unexpected. Previous studies showed that high environmental temperatures produced lowering in tolerance to acceleration in both man and animal. It was found that the elevated temperatures produced no significant change in the time required to respond to visual stimuli until we reached the level of impending heat exhaustion. On several occasions at the 160° F level the subjects failed to answer the lights although they reported the lights as appearing bright and clear. Coordination at this temperature level became poor and the capacity for concentration became very limited.

667

Burgess, B. F. 1959 THE EFFECT OF TEMPERATURE ON TOLERANCE TO POSITIVE ACCELERATION. Aerospace Medicine 30(8):567-571, Aug. 1959  
See also (Naval Air Development Ctr., Johnsville, Pa.) NADC MA-5905.  
ASTIA AD-218 957

ABSTRACT: With the advent of space flight, the problems associated with the physiological effects of extreme temperatures may become a critical factor relating to pilot performance under conditions of high acceleration. In order to determine the effects of high environmental temperatures on G tolerance, six trained centrifuge subjects were exposed to positive acceleration in the heated gondola of the Johnsville centrifuge. Seven thermocouples were located at strategic places over the body surface in order to obtain an accurate recording of skin temperature. Although humidity was not controlled, it was recorded during all centrifuge runs. The environmental temperatures studied ranged from 75° F to 160° F where a decrement in G tolerance of 1 G has been obtained at the upper temperature range. (AUTHOR)

668

Burgess, B. F. June 1960 TOLERANCE TO ACCELERATION. Mechanical Engineering Magazine. 82(6):62-63. See also "The Effect of Temperature on Tolerance to Positive Acceleration," ASME Paper n. 59-A-212

ABSTRACT: Experiments were used to establish a realistic maximum temperature that can be tolerated with only ordinary clothing, during intermittent positive acceleration for periods of 1 hour or longer. The change in tolerance to acceleration was used as criterion for determining the efficiency of the com-

pensatory mechanisms of the body in combating the stress imposed by the high environmental temperature. The physiologic end-point used was peripheral light loss. Six trained centrifuge subjects received positive acceleration in an environmental temperature that ranged from 75° to 160° F. The experiment was terminated at the 160° F. level because the skin temperature had reached 102° F., and symptoms of impending heat exhaustion were prevalent. The lowest temperature to produce a degradation in g tolerance was 100° F., where a decrement of approximately 0.2 g units was observed. At 160° F., there was an average decrease of 1.0 per cent. The average time required for subjects to lose peripheral vision at their maximum g levels was 3.0 seconds after peak g was attained. Temperature had no apparent effect on this time nor on the time necessary for subjects to regain peripheral vision.

669

Burgess, Eric 1958 SATELLITES AND SPACEFLIGHT  
(New York: MacMillan, 1958)

ABSTRACT: A factual survey of developments in the field of rocket propulsion, interplanetary travel and the establishment of satellite bodies.

670

Burns, N. M. & R. L. Burdick 1961 EFFECTS OF PRESSURE SUIT INFLATION AND REACTION TIMES OF PROJECT MERCURY ASTRONAUTS.  
Aerospace Med. 32(9):849-852.

SUMMARY: The reaction times of the Project Mercury astronauts were tested under two conditions of pressure suit inflation: 0 psi and 5 psi. Under the 5 psi condition, reaction times increased significantly as did the frequency of inadvertent actuation.

671

Burton, Ralph 1958 VIBRATION AND IMPACT  
(Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1958) Lib Cong. Card  
No. 58-5055

ABSTRACT: Contents include chapters on the following subjects:

1. Introduction
2. Free Vibration
3. Vibratory Systems Commonly Found in Machinery
4. Damping
5. Steady Forced Vibration

6. Impact
7. Nonlinear Vibration
8. Measurement: Instruments and Analogs.
9. Systems with Two Degrees of Freedom
10. Numerical Computation of Natural Frequencies for Systems with Many Degrees of Freedom.
11. Waves
12. Vibrating Beams and Related Subjects
13. Analysis of Control Systems
14. Fatigue

672

Burkhardt, W. 1939 STURZ AUS DER HÖHE (Dives from High Altitude)  
Deutsch. z. Ges. Gerichtl. Med. (Berlin) 30: 334-341

673

Burmeister, H. 1939 UNTERSUCHUNGEN UBER ANDERUNGEN DER OPTISCHEN REAKTIONSZEIT  
DES MENSCHEN BEIM EINWIRKEN HOHER FLIEHKRAFTE (Investigations of Changes  
of the Optical Reaction Time of the Human under the Influence of Higher  
Acceleration)  
Luftfahrtmedizin 3: 277-284

ABSTRACT: In centrifugal tests at the Institute for Research in Aviation Medicine in Berlin, it was observed that subjects exposed to high flying power seemed transitorily apathetic and that their reaction to external stimuli seemed inhibited for a time. Often it seemed as if the person had lost control over his movements. The rate of reaction and the mental process appeared disturbed and retarded. An attempt is made to find an explanation for this phenomenon by a study of eight test subjects. The change in optic reaction was recorded in 17 tests in the centrifuge. Focus in the chest-back direction produced a slight prolongation of the reaction time and a slightly increased dissemination in five persons at 4 g. Forces in the head-seat direction caused a prolonged reaction time and increased dissemination at three g. At 4.5 g, these changes were more evident and the resulting visual disturbances frequently led to failure of reaction.

674

Burns, Neal M., Ralph B. Zirgler, Rosalie Noble, and Edmund C. Gifford 1960  
A BIBLIOGRAPHY OF PSYCHOPHYSIOLOGICAL STUDIES RELEVANT TO SPACE AND ORBITAL FLIGHT  
(U.S. Naval Air Material Center, Philadelphia 12, Pa.) Weptask Assignment No. RAE 20C 030/2001/R005 01 002, Problem Assignment No. C04AE13-1. ASTIA AD 246 414

ABSTRACT: This report is a listing of psychological, physiological, and environmental reports pertinent to man's role in space and orbital flight. Five hundred and eight-two entries are provided on 3 x 5 inch file card forms with the content of the report indicated by the category into which it is placed. The literature review for this bibliography was completed in April 1960.

675

Burns, N.M. and R.L. Burdick 1961 COCKPIT DESIGN STUDIES: STANDARD COCKPIT MOCKUP, PRESSURE SUIT MOBILITY. II. THE PROJECT MERCURY SUIT.  
(Naval Air Material Center, Philadelphia, Pa.) NAMC-ACEL-443, 21 Feb. 1961.

676

Burns, O. 1926 WESEN UND BEKAMPFUNG DER SEE- UND LUFTKRANKHEIT (Cause and Treatment of Sea and Air Sickness).  
Münchener medizinische Wochenschrift (Munich) 73(24):977-979.

ABSTRACT: The writer bears out his contention that the essential disturbance of the physiological equilibrium which occurs in the production of sea and air sickness is abnormal vestibular stimulation. By turning the individual experimented with to right and left about a vertical axis on Bárány's chair with his head upwards, bent backwards or inclined towards the shoulder, he has succeeded in accurately simulating the various gyrations of a ship at sea. It was found that those who rapidly became sick at sea soon exhibited pallor, perspiration, and sickness, whereas in those who were "good sailors" these disagreeable phenomena remained absent.

This method supplied the important possibility of undertaking therapeutic experiments against sea sickness.

Sea sickness is the result of an abnormal reflex. The sensory limb of the reflex arc is formed by the kinaesthetic, vestibular and optical paths. These are in close alliance and, in conjunction with the coordination centre, constitute physiological equilibrium.

With this process there is a corresponding subconscious realisation in the cerebral cortex of the attitude of the body in space. The vago-sympathetic centres, with their afferent branches especially those in the blood-vessels and stomach, form the motor segment of the arc. This reflex arc can be influenced by therapeutic measures at five places:

1. At the sensory part.
2. At the reflex centre.
3. At the motor, that is to say the vaso-motor nucleus.
4. At the afferent branch of the vagus to the stomach.
5. At the stomach itself.

(J. Laryng. & Otol. 42:127-128 (1927))

677

Burnett, Hal A. 1948 EARLY EVALUATION OF BLAST INJURY  
The Military Surgeon 103:275-278, Oct. 1948.

ABSTRACT: Blasts from high caliber missiles produce bizarre symptoms and signs in a surprising number of instances. Careful evaluation of each case will prevent mishandling and contribute to the welfare of the patient.

678

Burns, W. 1960 REPORT OF THE ANNUAL MEETING OF THE UNITED STATES ARMED FORCES - NATIONAL RESEARCH COUNCIL COMMITTEE ON HEARING AND BIOACOUSTICS HELD IN WASHINGTON, 15-16 NOVEMBER, 1960.  
(Royal Naval Personnel Research Committee, MRC, London, England.)  
RNP 61/1003, HES 41, April 1961.

ABSTRACT: A summary report of the annual meeting of the Council of the Armed Forces-National Research Council Committee on Hearing and Bioacoustics is presented. Major topics considered at this meeting are: 1) community noise problems resulting from turbojet transport aircraft, the psychoacoustic problems following the wide incidence of noise peculiar to these engines, and criteria for acceptable maxima of jet noise exposure for tolerability in residential areas; 2) assessment of noise exposure for avoidance of hearing loss; 3) acoustic implications of space travel; and 4) problems of vibration as an environmental factor. (Tufts)

679

Burnstine, Murray 1962 STEERING WHEEL IMPACT

In: Impact Acceleration Stress: Proceedings of a Symposium With a Comprehensive Chronological Bibliography, National Academy of Sciences, National Research Council, Publication No. 977, pp. 135-140

ABSTRACT: This paper deals with the manner in which automobile steering wheels have been observed to deform when impacted by occupants. The steering wheel assemblies discussed were removed from automobiles involved in fatal high collisions. Reconstruction of the collision events utilizing body vehicle and injured occupant measurements indicates that the steering wheel-mast jacket assembly is often forced from its design position and later impacted by occupants at unfavorable angles. Examples of the various modes with which occupants strike the wheel are given. The deformation observed indicates that static testing of design prototypes is not realistic. The need for radial energy absorption characteristics is demonstrated. Bruising observed, due to local high unit bearing or contact pressures, can be reduced by increasing the projected area of the steering-wheel rim.

680

Burt, A. S. 1945 ANNOTATED BIBLIOGRAPHY ON THE PHYSIOLOGICAL EFFECTS OF ACCELERATION IN AIRCRAFT (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Project No. X-610 (Av-312-h) Rept. No. 1, 1 Sept. 1945. ASTIA ATI 173 271

ABSTRACT: This bibliography was compiled from the literature available in the Bureau of Medicine and Surgery, Washington, D. C., the Technical Information Section of the Bureau of Aeronautics, and the files of the medical department, NAS, Pensacola. For the most part, it includes only the classified reports which have been issued on the subject, no attempt having been made to cover the open literature which has already been very adequately listed in "A Bibliography of Aviation Medicine" by E. C. Hoff and J. F. Fulton, Chas. C. Thomas, Springfield, Ill., 1942, and in the supplemental bibliography by P. M. Hoff, E. C. Hoff, and J. F. Fulton, *ibid.*, 1944, and reviewed by Ham (2).

The papers are so arranged as to present a logical development of the subject matter rather than by author or chronology. A subject and an author index are included to aid in locating individual references, also an index by issuing agency. While many of the sections, particularly the one on decelerative forces in crashes, are known to be very incomplete and some of the classifications are admittedly arbitrary, it is hoped that this compilation of material, which has for the most part not been previously reviewed, will be of aid in further research on acceleration.

681

Burton, A.C. 1944 RATES OF FREE-FALL AND OF OPEN PARACHUTE DESCENT FROM HIGH ALTITUDES.  
Proc. Assoc. Comm. Aviation Med. Research, Appendix G, 14 July 1944

682

Burton, R.R., W.P.C. Richards and A.H. Smith. 1963 PATHOLOGY OF CHRONIC ACCELERATION. (Paper, Aerospace Medical Association 34th Annual Meeting April 29-May 2, 1963, Statler Hilton Hotel, Los Angeles, Calif.)

ABSTRACT: Chronic acceleration produced by centrifugation is a highly lethal treatment. When growing chickens are exposed to an accelerative force of 2.5 G, about half of them die in eleven days -however, the mortality curve is not a smooth exponential relationship. Resistance to chronic acceleration require a true physiological adaptation, and the factors involved in that adaptation are heritable. After five generations of selection (on the basis of survival) for resistance to chronic acceleration, the exposure to 2.5 G leading to a 50 per cent mortality is increased to 60 days.

When animals dying during chronic acceleration are examined post-mortem, a variety of pathological changes are evident-however, none is present systematically. It seems likely that several pathologies are involved in chronic acceleration death. Recent routing examination of centrifuged birds has indicated about 25 externally observable items which change in some birds during chronic acceleration, including: general appearance; evidence of normal nutrition; posture and locomotion; and reflexes. When these were graded on a + (normal), or - (abnormal) basis, a score varying from +20 to -20 was obtained. On the basis of rate of development of symptoms (zero-time being the onset of symptoms, rather than start of centrifugation) the birds can be divided into five groups. Aerospace Med. 34(3):249, March 1963.

683

Bushnell, D. 1949-1956 ORIGIN AND OPERATION OF THE FIRST HOLLOMAN TRACK. VOLUME I. HISTORY OF TRACKS AND TRACK TESTING AT THE AIR FORCE MISSILE DEVELOPMENT CENTER, HOLLOMAN AIR FORCE BASE, NEW MEXICO, 1949-1956 (Air Force Missile Development Center, Holloman Air Force Base, N. Mex.)  
ASTIA AD-231 907

CONTENTS:

Origin of the Holloman high-speed track  
Beginnings of track testing  
Planning and construction of the original Holloman track  
Aeromedical experiments on the Holloman track: 1953-1956  
Track administration and development  
Administration of the Holloman high-speed track  
The development of Sleran  
Project 6876, track facility development

Military hardware on the 3550 ft track, 1950-1956  
The Snark program on the Holloman track (June 1950-March 1952)  
Project Sleighride (March 1952-February 1954)  
Q-2 acceleration tests (September-October 1952)  
OQ-19 launchings (December 1952-February 1955)  
MX-1601, Jet vane control tests (February 1953-September 1954)  
Matador recovery system tests (July 1953-March 1956)  
B-58 flutter model testing (July 1954-March 1955)  
Acceleration tests, flight control components (January -March 1955)

684

Bushnell, D. 1958 HISTORY OF RESEARCH IN SPACE BIOLOGY & BIODYNAMICS AT  
AIR FORCE MISSILE DEVELOPMENT CENTER, HOLLOMAN AFB, 1946-1957. (Air  
Force Missile Development Center, Holloman AFB, New Mexico). Dec. 1958.

ABSTRACT: Subjects discussed include: Subgravity studies, deceleration and  
windblast experiments, Daisy track tests, Project Man High, cosmic radiation  
studies, aircraft crash forces, and tolerance to total pressure changes.

685

Bushnell, David 1958 RESEARCH ACCOMPLISHMENTS IN BIODYNAMICS: DECELERATION  
AND IMPACT AT THE AIR FORCE MISSILE DEVELOPMENT CENTER, 1955-1958  
(Air Force Missile Development Center, Holloman AFB, New Mexico) Oct. 1958  
ASTIA AD 208 015

ABSTRACT: Dr. David Bushnell, of the Air Force Missile Development Center's  
Historical Office, presents a carefully documented account of the successes and  
failures encountered in biodynamics research programs other than escape physiology.  
He has endeavored to place these accomplishments within the larger context of such  
work undertaken elsewhere by the United States Air Force, the United States  
Navy, industrial corporations and academic institutions of the United States,  
plus some consideration of related efforts in Canada, Germany, and the Soviet  
Union.

686

Bushnell, D. 1960 THE BEGINNINGS OF GUIDANCE SYSTEM TESTING AT THE AIR  
FORCE MISSILE DEVELOPMENT CENTER, HOLLOMAN AIR FORCE BASE, NEW MEXICO  
1955-1959 (Air Force Missile Development Center, Holloman Air Force Base,  
N. Mex.) ASTIA AD-231 908

CONTENTS:

Development of the Holloman mission in guidance testing  
Guidance and control testing on the Holloman track

687

Busis, S. N. 1960 LABYRINTHINE VESTIBULAR FUNCTION AND TESTING  
METHODS. Arch. Otolaryngol. 72 (1): 2-10

ABSTRACT: After a detailed description of the vestibular apparatus, the author discusses the problem of quantitatively and qualitatively estimating the vestibular function. This problem is reflected in the maze of techniques and, more importantly, in the divergent attitudes of established investigators toward these methods. The techniques used in evaluating the vestibular apparatus are as follows:

1. Caloric stimulation
  - A. Minimal
  - B. Cold Air
  - C. Mass
  - D. Alternate hot and cold
2. Rotation
  - A. Barany
  - B. Cupulometry
3. Fistula test
4. Galvanic stimulation
5. Optokinetic nystagmus
6. Postural tests.

688

Busnengo, E. 1961 BEHAVIOR OF THE ELECTROCARDIOGRAM OF SUBJECTS SUBJECTED  
TO ACCELERATION ALONG VARIOUS BODY AXES.  
Rev. Med. Aero (Paris) 2:25-27, Dec. 1961 (Fr)

689

Busse, E. W. PSYCHOPHYSIOLOGICAL MECHANISMS OF STRESS  
(Duke University School of Medicine, Durham, N. C.)  
Proj. 9778, Contract AF 49(638)-354; AFOSR, DLS, RPO - 805

ABSTRACT: This research covers the development of multiple-focused techniques for the investigation of the neurophysiological, neurohormonal, and psychophysiological mechanism underlying the stress response capability of human beings. It will involve the identification of and focusing on specific physiologic and psychologic factors in order to evaluate the interaction of specific emotional, neurohormonal, and neurophysiologic factors. The ultimate aims are to establish techniques applicable to the evaluations of human tolerance to stressors of any type, and to formulate methods for altering human response to stressful situation.

690

Busseling, J. F. 1959 A THEORY OF SMALL DEFORMATIONS OF SOLID BODIES.  
(U.S. Air Force Office of Scientific Research, Washington, D.C.)  
AFOSR TN 59-605 9 Feb. 1959; ASTIA AD-238 419.

ABSTRACT: A theory is presented which is capable of giving a mathematic description of the following phenomena observed in the deformation and heating of solid bodies: thermal stresses, thermoelastic damping of vibrations, dynamic and static moduli, Bauschinger effect and other anisotropic hardening phenomena in plastic deformation, primary creep preceding the secondary stage of steady creep under constant stress, creep recovery and stress relaxation. The variational principles of thermoelasticity, creep and of the theories of plasticity are all derived from one thermodynamic variational principle which is formulated with the aid of the entropy displacement field introduced by Biot. Thermoelastic damping of bending vibrations of beams and creep damping of pure shear vibrations are considered in some detail. (AUTHOR)

691

Busyrev, A. 1962 SCIENCE AND TECHNOLOGY IN THE WORLD.  
Sovetskaya Aviatsiya, Issue Nr. 142 (3312), 19 June 1959, p. 4, col. 3-4.  
(Translated by Translation Services Branch Foreign Technology Division,  
Wright-Patterson AFB, Ohio) Rept. No. FTD-TT-61-255/l+2 11 Jan. 1962;  
ASTIA AD-271 867.

ABSTRACT: Briefly discusses training of flight surgeons and present experimentation intended to increase protection for pilots of high-speed and high-altitude aircraft. (CARI)

692

Butz, J.S., Jr. 1958 ORBITAL RE-ENTRY WILL INTENSIFY DEMANDS ON STRUCTURES  
Aviat. Wk. 68:50-51, 53, 55, 57, 59, Apr. 21, 1958

ABSTRACT: Outlines main structural problems faced in proposals for Dyna Soar, an orbital bomber.

693

Butz, J.S., Jr. 1958 RADICAL CONFIGURATIONS MAY FIND ROLE IN PUSH TOWARD  
SPACE FLIGHT  
Aviat. Wk. 68:48-49, 51, 52, Feb. 24, 1958

ABSTRACT: Wedge-shaped fuselages and biplane and triplane wing arrangements may be used at hypersonic speeds, such as those that might be attained in re-entry from space, to raise lift-drag ratios to acceptable values.

694

Buys, E. 1924 CONTRIBUTION A L'ETUDE DU NYSTAGMUS OCULAIRE DE LA ROTATION CHEZ L'HOMME (CONTRIBUTION TO THE STUDY OF OCULAR NYSTAGMUS BY ROTATION TO MAN) Rev. d'Oto-Neuro-Ocul. 2, 641, 721 (1924); 3, 10,105, 2 pl. (1925).

695

Byford, G. H., & P. Howard 1956 THRESHOLD DETERMINATION TECHNIQUES ON THE HUMAN CENTRIFUGE. (RAF, Institute of Avia. Med., Farnborough) FPRC Memo 75.

696

Byford, G. H. and P. Howard 1958 THE DISTRIBUTION AND ACCURACY OF "G" IN A HUMAN CENTRIFUGE. (RAF, Instit. of Aviat. Med., Farnborough, Eng.) FPRC Memo 97, Sept. 1958.

ABSTRACT: The errors encountered in the production and measurement of "g" forces in a human centrifuge are examined from the point of view of the definition of the basic unit "g", and of the spatial distribution of forces within the car. Theoretical equations are developed for this distribution and specific evaluations made for absolute and % errors in the R.A.F. Institute of Aviation Medicine centrifuge. The theoretical results are confirmed by measurements, and an analysis made of the centrifuge performance under normal operating conditions. It is suggested that standardised measurement techniques could be adopted.

697

Byford, G. H. 1959 INSTRUMENTATION AND THE HUMAN CENTRIFUGE. (RAF, Institute of Aviation Medicine, Farnborough, England; North Atlantic Treaty Organization, Advisory Group for Aeronautical Research & Development; Aero-Medical Panel; Aachen, Germany) Sept. 1959

698

Byford, G. H. 1961 ACCELERATION RESEARCH PROGRAM IN GREAT BRITAIN. (Paper, Panel on Acceleration Stress of the Armed Forces-NRC Committee on Bio-Astronautics, 6-11 March 1961, NASA Ames Research Ctr., Moffett Field, Calif.)

699

Byford, G. H. 1961 INSTRUMENTATION AND THE HUMAN CENTRIFUGE. In Bergeret, P., ed., Bio-Assay Techniques for Human Centrifuges and Physiological Effects of Acceleration. (London, New York, Paris: Pergamon Press, 1961). AGARDograph 48. Pp. 42-51.

700

Byford, G. H. 1961 EYE MOVEMENTS AND THE OPTOGYRAL ILLUSION.  
(RAF Institute of Aviation Medicine, Farnborough) Rept no. FPRC/1174,  
4 April 1961, ASTIA AD-279662

ABSTRACT: 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:

1. A small, initial apparent displacement-usually less than  $10^{\circ}$  - 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.
2. A smoothly continuous indirectional motion, 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.

701

Byford, G. H. 1961 EYE MOVEMENTS AND THE OPTOGYRAL ILLUSION  
J. of Aerospace Medicine 32(3):224, March 1961.

ABSTRACT: The optogyral illusion has been the subject of considerable interest in both clinical and aviation medical spheres. There is a diversity of opinion on the role which nystagmic movements of the eyes play in this phenomenon; some maintaining that the illusion results from the passage of

images across the retina during nystagmus and others that these movements of the eyes play no part in the production of the illusion. Experiments have been conducted with a view to establishing the existence or otherwise of a correlation between ocular nystagmus and the optogyral illusion. A vestibular stimulation was provided by a servo controlled rotating chair; the subject being rotated about a spinal axis in the normal seated position. Eye movements were measured by means of a contact lens and photoelectric cell, with a sensitivity of not less than 1 minute arc of eye rotation per cm. of trace deflexion. In addition, qualitative experiments were used to examine the illusion whilst an immovable image was maintained on the retina. No evidence was found which would support the hypothesis that nystagmic eye movements play any part in the production of the optogyral illusion. It is suggested that the eye movements, and sensations of rotation, are separate effects which stem from the same cause.

702

Byford, G. H. 1962 THE FIDELITY OF CONTACT LENS EYE MOVEMENT RECORDING  
Optica. Acta., 9:3, 1962

ABSTRACT: The fidelity with which a contact lens may follow horizontal movements of the eye is examined under steady state, or fixation, conditions and also in the presence of normal optokinetic nystagmus. During fixation no relative displacement between lens and eye could be demonstrated for eye deflections less than 30' arc, and only small differences over the test range,  $\pm 9^{\circ}$ . Simultaneous photoelectric and high speed cine recordings of optokinetic nystagmus showed that the lens may be used with accuracy for this purpose. A possible mechanism of lens movement is discussed.

703

Byford, G. H. 1963 EYE MOVEMENTS AND THE OPTOGYRAL ILLUSION  
Aerospace Medicine, 32(2):119-123.

ABSTRACT: 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  $10^{\circ}$  -- 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.

704

Byrne, W. A. 1943 FINAL REPORT ON TEST OF ANTI-"G" DEVICES UNDER SIMULATED COMBAT CONDITIONS. Proof Dept. AAF Proving Ground Command, (Eglin Field) Serial No. 4-43-40. AAF Board Project No. (M-4)205. 3 Nov. 1943

ABSTRACT: (a) Pilots wearing an anti-"g" suit have a definite tactical advantage over those not protected in combat. They are also less fatigued.  
(b) Guns can be fired without difficulty under as much as 8.8 "g".  
(c) The Berger Bros. GPS is definitely superior to the Clark-Wood AOS.  
(d) The instrument vacuum pump installation is more satisfactory than the Cornelius Air Compressor installation from the standpoint of reliability, ease of installation and maintenance, and adequacy at altitude.  
(e) Photographs of GPS and AOS are included.

705

Byrnes, V.A. 1942-43 EYE PROBLEMS IN COMBAT AVIATION.  
Tex. St. J. Med., 38:399-402

ABSTRACT: Discusses particularly the problems of night vision and dark adaptation. Brief discussion of acceleration problems: Blacking out under g occurs when the force is greater than 4 g. Loss of consciousness occurs between 5 and 8 g. Devices to prevent this are not satisfactory because of their bulk. Crouching raises the black-out threshold about 2 g. If the pilot could lie prone, he could withstand a force of 10 g. Retinal hemorrhage may be caused by negative g. (CARI)

Byrnes, V. A. 1951 VISUAL PROBLEMS OF SUPERSONIC SPEEDS.  
Amer. J. Ophth. 34(2):169-177, Feb. 1951.

ABSTRACT: Some of the visual problems of supersonic speeds have been discussed. The optical effect of the shock wave and the effect of slanting surfaces on incident light have been pointed out. The effects of vibration on the eye and the effect of the delay in visual perception have been mentioned. The restricting visual effect of acceleration on the maneuverability of supersonic craft has been reviewed. Possible effects of temperature and high speed escapes on the eyes have been pointed out. These will all be factors relating to the use of the eyes in flying the very high speed aircraft of the future.  
(AUTHOR)

ACCELERATION

C

707

Cabanon, A. 1961 THE CENTRIFUGE OF THE AIR TEST CENTER OF BRETIGNY.  
(Paper, Panel on Acceleration Stress of the Armed Forces-NRC Committee on Bio-Astronautics, 6-11 March 1961, NASA Ames Research Ctr., Moffett Field, Calif.)

708

Caidin, M., & G. Caidin 1962 THE FORCES OF GRAVITY  
In Aviation and Space Medicine, Man Conquers The Vertical Frontier  
(New York: E. P. Dutton & Co., Inc., 1962) Chapter 10

709

Caidin, M. and B. Caidin 1962 AVIATION AND SPACE MEDICINE: MAN CONQUERS THE VERTICAL FRONTIER  
(E.P. Dutton & Co., Inc., New York, 1962, 215 pp.)

ABSTRACT: This treatise on aviation and space medicine is illustrated with many photographs. The topics discussed include historical aspects of aviation medicine, gravity, vertigo, high altitude flight, oxygen supply during flight, decompression chamber flight, pressurization and pressure suit, and escape and survival.

710

Calkum, F. J. and R. L. Larkins 1959 DEFLECTION OF THE HOLLOMAN TRACK UNDER STATIC LOAD.  
(U.S. Air Force Missile Development Center, Holloman AFB, New Mex.)  
Rept. no. AFMDC TN-59-2. ASTIA AD 209 778

ABSTRACT: Measurements were made of the deflection of the AFMDC track under a static load of 100,000 lbs (approximately five times the weight of present day sleds) which was applied to the track at 2 adjacent tie-down points. Deflection of the rails was recorded along the track from the load points to a point at which no deformation could be measured by the most precise survey methods. Subsequent observations were made at the same observation points to determine the rate of settlement under static load and the rate of recovery after removal of the load. Under the influence of the load a maximum deflection of .05 in. was observed. The deflection was smaller than .005 in. at a distance

24 ft. from a load point. Recovery after the removal of the load was slow and incomplete. (Author)

711

Cambeis, L. 1963 BIBLIOGRAPHY OF IMPACT ACCELERATION LITERATURE.  
ANNEX TO SYNTHESIS OF IMPACT ACCELERATION TECHNOLOGY FOR AVIATION  
CRASH INJURY PREVENTION. (PROJECT SIAT).  
(U.S. Army Transportation Research Command, Fort Eustis, Va.)  
TRECOTR 63-31B, June 1963. See Miller, C.O. 1963. TRECOTR 63-31A.

ABSTRACT: This report was prepared by Flight Safety Foundation, Inc., New York. It contains a listing of approximately 900 references related to impact acceleration by author and by organization. (CARI).

712

Cameron, G.R., R.H.D. Short, and C.P.G. Wakeley 1942 PATHOLOGIC CHANGES  
PRODUCED IN ANIMALS BY DEPTH CHARGES Brit. J. Surg. 30:49-64

713

Cameron, J.E. 1951 SEAT ASSEMBLY UPWARD EJECTION (Boeing Airplane Company,  
Seattle 14, Washington) 10 Sep. 1951, ASTIA ATI-131225

714

Cammack, K., et al. 1959 DECELERATION INJURIES OF THE THORACIC AORTA.  
A.M.A. Archives of Surgery 79:244-251, Aug. 1959

SUMMARY: An attempt has been made to explain the forces concerned in deceleration injuries of the thoracic aorta and to account for the usual sites of laceration on a physical basis.

We have stated the signs and symptoms of this injury and have urged early thoracotomy when any consideration has been given to such a diagnosis. (AUTHOR)

715

Campbell, B. J. 1961 A COMPARISON OF AUTOMOTIVE CRASH INJURY RESEARCH SAMPLES WITH COMPLETE STATE DATA.  
(Automotive Crash Injury Research, Cornell University, New York, N. Y.)  
Feb. 1961

DISCUSSION AND CONCLUSIONS: The hypothesis of this study is that ACIR data adequately represent the population from which they are selected. On a purely logical basis (with no reference to empirical data), the nature of sampling procedures employed supports this contention. The attempt to supplement this reasoning with empirical data produces some difficulties. These difficulties stem from the fact that methods employed necessitate demonstration of the similarity of distributions, and tests of statistical significance cannot very well accomplish this. When a difference is obtained, the hypothesis of similarity is rejected, but when the opposite happens, and no significant difference is found, it is not necessarily correct to accept the hypothesis of similarity. Failing to reject the hypothesis of similarity does not furnish proof that there is similarity. This situation is an outgrowth of the logical foundations on which significance tests are based. Despite these difficulties, the fact remains that by conducting repeated tests, many opportunities were furnished during which differences between ACIR and State data could be established. Since substantial differences failed to emerge, the empirical data lend support to the previously mentioned logical basis for believing the samples to be representative. In this study, 31 opportunities were afforded for detection of stable differences between ACIR and State data, and in only four cases were such differences found. Moreover, in at least two of these four cases, it was clear that there were reasons for the significance other than sample inadequacy. It is concluded that ACIR data adequately represent comparable accident events in the areas sampled. (Author)

716

Campbell, B. J., I. Drillien et al 1961 SUMMARY: REPORT: AUTOMOTIVE CRASH INJURY RESEARCH OF CORNELL UNIVERSITY. (1953-1961)  
(Automotive Crash Injury Research, Cornell University, New York, N. Y.)  
3 April 1961

717

Campbell, Eldbridge, and H. Kuhlenbeck 1950 MORTAL BRAIN WOUNDS: A PATHOLOGICAL STUDY Journal of Neuropathology 9:139-149

718

Campbell, F. J. 1960 THE RELIABILITY OF ACCIDENT AND INJURY SEVERITY RATING PROCEDURES USED AT ACIR.  
(Automotive Crash Injury, Cornell University, New York, N. Y.) Dec. 1960

719

Campbell, F. J. 1961 THE CONSISTENCY OF ACIR ACCIDENT-INJURY RELATIONSHIP  
IN FOUR STATES.  
(Automotive Crash Injury Research, Cornell University, N. Y.) June 1961

720

Campbell, H.E. 1954 DECELERATION AND MOTOR CAR.  
J A M A 154:1023, March 20, 1954

ABSTRACT: The motor car manufacturers must build the automobile to crash.  
An active program resulting in safety belts for every motor car occupant  
can save more lives per dollar than anything else we can do.

721

Campbell, H. E. 1956 REARWARD SEATING URGED FOR AIRLINE USE  
Aviation Week, 16 Jan. 1956

722

Campbell, H. E. 1957 DETROIT - ACCELERATION AND DEATH.  
Car Life 4(2):72-73, Feb. 1957.

723

Campbell, H. E. 1959 HOW CAN WE GET SAFE CARS?  
Rocky Mountain Medical Journal(Denver) 56(1):41-47, Jan. 1959.

SUMMARY: We are well along in our second million of motorcar dead. The Congress  
is the ultimate expression of public opinion. We have had years of clamor and  
outcry, and still we cannot get automobiles designed for safety. The Congress  
must integrate and implement the many people who know that highway safety is  
a matter of motorcar design, and who have the knowledge and the desire to  
bring it into being. (Author)

724

Campbell, P.A. 1942 A PRELIMINARY REPORT ON THE STUDY OF AIRSICKNESS.(Sch.  
Avia. Med. Randolph AFB) Proj. No. 31, Report No. 1.

725

Campbell, P.A., M.V. Thorner, A. Hemingway, F.E. McDonough, and F.W. Ogden  
1942 A PRELIMINARY REPORT ON THE STUDY OF AIRSICKNESS (NRC, Canada, Com.  
Avn. Med.) Report No. 74, 1942

726

Campbell, P. A. 1952 HUMAN ORIENTATION DURING TRAVEL IN THE AEROPAUSE.  
In White, C. S. and O. O. Benson, Jr., eds., Physics and Medicine of the  
Upper Atmosphere, A Study of the Aeropause (Albuquerque, N. Mex.: Univ.  
of N. Mex. Press, 1952) pp. 488-493.

ABSTRACT: Orientation of man in his environment involves integration of stimuli received from the visual, the kinesthetic, and the vestibular systems. The normal functioning of these mechanisms is determined by the following limiting factors: (1) adequate oxygenation must be provided for unimpaired performance of the brain and nerves; (2) abnormal motions such as spinning and tumbling should be avoided; (3) violent or prolonged linear and (4) gravitational forces should not deviate markedly from 1 g. The paper reviews briefly the present status of experimental research on human reactions under conditions where the above limitations are exceeded.

727

Campbell, P. A. 1952 MEDICAL ASPECTS OF FLIGHT ABOVE THE ATMOSPHERE  
J. Am. Med. Assoc. 150(1):3-6

ABSTRACT: Flights beyond the atmospheric layer of the earth create a number of physiological problems which may be divided into the following main categories: (1) those resulting from rapid penetration of the atmosphere (high temperature and acceleration); (2) those resulting from loss of the life-sustaining qualities of the atmosphere (oxygen, nitrogen, carbon dioxide, and water); and (3) those resulting from the loss of protection afforded by the filtering qualities of the atmosphere (cosmic and ultraviolet radiation, meteorites). The physical and physiological factors involved are briefly summarized.

728

Campbell, P. A. 1952 KNOWN AND PREDICTED PROBLEMS OF HUMAN TRAVEL IN THE AEROPAUSE. In White, C. S., & O. O. Benson, Jr., eds., Physics and Medicine of the Upper Atmosphere, A Study of the Aeropause (Albuquerque, N. Mex.: Univ. of New Mexico Press, 1952) p. 479

729

Campbell, P. A., 1957. SPACE TRAVEL: A SYMPOSIUM. INTRODUCTION.  
J. Aviation Med. 28(5):479-480.

ABSTRACT: Presents two graphs plotting altitude achievements for sixty years.

730

Campbell, P. A. 1958 ACHIEVEMENTS OF THE PAST YEAR  
J. Aviation Med. 29(7):485-492, July 1958.

ABSTRACT: Significant events of the year 1957-1958 in the field of space travel are reviewed. Achievements in the human parameters of space flight are also discussed, including accomplishments in acceleration, speed, duration of flight, altitude, weightlessness, and temperature control.

731

Campbell, P.A. 1958 AVIATION MEDICINE ON THE THRESHOLD OF SPACE:  
A SYMPOSIUM--ACHIEVEMENTS OF THE PAST YEAR. J. Aviation Med.  
29(7):485-492. July 1958.

ABSTRACT: Briefly traces with charts and graphs the development of aviation medicine toward space medicine as a concomitant of technological development increasing speeds and altitudes attainable.

732

Campbell, P. 1958 HUMAN LOGISTICS FROM THE VIEWPOINT OF SPACE TRAVEL.  
In Alperin, M., M. Stern, & H. Wooster, eds., Vistas in Astronautics: Proceedings of the First Annual AFOSR Astronautics Symposium.  
(New York: Pergamon Press, 1958) Part 6, Human Factors, Pp. 285-287.

733

Campbell, P. A. 1958 INTRODUCTION TO THE PROBLEM OF ESCAPE AND RESCUE DURING SPACE OPERATIONS. Proceedings of Second International Symposium on the Physics and Medicine of the Atmosphere and Space, Nov. 1958

734

Campbell, P. A. 1959 ESCAPE AND SURVIVAL DURING SPACE OPERATIONS.  
Air University Quarterly Review, Winter 1958-1959

735

Campbell, P. A. 1959 AVIATION MEDICINE ON THE THRESHOLD OF SPACE:  
GENERAL CONSIDERATIONS  
Ann. Intern. Med., 50(6):1542-1549, June 1959.

736

Campbell, P. A. 1959 PROGRESS TOWARD SPACE FLIGHT  
Federation Proc. 18(4):1255-1259, Dec. 1959.

737

Campbell, P. A. 1960 AVIATION MEDICINE TO SPACE MEDICINE IN FOUR DECADES  
Med. Times 88(11):1245-1253, Nov. 1960

ABSTRACT: The medical problems which have accompanied man's progress from aviation to space flight are reviewed and discussed. The problems of anoxia and aerocombolism at high altitudes have been solved by improvements in oxygen systems and oxygen-breathing techniques and by the development of pressurized and sealed cabins; New airfoil design and new propulsion methods have reduced the excessive vibrations experienced during flight at the speed of sound. The intense temperatures generated by atmospheric friction have been circumvented by improvements in materials, design, and air conditioning. Still remaining, however, are the apparent barriers of the aeropause, the Van Allen radiation belts, and the Newell barrier (radiation from high speed penetration of the sparsely distributed hydrogen atoms of space). Problems of weightlessness, launch acceleration, and deceleration and heating during re-entry are serious but solvable. More or less absolute limitations of space flight are imposed by the inability of matter to exist at a speed-of-light velocity (according to the theory of relativity) and by the distance which can be traversed in an acceptable period of time (thereby curtailing the distances man may wish to go).

738

Campbell, P. A. 1960 PROBLEMS OF LUNAR COLONIZATION.  
In Lectures in Aerospace Medicine, 11-15 January 1960. (School of  
Aviation Medicine, USAF Aerospace Medical Center, Brooks AFB, Texas)

739

Campbell, P.A. 1961 MEDICAL AND BIOLOGICAL ASPECTS OF THE ENERGIES  
OF SPACE. ( New York: Columbia University Press, 1961)

740

Cambridge Instrument Co., Inc., New York, N. Y. n.d.  
OMNIDIRECTIONAL ACCELEROMETER, DEVICE 9032, INSTRUCTIONS FOR USE  
AND CARE OF.

741

Canfield, A.A., A.L. Comrey, R.C. Wilson and W.S. Zimmerman. 1948 THE  
EFFECT OF INCREASED POSITIVE RADIAL ACCELERATION UPON HUMAN ABILITIES  
(PART II: PERCEPTUAL SPEED ABILITY) (Univ. of So. Calif., Dept of  
Psychol.) Contract No. N6 ori 77, Task Order 3, Sept. 1948

742

Canfield, A. A., A. L. Comrey and R. C. Wilson 1948 AN INVESTIGATION OF  
THE MAXIMUM FORCES WHICH CAN BE EXERTED ON AIRCRAFT ELEVATOR AND  
AILERON CONTROLS. (Univ. of Southern Calif., Dept. of Psychology,  
Rept. to the Office of Naval Res.) Contract N6Ori77, Sept. 1948.

743

Canfield, A.A., Jr. 1949 THE EFFECT OF INCREASED POSITIVE RADIAL ACCELERATION  
ON THE SPEED AND ACCURACY OF REACHING MOVEMENTS.  
(Dissertation, University of Southern California)

744

Canfield, A. A., A. L. Comrey, and R. C. Wilson, 1949 A STUDY OF REACTION  
TIME TO LIGHT AND SOUND AS RELATED TO INCREASED POSITIVE RADIAL ACCELERATION.  
J. Aviat. Med. 20(5): 350-355.

CONCLUSIONS: It is concluded on the basis of the experiment reported here that  
the reaction time to both light and sound stimuli becomes significantly longer  
under conditions of increased radial acceleration. The superiority of reaction  
to sound, in addition to the known failure of sight at crucial G-levels, suggests  
the advisability of presenting important signals to the pilot in the auditory  
sense modality rather than the visual. This is especially vital in those cases  
where such signals demand emergency action. The tremendous speed of the aircraft  
of today and tomorrow will necessitate action to conserve every split second.  
Taking steps such as those suggested here should help to take some of the burden  
from the limiting factor in aircraft design - the pilot.

745

Canfield, A. A. et al 1950 THE EFFECT OF INCREASED POSITIVE RADIAL ACCELERATION UPON DISCRIMINATION REACTION TIME. J. Exper. Psychol. 40(6):733-737, Dec. 1950.

ABSTRACT: Twenty-three volunteer college students were tested on the human centrifuge at the University of Southern California at 1, 3 and 5 g (use of the Navy Coverall Type Z-2 anti-g suit enabled testing at 5 g with no physiological embarrassment).

The test problems were presented on a panel mounted vertically in front of the subject. He was to move a toggle switch in the direction that a red light lay from a green one on this test panel. A small white light in the center served as a warning light and the test stimuli were presented from 1.5 to 2.5 seconds after the appearance of this warning light. This foreperiod was varied from response to response in an irregular order. Each subject was given six experimental trials on each of four testing days, two runs each at 1, 3, and 5 g. Each experimental trial lasted about fifteen seconds, during which time the subject made five separate responses.

The subject's ability to make discriminatory reactions was impaired significantly under increased positive radial acceleration forces of 5 g in the first few trials for the first couple of experimental days only, and thereafter was unaffected. Any physiological compensatory mechanism seems unlikely, and the impairment is attributed to effects of novelty, distraction and apprehension. After a few exposures, the subject functions as well at 5 g as at 1 g.

These results and others on the Spatial Orientation and Perceptual Speed Test (in the same laboratory) support the view that no drastic changes in mental efficiency occur in the pilot wearing an anti-g suit up to 5 g, i.e., as long as vision is maintained.

Further research is needed on these and other skills under conditions of lengthened exposure and increased level of force to determine if some critical point, short of unconsciousness, does exist where these functions might be impaired. (J. of Aviation Medicine 23(2):204-205, April, 1952)

746

Canfield, A. A. 1950 THE EFFECT OF POSITIVE G ON THE SPEED AND ACCURACY OF REACHING MOVEMENTS. Amer. Psychol. 5(9):482

747

Canfield, A. A. 1950 THE INFLUENCE OF POSITIVE G ON REACTION TIME. Amer. Psychol. 5(7):362.

748

Canfield, A.A. 1950 THE HUMAN CENTRIFUGE.  
Research Reviews. March 1950

749

Canfield, A. A., A. L. Comrey, and R. C. Wilson 1953 THE INFLUENCE OF IN-  
CREASED POSITIVE G ON REACHING MOVEMENTS.  
J. Applied Psychol. 37(3):230-235

ABSTRACT: From the results of this experiment, using 48 subjects, certain conclusions about the effect of increased positive radial acceleration on reaching movements may be advanced. Both the speed and accuracy of reaching movements at increased g levels are seriously impaired, the degree of impairment being roughly equivalent to the amount of force imposed. The kinesthetic cues governing the thrust of the arm under normal circumstances are inadequate to maintain similar accuracy or speed under radial accelerative conditions. Due to the increased weight of the arm and the inadequacy of the normal kinesthetic cues, two types of errors are found, one being the negative inertia error and the other the error of downward tendency. The most favorable location of controls for the pilot of high-speed aircraft, both from the standpoint of speed and accuracy, is to the side of the pilot's preferred hand and below its normal resting point. Emergency controls that might have to be manipulated under conditions of increased positive radial acceleration should be no smaller than two inches in diameter if a pushing motion is required.

750

Cantor, J.J. 1945 RUPTURE OF TYMPANIC MEMBRANE DUE TO AIR BLAST  
Ann. Otol., Rhin. & Laryng. 54:554-562, Sept. 1945.

ABSTRACT: During the period of blast: The rupture of the tympanic membrane can be explained without a negative pressure being present. The damage done, such as the removal of the ossicular chain, can not be explained by a negative pressure of even 15 pounds to the square inch but can be explained by this positive pressure hypothesis. The pathway of the blast is through the eustachian tube and not through the external auditory canal. Unilateral rupture of the tympanic membrane is due to the occlusion of the unruptured side because of pathological or anomalous conditions of the eustachian tube. Nasal pathology may be responsible for the rupture of the tympanic membrane.

751

Caporale, R. & V. Camarda 1958 THE VESTIBULAR FUNCTION OF SOME PILOTS OF AN  
ACROBATIC CREW. Revista di Medicina Aeronautica, March 1958, pp. 12-36

Summary: This study sought to determine the threshold of stimulation of the labyrinthic neuro-epithelium. The four subjects were pilots, with approximately 1000 jet-hours each, who had trained daily for more than a year in F-86E acrobatic

flight, this duty ending about two months before the present tests. Equipment used was the TOENNIES seat, a gyrating seat which can impart absolutely constant positive angular accelerations ranging between  $0.5^{\circ}$  and  $10^{\circ}/\text{sec.}^2$ , and a 2-channel electronystagmograph with preamplifier to increase signals from electrodes attached at periorbital contours of one or both eyes and "grounded" to ear lobe.

Acrobatic flight in jet fighter planes had an effect on the vestibular apparatus of the pilots tested. In each pilot one of the two labyrinths proved less excitable than the other. Moreover, both "followers of the left" had hyperexcitable left labyrinth and those of the right hyperexcitability of the right labyrinth. It seems that the vestibular assymetry is a function of the position of the pilot in the acrobatic V-formation most frequently used.

The authors hypothesize that attitude of the head assumed during acrobatics should be in agreement with the determination and localization of the vestibular hyperexcitability. (CARI)

752

Caporale, R. 1961 BEHAVIOR OF SOME POSTURAL REFLEXES IN INTACT, DELABYRINTHIZED OR DECEREBRATED PIGEONS DURING VARIATIONS OF ACCELERATION IN WEIGHTLESSNESS IN SUB-GRAVITY ROTATION.  
Rev. Med. Aero (Paris) 2;165-170, Dec. 1961 (Fr.)

753

Caporale, R. 1962 COMPORTAMENTO DI ALCUNI RIFLESSI POSTURALI IN COLUMBI INTATTI, SLABIRINTATI O DECEREBRATI, DURANTE VARIAZIONI DI ACCELERAZIONI TRA DUE E ZERO G (BEHAVIOR OF SOME POSTURAL REFLEXES IN INTACT, LABYRINTHECTOMIZED, OR DECEREBRATED PIGEONS, DURING VARIATIONS OF ACCELERATIONS BETWEEN TWO AND ZERO G)  
Rivista di medicina aeronautica e spaziale (Roma), 25 (2): 243-256. April-June 1962. In Italian, with English summary on p. 254

ABSTRACT: Cinematographic registration was made of static reflexes and posture kinetics (spontaneous posture, changes of head position in space, hop preparation reflex) of pigeons subjected to accelerations between 2 and 0 g in the subgravity tower. Intact pigeons displayed no significant changes due to subgravity. Decerebrated pigeons retained the hop preparation reflex and the capacity to fly; however, the static head reflex was weaker than that of intact animals. Totally labyrinthectomized pigeons demonstrated a disappearance of compensatory static reflexes, hop preparation reflex, and voluntary equilibration. Hemilabyrinthectomized animals retained normal posture similar to intact animals but tended to fly circularly around the intact side; the hop preparation reflex was retained while the compensatory head reflexes were missing.

754

Caporale, R. 1962 BEHAVIOR OF OCULAR NYSTAGMUS OF LABYRINTHINE ORIGIN IN HUMANS AND RABBITS SUBJECTED TO RADIAL ACCELERATIONS. Riv. Med. Aero 25:653-666, Oct.-Dec. 1962 (Italy)

755

Cappel, K. L., C. A. Belsterling, et al. 1961 FEASIBILITY STUDY ON A DYNAMIC ESCAPE SIMULATOR (HUMAN CENTRIFUGE). FINAL REPORT. (Laboratories for Research & Development, Franklin Institute, Philadelphia, Pa.) Rept. No. F-A2407; Contract AF 33(616)7118; ASTIA AD-259 716

ABSTRACT: The construction of a device capable of simulating the acceleration patterns of escape from high speed aircraft was found to be feasible. The reduction in the rates of simultaneous rotation of the main arm, fork and cab is recommended in the interest of economy and protection of the subject from excessive gyroscopic forces. The construction of the major components of the proposed Simulator is within the state-of-the-art and can be accomplished with existing techniques. A high proportion of the components are shelf items which have proved satisfactory in operation. (AUTHOR)

756

Capucci, M. 1949 EFFECTS OF ACCELERATION IN FLYING ON EYES Rivista di Medicina Aeronautica (Rome) 12: 261-267

757

Carayon, A., & V. André 1956 NOTES SUR LES ACCIDENTS CRANIOCERVICAUX DU PARACHUTAGE. (Note on Cranio-cervical Injuries Caused by Parachuting) Société de Médecine Militaire française, Bulletin mensuel (Paris), 50(4):124-126

ABSTRACT: Cases are recorded of cranio-cervical injuries (fractures, dislocations, closed injuries, contusions) occurring during parachute jumps. Lesions are attributed to either a faulty jump due to bad terrain, violent winds, or bad body position, and to the shock produced by the opening parachute. Lesions caused by the shock of an opening parachute are not usually evident during rapid physical examination and lead to painful manifestations. Mention is made of therapeutic techniques.

758

Carbery, W. J., C. A. Steinberg, W. E. Tolles, & A. H. Freiman, 1961  
AUTOMATIC METHODS FOR THE ANALYSIS OF PHYSIOLOGIC DATA  
Aerospace Medicine 32(1):52-59, Jan. 1961.

ABSTRACT: A computer facility for the rapid analysis of physiologic data from the manned space satellite is described. The details of this facility and methods for performing each of the analytic operations are discussed. Main features of the facility are 1) automatic signal recognition and measurement, 2) automatic analysis of several channels of simultaneously recorded data for early detection of significant changes, and 3) automatic analysis to determine underlying causes of these changes. Results obtained from analyses of similar types of data in the laboratory are presented to demonstrate the feasibility of the computer facility for use in experiments with manned space satellites. (Tufts)

759

Carlson, A. J., A. C. Ivy, L. R. Krasno and A. H. Andrews 1942 THE PHYSIOLOGY  
OF FREE FALL THROUGH THE AIR: DELAYED PARACHUTE JUMPS.  
Quart. Bull. Northw. Univ. Med. Sch. 16:254-266. 1942.

760

Carlson, D.D. and R.H. Underwood 1961 DESIGN OF AN AEROSPACE SYSTEMS  
ENVIRONMENTAL CHAMBER. (Arnold Engineering Development Center, Arnold  
Air Force Station, Tenn.) Rept. No. AEDC TR 61-10, ASTIA AD-260 486

ABSTRACT: Design parameters for large space environmental chambers are discussed. The feasibility, ranges, and limitations of simulating these parameters in the U.S. Air Force's Mark I Aerospace Systems Environmental Chamber are presented. (Author)

761

Carlson, L.D. PHYSIOLOGICAL MECHANISMS INVOLVED IN TOLERANCE TO  
AEROSPACE FLIGHT ENVIRONMENTS. (Kentucky University, Lexington)  
Project 7220(805A), Contract AF 33(616)-8414; MRMB, AMRL

ABSTRACT: The contractor will conduct research on the physiological mechanisms influencing human responses to hypodynamic environments and the subsequent return to normal conditions, changes in the respiratory mechanisms during acceleration and their effect on human tolerances and the mechanisms of human body temperature regulation during exposure to thermal extremes peculiar to aerospace flight. At the completion of each work phase the contractor will reduce, analyze and present the data obtained.

762

Carlson, N.W. 1958 AN ANALYSIS OF A DEVICE FOR CONTROL OF  
ROTATIONAL MOTION. (Wright Air Development Center, Wright-Patterson  
AFB, Ohio) WADC TN 58-81, April 1958. ASTIA AD 151106

ABSTRACT: By varying the moment of inertia of a rotating body, speed changes are possible without a reaction on the support. A mechanical decelerator, based on the above principle has been successfully tested in the laboratory. Although, this device was originated to control flat spin encountered in freefall human parachute drops, other applications appear useful.

763

Carlson, Toby N. & Morton Glass 1962 VERTICAL VELOCITIES OBTAINED FROM AIRCRAFT  
ACCELEROMETER MEASUREMENTS IN A SEVERE THUNDERSTORM  
(AF Cambridge Research Laboratories, Bedford, Mass. ) AFCRL-62-499, Project  
8620, May 1962. ASTIA AD 282 772

ABSTRACT: A penetrative flight by a T-33 aircraft was made through a large thunderstorm on July 26, 1960, over northern Arizona. From instruments recording airplane acceleration, angle of attack, and pitch angle, precise measurements yielded a vertical velocity every 60 ft. of flight path. Calculated velocities differed from the true motions by a constant of integration. Evaluating the constant by alternate procedures produced two velocity distributions, differing from each other by a constant.

764

Carlson, W. A. 1939 PSYCHOLOGY AND AVIATION.  
J. Aviation Med. 10(4):216-222, Dec. 1939.

ABSTRACT: Aviation is a comparatively new field that has taken man into an unusual environment. Consequently, an attempt must be made to determine what abilities and traits are necessary in an individual to make a good pilot. Normal or above-average intelligence is one prerequisite for a good pilot. Piloting an airplane demands a good and accurate capacity for learning, the ability to remember these learned reactions and sound judgment as to when to execute them. Normal span and control of attention is another requirement for a flier. A good pilot must also be emotionally stable. Youth is a desirable characteristic of the flyer. Reaction time becomes slower as a person grows older though this slowing down process varies in different persons.

765

Carlton, L. M., R. A. Rasmussen, & W. E. Adams 1945 BLAST INJURY OF LUNG:  
POSSIBLE EXPLANATION OF MECHANISM IN FATAL CASES - EXPERIMENTAL STUDY  
Surgery 17(6):786-793, June 1945.

ABSTRACT: The cause of death following increased intrabronchial pressure produced by single or multiple blasts of air in eighteen dogs was coronary air embolism in fifteen, with pneumothorax as a contributory factor in eight. Pneumothorax appeared to be the sole cause of death in the remaining three. Other gross findings noted in these animals were similar to those reported in human beings following blast injury. In some patients dying immediately following a blast injury the cause of death has not been adequately explained. Coronary air embolism may be very easily overlooked and might well be the cause of death in some cases of blast injuries.

766

Carlsten, A., C-J. Clemedson and H. Hultman 1955 THE ELECTROCARDIOGRAM OF  
RABBITS IN BLAST INJURY.  
Acta. Physiol. Scand. 33:243-256.

767

Carlyle, L. 1959 LITERATURE SURVEY ON AIRCREW RESTRAINT.  
(Douglas Aircraft Co., El Segundo, Calif.) Rept. ES 29260, 10 Feb. 1959

SUMMARY: This report has been prepared to serve as a general reference for future development of air crew safety and restraint systems. A survey of the literature on human response to accelerative forces and mechanics of vertebral injury plus current and proposed safety and restraint systems was made and abstracted for the report. (AUTHOR)

768

Carlyle, L. 1960 MAN AND SPACE  
(Paper SAE National Aeronautic Meeting, New York, N. Y., April 5-  
8, 1960)  
(Society of Automotive Engineers, Inc., New York, N. Y.) Rep. 173A

ABSTRACT: Procedures are described for determining functional human envelopes for flight in vehicles within the earth's atmosphere and beyond. As a first step, a comparison of various types of manned flight is made to determine functional and, consequently, volumetric requirements of a human occupant. The use of two-dimensional manikins based on anthropometric data is described and a composite (5th through 95th percentile of body sizes) functional envelope is developed. Allowances are made for heavy flight clothing and boots. The effect of a full-pressure garment is considered. Factors unknown as yet about interplanetary flight are considered in relation to this approach. (Tufts)

767

Carlyle, L. 1961 CINEFLUOROGRAPHIC TECHNIQUE IN ACCELERATION STUDIES.  
(Paper, Symposium on Biomechanics of Body Restraint and Head Protection,  
Naval Air Material Center, Philadelphia, Penn. June 14-15, 1961).

ABSTRACT: The high incidence of vertebral fractures in aircraft accidents is a major problem in aviation safety. However, none of the studies done on this subject casts sufficient light on the basic problem - the true dynamics of the living vertebral column when subjected to acceleration forces.

The development of electronic image intensification devices to increase the brightness of the fluoroscopic image at tolerable radiation dosages has radically improved the utility of x-ray equipment and offers a means of implementing research studies formerly considered impractical. This paper describes the function of the electron optical image intensifier which, for a given input of radiant energy, can produce an image at least 3000 times brighter than that obtained by orthodox fluoroscopy. A test film will be shown to demonstrate the technique.

768

Caro, C.G., J. Butler & A.B. DuBois 1960 SOME EFFECTS OF RESTRICTION OF CHEST CAGE EXPANSION ON PULMONARY FUNCTION IN MAN: AN EXPERIMENTAL STUDY.  
J. Clin. Invest. 39:573-583, April 1960.

ABSTRACT:

1. The total lung capacity and its subdivisions were reduced by restricting chest expansion in normal man.
2. The lung pressure-volume relationship was altered (smaller volume resulting from unit pressure) over much of the vital capacity. Respiratory frequency was increased and tidal volume was reduced. Airway conductance at resting lung volume was not changed despite reduced functional residual capacity. There was slight unevenness of alveolar ventilation with evidence of non- or poorly ventilated lung units. Systemic arterial  $O_2$  tension fell during oxygen breathing, and there was a slight increase of peripheral venous pressure.
3. Following release of chest restriction, the mechanical changes in the lungs were reversed via a hysteresis-like pathway. They appear to be explained in part by the opening of lung units which had become closed during chest restriction.

769

Carpenter, A. 1954 ACCELEROMETERS AND PSYCHOLOGY  
(Applied Psychology Research Unit, Cambridge, Great Britain)  
Rept. No. APU 225/54, Dec. 1954

ABSTRACT: A brief list is given of the possible applications of acceleration-sensitive instruments in psychological experiments, and the theoretical basis of these sensitive instruments is described. In the type of accelerometer

described, a magnetic bridge unit is used to measure the displacement of the spring-mounted mass, relative to the instrument case, that is produced by applied acceleration. With the circuits energized by an alternating current of a suitable frequency, the device becomes sensitive to deflections of about 0.0001 inch. The constructional details of the design are given, and practical considerations are mentioned.

770

Carpenter, M. S. 1962 ASTRONAUT PREPARATION.  
(In Results of the First U. S. Manned Orbital Space Flight, February 20, 1962) (Washington, D. C.: National Aeronautics and Space Administration, 1962) Pp. 105-111.

771

Carpenter, M. S. 1962 PILOT'S FLIGHT REPORT  
(In Results of the Second United States Manned Orbital Space Flight, May 24, 1962, pp. 69-75. Washington, D. C.: National Aeronautics and Apce Administration, 1962) NASA SP-6.

ABSTRACT: An account of the major events and personal observations of the MA-7 flight is reviewed by the pilot. Prior to and during powered flight, launch-vehicle noise and vibration were less than expected. As in the MA-6 mission, the astronaut quickly adapted to weightless flight and remarked that it was more comfortable and provided greater mobility than under normal gravity. Astronaut Carpenter also observed the space particles and the bright horizon band, previously reported by Astronaut John H. Gleen, Jr., and secured new information on both phenomena. The final phases of the flight, including retrosequence, reentry, landing, and egress, are covered in detail.

772

Carpenter, M. S. 1963 ORBITAL EXPERIENCE  
In (School of Aerospace Medicine, Brooks AFB, Texas) Lectures in Aerospace Medicine (Address given 4 Feb. 1963; to be published at later date)

ABSTRACT: Astronaut Carpenter discussed various aeromedical aspects of his space flight of 24 May 1962 in the Aurora 7 Mercury-Atlas orbital flight, in which he completed a 3-orbit mission reaching a maximum altitude (apogee) of 164 miles, and attained an orbital velocity of 17,532 mph. Vibration and acceleration effects were stated to present no problem. The Gemini or Apollo missions re-entry profiles would not exceed the 11 G Redstone or 8 G orbital re-entry accelerations. He mentioned training missions in the centrifuge at Johnsville up to 16 G, and that decrement did not become evident until after 8-10 G. Vibration difficulty on the previous flight by J. H. Gleen was overcome by simply placing a sponge between the helmet and couch, which successfully eliminated vibration. (CARI)

773

Carr, S. J. 1944 COMPARATIVE TRIALS BETWEEN FRANKS' AND COTTON'S ANTI-G SUITS.  
(RAF Institute of Aviation Medicine, Farnborough) F.P.R.C. Rept. No. 567, February 1944.

774

Carringer, E.M., M.G. Hoppe and B.H. Nichols 1961 ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY. VOLUME III, NUMBER 6 (ENTRIES 31,146-31, 373). (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Calif.)  
ASTIA AD-260 278

775

Carringer, E. M., M. G. Hoppe, & B. H. Nichols 1961 ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY, VOLUME IV, NO. 3 (ENTRIES 40, 454-40, 728). (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Calif.) (Contract NASw-6) September 1961. ASTIA Doc. No. AD-264 956.

776

Carringer, E.M., M.G. Hoppe & B.H. Nichols 1962 ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY, VOLUME V, NO. 2 (ENTRIES 50,206-50,417). (Jet Propulsion Lab., Calif. Inst. of Tech.); ASTIA AD 273 505.

777

Carringer, E.M., M.G. Hoppe, and B.H. Nichols 1962 ASTRONAUTICS INFORMATION, OPEN LITERATURE SURVEY VOLUME V, NO. 3 (ENTRIES 50,418-50,669). (Jet Propulsion Lab., Calif. Inst. of Tech.); ASTIA AD 274 399.

778

Carroll, J., & H. F. Roegner 1958 PRELIMINARY PHOTOGRAPHIC EVALUATION REPORT OF BRANIFF ACCIDENT FOR ALPA (Aviation Crash Injury Research, A Division of Flight Safety Foundation Inc., Phoenix, Arizona) Rept. AvCIR-8-PR-100; Dec. 1958

779

Carroll, J. 1960 PRINCIPLES OF CRASH INJURY INVESTIGATION.  
(Aviation Crash Injury Research, Phoenix, Arizona) AvCIR 62-0-107, September 1960.

780

Carroll, J. and H. F. Roegner 1960 CRASH INJURY REPORT: US ARMY U-1A DE HAVILLAND OTTER ACCIDENT, FORT CARSON, COLORADO, 16 JUNE 1959. (Aviation Crash Injury Research, Phoenix, Arizona) AvCIR-9-PR-104, February 1960.

SUMMARY: A crash injury investigation revealed that injuries were the result of the occupants being thrown free due to seat and/or seat belt failures and striking interior structures and rifles.

The analysis of injury causation factors indicates the need for: (1) increased strength of seats and tie-downs, (2) a better restraint system for occupants, and (3) a method of stowing hand-carried weapons. (Author)

781

Carroll, J. 1960 CRASH INJURY INVESTIGATOR'S SCHOOL REFERENCE MANUAL. (Aviation Crash Injury Research, Phoenix, Arizona) October, 1960

782

Carroll, J. & W. R. Knowles 1960 CRASH INJURY EVALUATION: U. S. ARMY YHC-1B CHINOOK MOCKUP, MORTON, PENNSYLVANIA, 27 January 1960. (Aviation Crash Injury Research, Phoenix, Arizona) AvCIR-13-PV-118, TREC Tech. Rept. 60-54, September 1960.

SUMMARY: The U. S. Army model YHC-1B helicopter mockup was presented for a board review by the Vertol Aircraft Corporation, Morton, Pennsylvania, January 27, 1960.

Aviation Crash Injury Research participated in the mockup review independently from the mockup board, evaluating the aircraft from a crash survival point of view. As a result of the evaluation, which was based in part on previous accident experience, it was concluded that a number of desirable crash safety features exist: 1) The crew compartment and main cabin generally appear to offer crash-worthy features free from the great number of protruding, injurious components usually found in earlier model Army troop-carrying helicopters. 2) The YHC-1B presents a good cockpit arrangement with the instrument panel mounted low and out of striking range for an adequately restrained pilot and copilot. 3) Objects such as overhead consoles, lights, and motors are installed and mounted in a recessed manner thereby removing them from striking range of the pilot and copilot. 4) Provisions for emergency exits in the crew compartment are adequate.

783

Carroll, J. 1961 CRASH INJURY EVALUATION: U. S. ARMY YHU-1D BELL IROQUOIS HELICOPTER MOCKUP, FORT WORTH, TEXAS, 7 JULY 1960, 19-20 JANUARY 1961. (Aviation Crash Injury Research, Phoenix, Arizona) AvCIR 16-PV-127, TREC Tech. Rept. 60-74, February 1961.

SUMMARY: Two crash injury evaluations of the mockup of the YHU-1D were conducted

by AvCIR at the request of the U. S. Army Transportation Research Command (TRECOC). The first evaluation was conducted on 7 July 1960, at which time many of the design details had not been completed. A subsequent evaluation was made on 19-20 January 1961. Both evaluations were made at the Bell Helicopter plant, Fort Worth, Texas. The purpose of the evaluations was to: 1) Evaluate over-all crash safety of the basic aircraft structure; 2) Determine the existence, if any, of features which could lead to unnecessary exposure of crew members and passengers to serious or fatal injury in the event of an accident involving crash conditions of a survivable nature; 3) Make recommendations for remedial action in the areas where deficiencies exist in order to improve the overall crash safety aspects of the aircraft; and 4) Point out desirable crash safety features revealed through inspection of the mockup, engineering drawings, and detailed specifications.

The above work was accomplished through a comprehensive crash injury evaluation of the entire aircraft, its components, and equipment. This was supported by discussions with members of the Bell engineering staff and reference to applicable technical manuals and military specifications.

As a result of the evaluation, which was based in part on previous accident experience with the similar HU-1A helicopter, it was concluded that: (1) The basic structure of the YHU-1D provides a strong, crashworthy platform with a reasonable degree of crash force energy absorption through a well-designed skid gear assembly; (2) the YHU-1D presents a good cockpit arrangement, with the instrument panel mounted low and out of striking range for an adequately restrained pilot or copilot; and that (3) provisions for emergency exit in both the crew and troop compartments are adequate, except as otherwise noted herein.

The evaluation also revealed a number of crash safety deficiencies existing in troop seats, litter installations, certain emergency escape provisions, potential fuel system hazards, and, in particular, the continued use of a magnesium cast transmission support case which has proven to be an inherent weak point of design in the Bell Iroquois helicopter series. In addition, the Military Specifications and crash load structural criteria governing the design and strength of various components, such as seats, litters, etc., are considered deficient in that minimum requirements specified are inadequate and incompatible with simultaneous application of crash forces in three planes, and with magnitudes and durations experienced in actual helicopter accidents.

Based on the data and analyses presented in this evaluation, several recommendations are made concerning the airframe, components, main cabin, furnishings, and related Military Specifications. These are contained in Section III. (AUTHOR)

784

Carroll, John J. 1962 A REVIEW OF U. S. AIR CARRIER ACCIDENTS IN WHICH FATALITIES RESULTED FROM FIRE FOLLOWING IMPACT, 1952-1961.  
(Civil Aeronautics Board, Bureau of Safety, Engineering Division,  
Washington 25, D. C.) June 1962

785

Carroll, K.D. 1960 PRIMATES IN SPACE CAPSULES.  
(Lockheed Missiles and Space Company, Sunnyvale, Calif.)  
SB-60-13

786

Carter, C. V. 1956 LOADS ON AIRCRAFT AND PILOT DURING SPINS AND POST-STALL  
GYRATIONS. (Chance Vought Aircraft) Memo E-1837, 4 June 1956

787

Carter, C.V. & W.W. Huff, Jr. 1959 THE PROBLEM OF ESCAPE FROM SATELLITE  
VEHICLES  
(Paper: Institute of Aeronautical Sciences 27th Annual Meeting, Jan. 26-29, 1959,  
New York City, New York)/ IAS Rept. No. 59-41

ABSTRACT: Problems of design of escape systems for manned satellite vehicles  
are discussed: escape prior to takeoff, during boost at high dynamic pressure,  
during exit from the atmosphere and entry of the atmosphere, and during orbit.  
Design procedures which can be employed to determine a satisfactory escape  
system configuration are presented.

788

Carter, E. T. and M. W. J. Bell 1958 BIOTHERMAL ASPECTS OF RE-ENTRY FROM  
EXTRA-ATMOSPHERIC FLIGHT.  
(Paper, American Rocket Society, New York 36, N. Y.) Paper 704-58

ABSTRACT: This paper points out certain biothermal problems that are expected  
to arise as a result of atmospheric re-entry of manned vehicles. Some solutions  
are presented, although the authors admit that they fall far short of being  
acceptable answers to the problem. It is also pointed out that these methods  
take into account only the stress of temperature and do not consider the possibil-  
ity that other stresses such as hypoxia or high g loading are present at the  
same time. These additional stresses could cause an intolerable situation for  
the vehicle occupant. More information is needed regarding human performance  
under the combined stresses of heat and acceleration.

789

Carter, L.J., ed. 1957 REALITIES OF SPACE TRAVEL: SELECTED PAPERS OF  
BRITISH INTERPLANETARY SOCIETY. (New York: McGraw, 1957)

ABSTRACT: Among the subjects treated in this series of articles published  
since 1948 are the following: Astronautics (introduction, history, and develop-  
ment), interplanetary flight, space flight (biological aspects of, and physical  
factors in), satellite vehicles, testing stations, and the future of space  
travel. The appendix contains a report on the British Interplanetary Society  
and a list of aeronautical and rocket societies.

790

Carter, R. L. 1958 VERTEBRAL INJURIES FROM EJECTION FORCES.  
(Paper presented at the 29th Annual Meeting, Aero-Med. Assoc., Washington,  
D. C., March 1958)

ABSTRACT: A review is presented of the literature concerning human tolerance to ejection forces. Evidence was found that all thoracic and lumbar vertebrae have essentially the same tolerance to positive accelerations of high magnitude and short duration. Consideration is given to factors which abet spinal injuries, especially body position. (J. Aviation Med. 29:233)

791

Carter, R. L. 1959 HUMAN TOLERANCE TO AUTOMATIC POSITIONING AND RESTRAINT SYSTEMS FOR SUPERSONIC ESCAPE  
(North American Aviation, Inc., Columbus Division, Columbus 16, Ohio, Engineering Department) Report No. NA59H-220 \*

Abstract: A complete torso and extremity positioning and restraint system for supersonic escape has been demonstrated with multiple live tests. This system requires no pre-positioning whatsoever on the part of the airman prior to initiating escape. All forces imposed upon the airman during these operations are well within human tolerance limits. The time required from initiation to inflation of the recovery parachute has not been compromised.

792

Carter R L. & G.A. Holcomb 1959 HUMAN TOLERANCE TO FORCES IMPOSED UPON AN AIRMAN DURING SIMULTANEOUS SEAT BOTTOMING, KNEE ELEVATING AND LEG POSITIONING AND RESTRAINING IN THE A3J-1 ESCAPE SYSTEM.  
(Paper, Meeting of Aero Medical Association, Statler Hilton Hotel, Los Angeles, April 27-29, 1959)

ABSTRACT: The seat bucket on the A3J-1 escape system adjusts to accommodate various height airmen while the rest of the seat and the seat catapult remain stationary. The seat bucket must be bottomed prior to firing the seat catapult in order to have proper center of gravity-rocket thrust relations when the seat leaves the rails. At the same time, the seat is being bottomed, the knees are being elevated and the legs positioned and restrained. This prevents flailing of the lower extremities, insures symmetry of the ejected mass, and reduces the decelerative forces imposed by the dynamic wind pressure. All these operations are accomplished in 0.2 seconds by ballistically powered units. This paper presents data that show that all forces imposed upon the airman during these operations are within human tolerance limits. Production units were tested using anthropomorphic dummies and a human subject. No deleterious effect whatsoever was experienced, not even mild, transient pain. The knee raising bar impacted the

legs with a maximum velocity of 7.6 feet per second. The leg restraining hooks impacted the legs with a maximum force of 110 pounds. Raising the knees did not produce spinal flexure. Movies of the human test are presented. (J. Aviation Med. 30(3):179, March 1959)

793

Carter, R. L. 1961 BIODYNAMICS OF CAPSULE RESTRAINT SYSTEMS.  
(Paper, Symposium on Biomechanics of Body Restraint and Head Protection, Naval Air Material Center, Philadelphia, Pa., June 14-15, 1961.)

794

Carter, R.L. 1961 HEAD IMPACT STUDIES  
(Paper, Symposium on Impact Acceleration Stress, Brooks AFB, Texas, Nov. 27-29, 1961)

ABSTRACT: Subjects wearing standard U.S. Navy flight helmets impacted their heads against an ejection seat headrest to determine voluntary tolerance limits to this type of acceleration. Accelerometers were mounted on the helmet and on the subject's forehead.

Six subjects were used in the study. Pain was used as the endpoint. Voluntary limits ranged from 42.2 G's to 67.3 G's. Impact velocities ranged to 31.3 ft/sec. Rates of onset of acceleration ranged to 13,460 G/sec. Total times of acceleration ranged from 0.018 to 0.029 sec.

The subjects experienced no ill effects following the tests.

795

Case, Robert W. 1938 TESTING APPARATUS FOR AIRCRAFT  
U.S. Patent n2, 115, 841. May 3, 1938

ABSTRACT: The apparatus drop tests the fuselage or any other similar mass. Cylindrical charts at various positions along the fuselage (or other structure) rotate and record the movement of the structure as it strikes the landing base. A tachometer records the revolutions of the cylindrical charts to determine their speed. Height of drop may be varied and damping springs under the landing base may be changed to change degree of impact force.

796

Cass-Beggs, D. 1943 INTERIM REPORT ON THE WORK DONE DURING THE YEAR 1942 ON THE CONSTRUCTION OF THE HUMAN CENTRIFUGE UNDER DOMINION GOVERNMENT GRANT A.M. 4 MADE THROUGH THE NATIONAL RESEARCH COUNCIL.  
(National Research Council of Canada, Toronto) C-2422, 2 March 1943.

ABSTRACT: Final stages in the construction of the human centrifuge and its electronic control are described.

797

Cassen, B., L. Curtis, and K. Kistler 1950  
INITIAL STUDIES ON EFFECT OF LABORATORY-PRODUCED AIR BLAST ON ANIMALS.  
J. Aviat. Med. 21:38-47

ABSTRACT: Simple equipment was developed for subjecting mice to a controlled airpressure pulse produced by bursting a diaphragm, separating the test chamber from a high pressure compartment. Twenty mice per hour may be tested, including autopsy for gross damage and recording the degree of lung hemorrhage produced by the blast. Preliminary observations have been made on 4000 mice. Degree of lung hemorrhage was dependent upon blast pressure, volume of compression compartment, spatial orientation, previously induced x-ray irradiation, and premedication with some Vitamin P-like compounds. (from AUTHOR'S SUMMARY)

798

Cassen, B., K. Kistler and W. Mankiewicz 1952 SOME EFFECTS OF AIR BLAST ON MECHANICALLY CONSTRAINED MICE.  
J. Aviation Med. 23(2)120-129.

ABSTRACT: Mice were held on heavy plates by attaching their feet with Scotch tape. The plates were suspended vertically at various distances from an explosive charge which was detonated. A large proportion of the mice died, gasping for breath, within 10-15 minutes after blast exposure. Autopsies showed that the mice killed had their lungs swollen to 2-3 times their normal average. Determinations were made of hemoglobin content (hemorrhage) and weight of the lungs. In another experimental series, the mice had parts of their bodies, either thorax or head, shielded during blast exposure. Shielding of the thorax did not reduce the incidence of swollen lungs but shielding of the head did reduce it. The authors conclude that the swelling (edema) of the lung was due not to direct injury of the lung but to injury of the brain (probably hypothalamic region).

799

Cassen, B., K. Kistler, and W. Mankiewicz 1952 LUNG HEMORRHAGE PRODUCED  
IN HEPARINIZED MICE BY AIR BLAST.  
J. Aviation Med. 23:115-119, 185.

ABSTRACT: Mice were heparinized (to prevent clotting of the blood) and then exposed to air blast in a special laboratory apparatus. The amount of pulmonary hemorrhage which resulted from this exposure was determined (method is described in detail) 1, 15, or 25 minutes after the experiment. The results indicate that bleeding was moderate for the first 15-20 minutes and more severe after that period of time. The authors conclude that there is a hemostatic mechanism (probably vasoconstriction) in the lung tissue which prevents severe bleeding for a limited time. If no clotting takes place, profuse hemorrhage occurs after hemostasis wears off.

800

Cassen, B., P. Kalian and H. Gass 1952 HIGH SPEED PHOTOGRAPHY OF THE MOTION  
OF MICE SUBJECTED TO LABORATORY-PRODUCED AIR BLAST  
J. Aviation Med. 23(2):104-114.

ABSTRACT: An apparatus is described by which the behavior of unconstrained mice subjected to air blast may be analyzed in high-speed motion pictures (2,400 frames per second). The part of the body which is struck first by the blast wave, is violently accelerated before the other parts start moving. There is much compression and distortion of the body before the animal flies off in a twisting and rotating motion.

801

Cassen, B., H. Gass and K. Kistler 1954 COMPARATIVE EFFECTS OF HIGH EX-  
PLOSIVE BLAST ON MECHANICALLY CONSTRAINED MICE AND RATS.  
J. Aviation Med. 25:123-127.

ABSTRACT: Field tests were conducted by subjecting both mice and rats simultaneously to dorsally incident air blast while their feet were loosely taped or tied to  $\frac{1}{4}$ -inch-thick steel plates. The technique was the same as that described for mice previously. It was found that although the weights of the animals differed by a factor of about ten, the relative degree of pulmonary edema produced in the rats and mice at the same position was the same; also, the pressure range producing lethality was the same for the two types of animals. (Author)

802

Cassidy, William B. 1961  
PERSONAL RESTRAINT AND IMPACT SYSTEMS FOR FLIGHT CAPSULES.  
(Paper, Symposium on Biomechanics of Body Restraint and Head Protection,  
Naval Air Material Center, Philadelphia, Penn. June 14,15).

ABSTRACT: In conjunction with the development of a capsule system for the F8U aircraft, a program was conducted to design a pilot restraint and impact system capable of preventing injury to the pilot during normal flight operation and emergency escape. The restraint system complied with the over-all capsule design philosophy to unburden the pilot of personal environmental protective equipment and at the same time provide effective restraint. Other design criterias included self attachment, simplified adjustment and lightweight easy operating hardware. Acceleration loads were determined for the critical separation, boost, recovery, and impact phases. Based on these load requirements, various restraint system configurations were designed and comparatively evaluated with existing systems considering such features as effectiveness, comfort, ease of ingress and egress, complexity, weight, etc. The use of a non-ejectable mesh seat permitted many design innovations to the restraint system unattainable with conventional ejection seat installation. Impace loads on the pilot were maintained within tolerable limits by using such devices as automatic restraint take-up, two position seat and capsule bridle attachment, properly sized recovery parachutes, inherent energy absorption characteristics of the aircraft structure and a contoured seat. Details of this research and development program will be presented, including conclusions and recommendations.

803

Castor, J.G.B. n.d. STUDIES ON AVIATION MEDICINE (THE X SECTION OF THE  
NATURAL RESEARCH COUNCIL OF JAPAN)  
In List and Dispostion of Documents Collected by the Aero-Medical Section,  
Air Technical Intelligence Group (ATIG Report No. 241)

804

Castor, John G.B. 1946 LIST OF JAPANESE AERO-MEDICAL RESEARCH PUBLICATIONS,  
CONTENT AND DISPOSITION  
(Air Technical Intelligence Group, Advanced Echelon, FEAF Air Materiel Command,  
Wright-Patterson Air Force Base, Dayton, Ohio) Report No. F-IR-91-RE.  
ASTIA ATI 26 382

ABSTRACT: Two lists of Japanese Aero-medical research publications are given. One is a list of documents in the hands of Japanese nationals and the other is a list of documents collected by the Aero-Medical section, Wright Field.

805

Castor, J.G.B 1946 ACCELERATION (G-FORCE) RESEARCH EQUIPMENT, STUDIES, RESULT AND TRAINING. (Hq., AMC, Wright-Pat. AFB, Ohio) Air Tech. Intelligence Review Rept. F-IR-127-RE, December  
ASTIA ATI No. 12710

ABSTRACT: In order to observe the changes of the intermediary carbohydrate metabolism produced by centrifugal effects in the direction of feet toward head or head toward feet, rabbits were subjected to centrifugal forces of 10g for 10 seconds in various directions, and the changes in blood sugar and lactic acid were determined. Furthermore, the influence on the above changes by anesthetics (urethane and luminal), as well as by vegetative nerve stimulants (pilocarpine, atropine, adrenlin, and ergotamine) and by vagotomy, was analyzed.

From the experimental results it may be concluded that hyperglycemia and hyperlactacidemia which are gradually produced by centrifugal effects in the directional of feet toward head or head toward feet, and persist for 1-1/2 hours after stopping the centrifugal action are probably due to the fact that the vegetative nerve center or the control center of the carbohydrate metabolism in the midbrain are irritated by the centrifugal forces. This stimulus, in turn, is transmitted to the liver via the sympathicus, where it results in the splitting of glycogen. It was furthermore pointed out that hyperlactacidemia which occurs immediately after stopping the centrifugal action in direction of head towards feet, and which is intensive but transitory, must be of peripheral and not of central origin.

806

Castor, J.G.B. 1956 ACCELERATION (G FORCES) RESEARCH, EQUIPMENT STUDIES, RESULTS AND TRAINING (Air Materiel Command, Wright-Patterson AFB, Ohio) Intelligence Rev. Report No. F-IR-127-RE, December 1956

807

Cathcart, W. T., Jr. 1959 AN ORBITAL SIMULATOR  
In 1959 Proceedings of the Institute of Environmental Sciences, Annual Technical Meeting, April 22-24, 1959, La Salle Hotel, Chicago, Illinois  
(Institute of Environmental Sciences, Mt. Prospect, Ill.) pp. 68-70

808

Catling, F.P. 1958 TRENDS IN NAVAL AVIATION INJURY PATTERNS.  
(U.S. Naval Air Station, Aero-Medical Department, Norfolk, Va.)  
Rept. No. AM 3-59, Oct. 1958. ASTIA AD 227 326.

SUMMARY: Data from the Naval Aviation Safety Center were accumulated from accident reports from the close of World War II (1946) through 1958. The data were examined and tabulated by specific accident type, phase, and damage classifications in current use at the Safety Center. Corresponding tables were constructed for fatal injuries. In addition, the data were developed for bailouts and ejections and their related injury patterns.

Taking the data in their entirety, they indicated that there has been a gradual shift over the years in the aircraft accident pattern. For instance, changes in the type of accidents, the phases in which they begin, the methods of escape and so forth, are occurring. Perhaps because of a universal inability to develop a satisfactory classification system, inadequate reporting procedures, or perhaps because it does not exist, practically no shifting is discernible in the patterns of injury, with one exception. This exception has been the steady increase in the proportion of fatal injuries which has grown steadily over the years in Naval Aircraft accidents.

809

Cattell, McKeen 1936 THE PHYSIOLOGICAL EFFECTS OF PRESSURE  
Biol. Rev. 11(4):441-476.

810

Cawthorne, T. 1959 VERTIGO.  
Proc Roy Soc Med 52:529-36, July 1959

811

Ceausu, V. 1960 PSYCHOLOGICAL PROBLEMS OF FLIGHT. (Problemele Psihologice ale Zborului) Revista de Psihologie (Bucuresti). 6(3):95-114. (In Rumanian, with French summary, p. 113).

812

Celander, H., C-J. Clemedson, U.A. Ericsson & H. Hultman 1955  
THE USE OF A COMPRESSED AIR OPERATED SHOCK TUBE FOR PHYSIOLOGICAL BLAST RESEARCH. Acta Physiol. Scand. 32:6-13.

813

Celander, H., C-J. Clemedson, U. A. Ericsson & H. Hultman 1955  
A STUDY ON THE RELATION BETWEEN THE DURATION OF A SHOCK WAVE AND THE SEVERITY OF THE BLAST INJURY PRODUCED BY IT. Acta Physiol. Scand. 33:16-18.

814

Černoch, O. and M. Kopecký 1951 NĚKTERÉ POZNATKY ZVYSETŘOVÁNÍ  
CVICENCU VYSADKOVÝCH ODDILU SOKOLA (Certain Observations On Examination  
of Young Parachutists)  
Vojenské Zdravotnické Listy, Prague, 20:108-111, May-June 1951

815

Chae, E. U. 1957 THE INFLUENCE OF TEMPERATURE UPON THE TOLERANCE OF MICE TO POSITIVE RADIAL ACCELERATION. J. Av. Med. ROKAF. 5(1).

816

Chaffee, J. W. 1961 THE EFFECT OF ACCELERATION ON HUMAN CENTERS OF GRAVITY. (General Dynamics Corp., Fort Worth, Tex.) Rept. no. FZY-013  
ASTIA AD 271 613

ABSTRACT: The location in two-dimensional (x-z) space of the center of gravity of the seated human body was studied on 25 living male subjects under conditions of experimentally controlled changes in the angle at which a 1 g acceleration acted upon the completely restrained body. Varying the direction of acceleration from 15 degrees through 80 degrees, measured from the torso axis forward, produced a migration of the group average center of gravity along a curved path of 2.15 seconds arc length, a consistent rotation of the axis of maximum individual variability from 10 degrees 53 minutes aft of the torso axis to a maximum forward angle of 90 degrees 16 minutes, and a characteristic fluctuation in absolute size of the individual variation about the group average. The practical applications of these findings to the design of rocket-powered systems (e.g., escape capsules) is discussed. (Author)

817

Chaffee, J.W. 1962 CHANGE IN HUMAN CENTER OF GRAVITY PRODUCED BY CHANGE IN DIRECTION OF ACCELERATION. ARS Journal, 32 (11): 1677-1680, November 1962

ABSTRACT: The two-dimensional location of the center of gravity of the seated human body was studied on 25 male subjects under conditions of experimentally controlled changes in the angle at which a 1-g acceleration acted upon the completely restrained body. It was found that varying the direction of the simulated acceleration vector from 15° through 80°, measured from the torso axis forward, produced: (1) a migration of the group average center of gravity along a curved path of 2.15-in. arc length; and (2) a consistent rotation of the axis of maximum individual variability ( supposed "optimum" thrust vector) from 10° 53' aft of the torso axis to a maximum forward angle of 90° 16'. Speculation concerning the practical applications of these findings to the design of rocket-powered systems (e.g., escape capsules) is presented. (Author's summary)

818

Chamberlain, N. E. and H. S. Overman 1952 PERSONNEL EJECTION CATAPULT TESTING DEVICE  
(U. S. Naval Proving Ground, Dahlgren, Va.)  
Report No. 915, 25 Jan. 1952. ASTIA ATI-139 471

ABSTRACT: This is the final report on a series of exploratory firing tests

conducted to investigate experimentally the ballistic characteristics of a personnel ejection catapult. Sixty rounds were fired in a test model of the catapult, during which variations were introduced in the length of stroke, catapulted weight, types of propellant, weights of charge and booster, and initial volume. The effects of variables on ballistic performance were recorded on high-frequency-response cathode-ray oscillograph equipment and are presented herein. Also included is an analysis of the theoretical performance of an ideal catapult, from which are derived criteria for the evaluation of the actual performance.

The performance of the Personnel Ejection Catapult Test Model, as reflected in the ratio of ejection velocity to maximum acceleration, is consistently within the range from 91% to 97% of ideal performance, and is relatively insensitive to the variations in propellant types, boosters and initial volumes which were used in these tests.

819

Chambers, A. N. 1957 HUMAN FACTORS CONSIDERATIONS IN THE SIMULATION OF ACCELERATION FORCES IN FLIGHT TRAINERS AND SIMULATORS (Dunlap and Associates Report, Stanford, Connecticut) ASTIA AD 110 604

820

Chambers, R. M. n.d. EFFECTS OF G ENVIRONMENTS ON PSYCHOMOTOR ABILITIES NADC-MA-6121. (Unpublished).

821

Chambers, R. M. and R. G. Lathrop n.d. CONSIDERATIONS IN TESTING FOR INTELLECTUAL IMPAIRMENT DUE TO ACCELERATION NADC-MA-6125 (Unpublished)

822

Chambers, R.M. and H.V. Doerfel 1959 CLOSED-LOOP CENTRIFUGE SIMULATION OF SPACE VEHICLE PERFORMANCE. (Paper presented at ARS semi-annual meeting, 8-11 June 1959, San Diego) ARS paper no. 807-59

ABSTRACT: This paper presents the development of some closed-loop human centrifuge simulations of proposed space vehicles, and presents some applications of these simulations to human factors problems anticipated in specific space maneuvers.

823

Chambers, R. M., & J. G. Nelson 1960 PILOT PERFORMANCE CAPABILITIES DURING CENTRIFUGE SIMULATIONS OF BOOST AND RE-ENTRY. (Paper, American Rocket Society, 15th Annual Meeting, 5-8 Dec. 1960, Washington, D. C.) ARS Paper No. 1401-60

ABSTRACT: Presents 9 principles concerning the effects of acceleration on human performance. These principles are derived from centrifuge experiments in which human subjects were exposed to acceleration environments which were designed to simulate three basic types of proposed space vehicles. These principles deal with the areas of : performance tolerance, practice effects restraint system, individual differences, control system, control feedback, task difficulty level, display characteristics, and higher mental process.

824

Chambers, R. M. 1960 HUMAN PERFORMANCE CAPABILITIES IN HIGH G ENVIRONMENTS (Presented at Amer. Psychol. Assn. Convention, Chicago, Illinois. 1-7, September 1960)

825

Chambers, R. M. 1960 EFFECTS OF G ENVIRONMENTS ON PSYCHOMOTOR ABILITIES (Paper, 31st Annual Meeting of the Aerospace Medical Association, Americana Hotel, Bal Harbour, Miami Beach, Fla., May 9-11, 1960)

ABSTRACT: The psychomotor abilities of the human pilot were tested in a series of 211 closed loop centrifuge runs in which the primary  $A_z$ ,  $-A_x$ , and  $+A_xG$  vectors and their combinations were systematically varied so as to produce a series of steady-state G fields. During specific flight co-ordination and tracking maneuvers, psychomotor task difficulty levels and acceleration amplitudes were also varied. Physiological and performance recordings were obtained simultaneously during each run. Piloting opinion regarding sensations and perceptions, breathing and visual symptoms, effects on control motions, and adequacy of restraint systems were also obtained from each pilot. An analysis of the various quantitative recordings resulted in a comparison of the effects of each experimental variable on specific psychomotor and physiological components. Performance tolerance curves were constructed which reflect the deterioration of piloting capabilities as a function of (1) G-vectors and their combinations, (2) acceleration amplitude, and (3) task difficulty.

826

Chambers, R. M., et al 1961 THE EFFECTS OF WATER IMMERSION ON PERFORMANCE PROFICIENCY (Naval Air Development Center, Aviation Medical Acceleration Lab., Johnsville, Pa.) NADC-MA-6133, 22 Aug. 1961.

ABSTRACT: In an attempt to study a wide range of human performance abilities

associated with weightlessness and the transition from weightlessness to high G reentry environment, the technique of water immersion and centrifugation was used to simulate these conditions. Six male subjects were immersed in water to the neck level for a 12-hour period and one subject for a 23-hour period. Eight selected performance tasks were administered: (1) before immersion, (2) during immersion, (3) after immersion and centrifugation so that gross motor and perceptual behavior could be sampled. It was found that behavior was not apparently affected by prolonged water immersion followed by reentry type accelerations.

827

Chambers, Randall M. 1961  
CONTROL PERFORMANCE UNDER ACCELERATION WITH SIDE-ARM ATTITUDE  
CONTROLLERS  
(U.S. Naval Air Development Center, Johnsville, Pennsylvania)  
NADC-MA-6110. November. ASTIA AD-269 487

ABSTRACT: This paper presents some procedures, data, and conclusions based on several closed-loop centrifuge experiments in which side-arm controllers were used by pilots to perform specific control tasks. Under certain conditions the pilots could perform as well in adverse acceleration fields as they could statically, even though they were exerting much more physical effort and psychological concentration, and they were enduring visual impairment, chest pains, breathing difficulties, and other stressful effects of acceleration. The pilots demonstrated a remarkable ability to adapt to physiologically severe acceleration environments, and they maintained control performance within acceleration time history profiles which contained vectors with amplitudes as high as  $+15 G_x$ ,  $-7G_x$ . Some closed-loop human centrifuge simulations were conducted which provided human factors data which may have application to the design and evaluation of side-arm controllers for use within proposed space vehicles.

828

Chambers, R. M. & J. G. Nelson 1961 PRINCIPLES CONCERNING PILOT  
PERFORMANCE IN CENTRIFUGE SIMULATIONS OF SPACE VEHICLES.  
(Aviation Medical Acceleration Lab., Naval Air Development Center,  
Johnsville, Pa.) Rept. No. NADC-MA-6143, 22 December 1961.  
ASTIA Doc. No. AD-270 282.

ABSTRACT: This report presents 9 principles concerning the effects of acceleration on human performance. These principles were derived from centrifuge experiments in which human subjects were exposed to acceleration environments designed to simulate three basic types of proposed space vehicles. These principles deal with the areas of: (1) performance tolerance, (2) practice effects, (3) restraint system, (4) individual differences, (5) control system, (6) control feedback, (7) task difficulty level, (8) display characteristics, (9) higher mental processes. The need for research on the effects of acceleration variables other than peak G and direction of G is noted, as is the problem of interaction between variables. (Author)

829

Chambers, R. M. & J. G. Nelson 1961 PILOT PERFORMANCE CAPABILITIES  
DURING CENTRIFUGE SIMULATIONS OF BOOST AND RE-ENTRY.  
ARS J.31(11):1534-1541, Nov. 1961.

ABSTRACT: One part of a human factors research effort that has been concerned with the human performance capabilities of pilots during accelerations experienced during boost, orbit, and re-entry rocket flight trajectories is summarized. Ss are 38 men who collectively received over 2,600 closed loop centrifuge exposures. Some of the conclusions reached are formulated as general principles dealing with areas of: 1) performance tolerance, 2) practice effects, 3) restraint system, 4) individual differences, 5) control system, 6) control feedback, 7) task difficulty level, 8) display characteristics, and 9) higher mental processes. Other research needs are noted. (Tufts)

830

Chambers, R. M. et al 1961 CHANGES IN PERFORMANCE PROFICIENCY UNDER  
CONDITIONS SIMULATED BY WATER IMMERSION AND CENTRIFUGATION.

ABSTRACT: An attempt was made to investigate changes in piloting proficiency and related human performance under gravitational conditions simulated by water immersion and centrifugation. Seven dimensions of human ability felt to best reflect the influence of these gravitational environments were studied: (1) tracking, (2) G-tolerance, (3) target aiming, (4) positioning, (5) complex discrimination-reaction time, (6) complex coordination, and (7) time estimation. Two separate experiments, a neck level immersion and complete immersion experiment, were performed each using six male subjects immersed for periods up to twelve hours. Before and after reduced gravity simulation in a water tank, the subjects were exposed to a 8 G re-entry profile produced by a human centrifuge. Changes in piloting skill level and in related performance capabilities were found. (Aerospace Med. 32(3):225, March 1961)

831

Chambers, R. M. 1962 PROBLEMS AND RESEARCH IN SPACE PSYCHOLOGY.  
(Aviation Medical Acceleration Lab., Naval Air Development Center,  
Johnsville, Pa.)  
NADC-MA-6145, 24 April 1962. ASTIA AD 275 830

ABSTRACT: The scientific literature on the psychological aspects of space flight is reviewed in the following areas: (a) psychological requirements for man in space, (b) sensing and perceiving (c) perceptual and motor skill performance, (d) cognitive processes and other higher mental abilities, (e) personality and emotional behavior, (f) psychological aspects of astronaut selection, and (g) psychological conditioning and training. (Author)

832

Chambers, R. M., W. F. Augerson, R. Kerr, & D. A. Morway 1962 EFFECTS OF POSITIVE PRESSURE BREATHING ON PERFORMANCE AND PHYSIOLOGY DURING ACCELERATION (Paper, 33rd Annual Meeting of Aerospace Medical Association, Atlantic City, N. J., 9-12 April 1962) Abstract: Aerospace Medicine 33(3):331, Mar.1962

ABSTRACT: Statistical analysis of results from two experiments indicated that breathing positive pressure oxygen facilitated performance during exposure to transverse (+Gx) and positive (+Gz) acceleration stress. In the first experiment, five test pilots were required to perform an orbital tracking task during steady-state accelerations ranging from 6 to 12 +Gx while breathing 100% oxygen under pressure and under control conditions of normal breathing. In the second experiment, six other subjects were required to perform a visual brightness discrimination task during exposure to steady-state accelerations ranging from 1 to 7 +Gx and from 1 to 5 +Gz. Effects on visual brightness discrimination were recorded under comparable breathing conditions. There were major individual differences in response to the effects of acceleration during pressure breathing. Analyses of the performance and piloting opinion data indicated beneficial effects on performance and pilot comfort from breathing 10% oxygen under pressure at the higher acceleration levels. (AUTHOR)

833

Chambers, R.M., R. Kerr et al. 1962 EFFECTS OF POSITIVE PRESSURE BREATHING ON PERFORMANCE DURING ACCELERATION. (Aviation Medical Accel. Lab., Naval Air Development Center, Johnsville, Pa.) Report No. NADC MA-6205, ASTIA AD-298 009

ABSTRACT: The effects of positive pressure breathing of 100% oxygen were evaluated in terms of increasing man's ability to perform a complex psychomotor task during sustained accelerations of 6, 8, 10, and 12 transverse G, and in terms of visual brightness discrimination requirements during sustained accelerations of 1, 2, 3, 5, and 7 transverse G, and 1, 2, 3, and 5 positive G. In addition, subjective reports regarding comfort and performance were obtained during all acceleration conditions. Details of the test results are included in this report.

834

Chambers, R. M., R. Kerr, W. S. Augerson, and D. A. Morway 1962 EFFECTS OF POSITIVE PRESSURE BREATHING ON PERFORMANCE DURING ACCELERATION. (U. S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-6205 July 2, 1962

ABSTRACT: The effects of positive pressure breathing of 100% oxygen were evaluated in terms of increasing man's ability to perform a complex psychomotor task during sustained accelerations of 6, 8, 10 and 12 transverse G, and in terms of visual brightness discrimination requirements durin sustained accelerations of 1, 2, 3, 5, and 7 transverse G, and 1, 2, 3, and 5 positive G. In

addition, subjective reports regarding comfort and performance were obtained during all acceleration conditions. The following tentative conclusions are suggested: (a) At 6, 8, and 10  $G_x$  no differences in ability to perform a complex three-dimensional psychomotor task were observed. However, at 12  $G_x$  there were definite suggestions that performance under conditions of positive pressure breathing of 100% oxygen was superior to normal (atmospheric) breathing of 100% oxygen. (b) Subjectively, the pilots reported that positive pressure breathing of 100% oxygen was superior to the condition of normal breathing of 100% oxygen in terms of breathing ease and general comfort. (c) During transverse accelerations at 1, 2, 3, 5, and 7  $G_x$ , significantly less lighting contrast was required at 5  $G_x$  for the condition of positive pressure breathing of 100% oxygen as compared with breathing 100% oxygen without pressure or normal air. (d) During transverse acceleration, both positive pressure breathing of 100% oxygen, and normal breathing of 100% oxygen, precluded the necessity of an increase in brightness contrast which was necessary for normal air conditions. (e) During positive accelerations at 1, 2, 3, and 5  $G_z$ , positive pressure breathing of 100% oxygen required significantly less lighting contrast at 3  $G_z$  than did either normal breathing of 100% oxygen or breathing normal air. (f) Subjectively, all subjects reported that positive pressure breathing of 100% oxygen was superior to the condition of normal breathing of 100% oxygen in terms of breathing ease and general comfort during exposure to transverse accelerations of 5 and 7  $G_x$  and to positive accelerations of 3 and 5  $G_z$ .  
(Author)

835

Chambers, R. M. and J. C. Ferguson 1963 PRELIMINARY COMPARISON OF HUMAN CENTRIFUGE CAPABILITIES IN THE UNITED STATES. (Letter report concerning) (U. S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6304

ABSTRACT: This report contains a chart to provide a convenient comparison of nine centrifuges, in existence or approved for construction, in terms of the following features: arm, main drive, radial G, gondola, payload, degrees of freedom, gimbals, availability of closed-loop operation, gondola environments, slip rings, and availability. Entries are based on the best available information as of 12 March, 1963.

836

Chambers, R.M. 1963 EFFECT OF ACCELERATION ON PILOT PERFORMANCE. (Aviation Medical Acceleration Lab., Naval Air Development Center, Johnsville, Pa.) NADC MA 6219, 26 March 1963. ASTIA AD 408 686

ABSTRACT: This report attempts to consolidate the findings of previous research in the area of acceleration effects upon performance and to relate these findings to basic piloting behaviors. The decrements in the visual, psychomotor response and intellectual processes which have been found to accompany acceleration stress are quantified where possible. Both transverse and positive accelerations have been shown to raise the level of contrast

required for visual brightness and to reduce general acuity at acceleration loads well below those which result in gross visual impairment. Similar impairments in discrimination response rates are also discussed. The techniques thus far used to assess higher mental ability under acceleration are presented as are some of the problems which complicate such measurements. Data from such studies are presented to illustrate the reduction in immediate memory and information processing capabilities of pilots experiencing both high level, short term and moderate, extended accelerations. (Author)

837

Chambers, R. M. 1963 LONG-TERM ACCELERATION AND CENTRIFUGE SIMULATION STUDIES  
(Naval Air Development Center, Aviation Medical Acceleration Lab., Johnsville, Pa.) April 11, 1963.

ABSTRACT: Some of the major effects of long-term acceleration on human performance and physiology are reviewed. Also, some of the results of recent centrifuge simulation studies of manned spaceflights and proposed spacecraft are presented. The paper is primarily concerned with the results of studies conducted on the Aviation Medical Acceleration Laboratory (AMAL) Human Centrifuge in support of NASA and USAF space projects. The problems of acceleration-nomenclature is outlined, and following Gauer's procedure, long-term acceleration is defined as any acceleration stress lasting longer than ten seconds. Physiological tolerance to  $+G_x$ ,  $+G_z$ ,  $-G_x$ , and  $-G_z$  acceleration vectors are discussed and it is pointed out that in addition to physiological tolerance limits, there are also performance tolerance limits which define the reliable functioning of any particular overt behavior system during acceleration. Major concepts in protection are discussed, recent work on contour couches studied on the AMAL centrifuge is reviewed, and a newly-developed universal contour couch is described. Some of the basic principles of centrifuge simulation of several types of space vehicles are outlined, and the use of the AMAL centrifuge in astronaut training is reviewed. Also, the effects of various acceleration profiles on visual and auditory performance, discriminating and responding, complex psychomotor skill performance, and higher mental functioning are discussed. (N63-19313)

838

Champlin, G. A. and E. S. Wilbarger 1959 BIO-FLIGHT PROJECT 2B REVISION I. REPORT FOR 10 SEPT. 1958 - 10 JULY 1959.  
(Army Medical Services Research and Development Command, Ft. Knox, Ky.)  
Rept. no. CSCRD-16 ASTIA AD 227 227

ABSTRACT: Primates have been successfully recovered following ballistic missile flight. The results assured environmental conditions to be adequate for the comfort of human travelers. A detailed preliminary inspection of the results in terms of biological measurements is included. Monkey Baker was said to be in excellent health. The autopsy performed on rhesus monkey Able revealed

no morbid pathology resultant from her flight. Physiological well-being under conditions of restraint, isolation, artificial environment and ballistic missile acceleration, weightlessness, spin, deceleration, and impact for a high phylogenetic order of research animal has been proven. Consciousness for monkey Able was proven past the peak decelerative force of re-entry on the in-flight films. All facets of medical preparation and engineered equipment, however, need detailed analysis and design refinement.

839

Champney, W. B., J. B. Athans, & C. D. Mayerson 1961 A STUDY OF HYPERSONIC AERODYNAMIC DRAG DEVICES. (Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio) WADC TR 59-324, Part II; ASTIA AD-272 013

ABSTRACT: A two-phase study of hypersonic zero-lift drag devices which could be used to recover space vehicles re-entering the earth's atmosphere has been made. The results of the first theoretical phase, which are summarized in an interim report, indicate that variable area drag devices produce less heating and deceleration than a fixed-area device of the same maximum size. Also, for a fixed-drag device, minimum peak decelerations occur with  $C_{D A/W}$  of 0.10. In this second test phase, various drag device models were tested at hypersonic speeds. Good agreement was found in heating and drag on simple shapes. Heat distributions and drags were determined for a number of complex shapes and some parametric relationships were established. Criteria for selecting an optimum device were also established. (AUTHOR)

840

Chance Vought Aircraft 1959 TYPICAL ACCELERATION LOADS IMPOSED ON PILOTS DURING CATAPULTING AND ARRESTING. (Chance Vought Aircraft Inc., Dallas Tex.) Report No. 1, CVA 39,169

841

Chance Vought Aircraft 1959 ANTICIPATED ACCELERATION LOADS ON PILOTS OF 1963-65 AIRCRAFT. (Chance Vought Aircraft Inc., Dallas, Tex.) Enclosure (5) to AER-E9M-677, Dec. 1959.

842

Chance Vought Aircraft 1959 PHYSIOLOGICAL AND PSYCHOLOGICAL CONSIDERATIONS FOR MANNED SPACE FLIGHT (Chance Vought Aircraft, Inc., Dallas, Tex.) CVA Rept. No. E9R-12349, 7 July 1959.

843

Chance Vought Astronautics 1960, MANNED SPACE FLIGHT SIMULATOR FACILITY.  
(Vought Astronautics, Dallas, Texas) Report No. AST/EOR-12965,  
May 1960

844

Chance Vought Aircraft 1960 INTEGRATED FLIGHT CAPSULE - PILOT SEAT.  
(Chance Vought Aircraft, Inc., Dallas, Tex.)  
CVA Report No. AER-EOR-12828

ABSTRACT: This report discusses the Pilot's Seat Study accomplished during preliminary design of the Integrated Flight Capsule. The study began as a simple replacement of the ejection seat with a light-weight pilot's seat, but recommendations resulting from the blackout protection study caused the study to be directed toward the design of a supinating pilot's seat. The research trade studies, and mockups lead to the final design of a tubular frame stainless steel mesh seat. It is concluded that supinating pilot's seat would be a comfortable and useful device once tested and qualified. Further studies are recommended to qualify the seat for service use.

845

Chance Vought Aircraft 1960 INTEGRATED FLIGHT CAPSULE - PILOT RESTRAINT  
(Chance Vought Aircraft, Inc., Dallas, Tex.)  
CVA Report no. AER-EOR-12829, 25 March 1960

ABSTRACT: This report discusses the pilot restraint system study accomplished during the preliminary design of the Integrated Flight Capsule. Present day pilot restraint systems were evaluated, and methods of eliminating their major deficiencies investigated. However, the majority of the study effort was directed towards the design of an optimum pilot restraint system. The integration of the pilot restraint and the pilot's flight garment was developed for several of the more promising methods of restraint. A mock-up of these methods used in the mock-up appear to be feasible methods of pilot restraint when used in conjunction with an integrated flight garment. Several of the pilot restraint methods considered appear to warrant further development toward providing the pilot with an optimum restraint system. This study was not concerned with the design of the garment; however, it was given consideration during the design of the system. Several studies in the area of head restraint are presented. These studies are suggested methods of head restraint which will support the head in the event high loads are experienced, while keeping at a minimum restriction of head movement during the long periods when head restraint is not required.

846

Chance Vought Aircraft 1960 INTEGRATED FLIGHT CAPSULE - IMPACT & FLOTATION  
BAG INFLATION SYSTEM  
(Chance Vought Aircraft Inc., Dallas, Tex.)  
CVA Report no. AER-EOR-12836, 25 March 1960

ABSTRACT: This report describes the studies made, system selected for inflation of the impact bags and flotation bags used on the integrated flight capsule. Three different types of inflation systems were investigated. The single air bottle, single pressure regulator system, requires extremely large lines to achieve desired results. A system using a single air bottle with a pressure regulator at each bag allows use of smaller lines, but the required inflation time of 3 seconds is not feasible using the proposed 900 cu. in. air bottle. Both of these systems can be designed; however, calculations are presented only to the point that the assumptions made for system design are insufficient to meet established criteria. The system recommended for this application is individual air bottles with no pressure regulators. The most apparent advantage of this system is insurance against loss of the entire recovery system in the event of failure of one bag.

847

Chance Vought Aircraft 1960 STRUCTURAL DESIGN LOADS  
(Chance Vought Aircraft, Inc., Dallas, Tex.)  
CVA Report no. AER E9R-12581 - CONF, 25 March 1960.

ABSTRACT: The structural design loads on the fuselage and stabilizing fins of the F8U-1 flight test capsule are presented.

The applied loads resulting from the capsule recovery system are also shown. Included are the parachute loads, boost rocket loads and landing impact loads. Procedures and criteria used in determining design conditions are discussed. A procedure for defining the maximum allowable combination of accelerations on the man is shown.

848

Chance Vought Aircraft 1960 SUMMARY OF INTEGRATED FLIGHT CAPSULE PARACHUTE  
RECOVERY SYSTEM PROGRAM.  
(Chance Vought Aircraft, Inc., Dallas, Tex.)  
CVA Report No. AER-E9R-12446, 25 March 1960. ASTIA AD 263 508

ABSTRACT: This report contains a review of the work accomplished to date on the recovery system for the Integrated Flight Capsule and outlines a program that would permit concurrent development of the recovery system and the capsule. The preliminary design parameters, established in previously completed feasibility studies, are included for information. The report includes a general summary of all the other sections which comprise the total report submitted under Bureau of Naval Weapons contract NOa(s)59-6150-c.

849

Chance Vought Aircraft 1960 INTERIM REPORT ON PARACHUTE RECOVERY AND IMPACT SYSTEMS

(Chance Vought Aircraft, Inc., Dallas, Tex.)

CVA Report No. AER-E9R-12582, 25 March 1960.

ABSTRACT: This interim report contains information on the parachute recovery system for the Integrated Flight Capsule flight test vehicle. The various energy absorption systems investigated for the landing impact condition are also discussed.

850

Chance Vought Aircraft 1960 PHYSIOLOGICAL REQUIREMENTS, INTEGRATED FLIGHT CAPSULE.

(Chance Vought Aircraft, Inc., Dallas, Tex.)

CVA Report No. AER-EOR-12841, 25 March 1960.

ABSTRACT: The improvement of the pilot environment in the Integrated Flight Capsule required definition of the physiological capabilities and limitations of the man. This was accomplished for cabin pressure, atmosphere composition, temperature, ventilation rate, environmental toxicity, accelerations, noise, vibration, body restraint, oscillation and tumbling, pilot incapacitation sensing, vision, thermal radiation effects, and body waste removal. The physiological requirements presented assumed that no personal protective equipment is worn.

851

Chance Vought Aircraft 1960 PILOT ACCELERATION PROTECTION ON THE INTEGRATED FLIGHT CAPSULE

(Chance Vought Aircraft, Inc., Dallas, Tex.)

CVA Report no. AER-EOR-12843

ABSTRACT: A first approximation of accelerations the pilot might expect to encounter in airplanes in the 1963-65 period is made based on stresses recorded during a large number of flight hours on current airplanes. The recorded G-time patterns are analyzed statistically for frequency of occurrence and mean levels. These acceleration levels are adjusted according to predicted performance of future airplanes and when compared to native human tolerance, show a need for pilot protection.

Several methods of increasing G tolerance are noted, and the anti-G suit and supination (tilting the pilot backward) are selected as the most practical. A review is made of centrifuge experimentation which defines the debilitating effects of G stress and the degree of protection afforded by the anti-G suit and a supinating seat.

852

Chandler, Richard F. 1962 DETERMINATION OF EQUIVALENT NATURAL FREQUENCY INDICATED BY ACCELEROMETERS MOUNTED OVER THE STERNUM DURING HUMAN IMPACT IN THE G<sub>x</sub> DIRECTION  
(6571st Aeromedical Research Laboratory, Holloman Air Force Base, New Mexico)  
Project 7850, Task 785001, ARL-TDR-62-29, Dec. 1962

ABSTRACT: Analysis of 29 human impact tests in the G<sub>x</sub> position on the Daisy Decelerator indicated that the natural frequency of the response measured by sternum accelerometers varies inversely as the duration of the onset of the input deceleration. The value of the product of response frequency (cps) and onset duration (sec) is approximately 0.5. (AUTHOR)

853

Chang, S. S. L. 1957 AN AIRFRAME PITCH LINEAR ACCELERATION CONTROLLER.  
National Electronics Conference Proceedings 12:134-151

854

Chapman, D.R. 1958 AN APPROXIMATE ANALYTICAL METHOD FOR STUDYING ENTRY INTO PLANETARY ATMOSPHERES.  
(National Advisory Committee for Aeronautics, Washington, D.C.)  
NACA TN 4276, May 1958.

ABSTRACT: Study is made of the decelerations, heating rates, and total heat absorbed for entry into Venus, Earth, Mars, and Jupiter.

855

Chapman, D.R. 1958 DECELERATION DURING ENTRY INTO PLANETARY ATMOSPHERES.  
(National Aeronautics and Space Administration, Ames Research Ctr., Moffett Field, Calif.) (Paper presented at 2nd International Symposium on the Physics and Medicine of the Atmosphere and Space, San Antonio, Tex., Nov. 10-12, 1958). See also in Benson and Strughold, eds., Physics and Medicine of the Atmosphere and Space (New York: John Wiley & Sons, 1960) pp. 339-351.

ABSTRACT: An analytical method recently developed for computing the motion of an orbiting vehicle during entry into planetary atmospheres is applied to study the deceleration-time curves for various types of shallow entry. It is pointed out that the initial rate of onset of deceleration, following the period of weightlessness in orbit, can be alleviated considerably by certain types of entry which start near perigee with a slightly super-circular velocity. Deceleration-time curves for vehicles with various amounts of aerodynamic lift are presented for entry into Earth, Mars, Venus, and Jupiter.

856

Chapman, D.R. 1959 AN ANALYSIS OF THE CORRIDOR AND GUIDANCE REQUIREMENTS FOR SUPERCIRCULAR ENTRY INTO PLANETARY ATMOSPHERES.  
(National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.) NASA Technical Rept. R-55. ASTIA AD 228 509

ABSTRACT: The analysis of supercircular entry is developed around a new dimensionless parameter which combines certain conditions at the conic perigee altitude with certain characteristics of the vehicle; this parameter conveniently determines either deceleration limited or heating-limited corridor widths for elliptic, parabolic, or hyperbolic approach trajectories. Illustrative calculations of corridor widths and the associated guidance problems are presented for Venus, Earth, Mars, Jupiter, and Titan. Generalized curves are presented for application to various entry conditions.

857

Chapman, D.R. 1960 DECELERATION DURING REENTRY INTO PLANETARY ATMOSPHERES. In Benson, O.O., and H. Strughold, eds., Physics and Medicine of the Atmosphere and Space. (New York: John Wiley & Sons, 1960) pp. 339-351

858

Charles, J. P. 1955 FRACTURED VERTEBRAE IN U.S. NAVY AIRCRAFT ACCIDENTS. J. Aviation Med. 24:483-490.

SUMMARY: The fractured vertebrae sustained in U. S. Navy aircraft accidents involving pilots only were reviewed over the five year period from January, 1948. The causal factor in fractures other than compression fractures of the lumbar and thoracic was clear. Transverse process fractures generally followed violent swerving or cartwheeling during a forced landing. Cervical fractures of all types most frequently involved nose overs followed by acute flexion of the neck. The majority of cases were compression fractures of the lower thoracic and upper lumbar vertebrae. In general the aircraft either stalled or mushed into the ground or struck an embankment in a nose-high altitude during the initial part of the slide. The evidence appears to indicate that vertical forces acting through the seat bottom rather than acute flexion of the spinal column are causing the compression fractures of the thoracic and lumbar vertebrae.

859

Chason, J. L., E. S. Gurdjian, B. F. Haddad, & J. E. Webster 1955 CHANGES IN CELL STRUCTURE FOLLOWING SUDDEN INCREASES IN INTRACRANIAL PRESSURE. (Proceedings, 2nd International Congress Neuropathology, London, 1955)

860

Chason, J.L., W.G. Hardy, J.E. Webster, and E.S. Gurdjian 1957 ALTERATIONS IN CELL STRUCTURE OF THE BRAIN ASSOCIATED WITH EXPERIMENTAL CONCUSSION (Presented at Harvey Cushing Society Meeting, April 26, 1957)

861

Chason, J. L., E. S. Gurdjian, W. G. Hardy, & J. E. Webster 1958 ALTERATIONS IN CELL STRUCTURE OF THE BRAIN ASSOCIATED WITH EXPERIMENTAL CONCUSSION. J. Neurosurgery 15(2):135-139

862

Cherniack, N.S., A.S. Hyde, & F.W. Zechman 1959 THE EFFECT OF TRANSVERSE ACCELERATION ON PULMONARY FUNCTION.  
(Wright Air Development Ctr., Wright-Patterson AFB, Ohio)  
WADC TR 59-347, ASTIA AD 226 054.  
See also J. Appl. Physiol. 14(6):914-916, 1959.

ABSTRACT: Since difficulty with respiration limits tolerance to transverse acceleration, the effect of this acceleration on different respiratory factors was tested in 15 subjects experienced in riding the WADC human centrifuge. Minute volume, respiratory rate, tidal volume, maximum breathing capacity, 0.5 second times vital capacity and total vital capacity were measured after two and three minute durations at 3 and 5 g with the subject's trunk perpendicular to the centrifugal force and legs and knees flexed at 90 degrees. Vital capacity was reduced significantly at 3 and 5 g. Maximum breathing capacity was significantly reduced at 5 g. One-half second timed vital capacity represented an increasing fraction of total vital capacity as acceleration increased. Minute volume and respiratory rate also increased significantly at 5 g while tidal volume was essentially unchanged. The subjects show marked reduction in breathing reserve at moderate acceleration which indicates that respiration probably becomes ineffectual at higher g-levels in most subjects. After calculation of the Air Velocity Index of Gaensler and by use of Miller, Wu, and Johnson's four quadrant system, results are obtained which indicate that the nature of the predominant respiratory defect during forward acceleration is restrictive. Of the respiratory parameters measured, vital capacity showed the greatest decrement. Since vital capacity decreased at different rates in different subjects it may be useful in predicting performance during acceleration and might be of aid in crew selection. (Author)

863

Cherniack, N.S., A.S. Hyde, & F.W. Zechman 1959 THE EFFECT OF TRANSVERSE ACCELERATION ON PULMONARY FUNCTION.  
J. Appl. Physiol. 14(6):914-916  
See also (Wright Air Development Ctr., Wright-Patterson AFB, Ohio)  
WADC TR 59-347, ASTIA AD 226 054.

ABSTRACT: Since difficulty with respiration limits tolerance to transverse

acceleration, the effect of this acceleration on different respiratory factors was tested in 15 subjects. Minute volume, respiratory rate, tidal volume, maximum breathing capacity, 0.5-second timed vital capacity and total vital capacity were measured at 3 and 5 g with the subject's trunk perpendicular to the centrifugal force and legs and knees flexed at 90 degrees. Vital capacity was significantly reduced at 5 g. One-half-second timed vital capacity represented an increasing fraction of total vital capacity as acceleration increased. Minute volume and respiratory rate also increased significantly at 5 g while tidal volume was essentially unchanged. Results are obtained which indicate that the nature of the predominant respiratory defect during forward acceleration is restrictive. Of the respiratory parameters measured, vital capacity showed the greatest decrement.

864

Cherniack, N.S., A.S. Hyde, J.F. Watson & F.W. Zechman, Jr., 1961 SOME ASPECTS OF RESPIRATORY PHYSIOLOGY DURING FORWARD ACCELERATION. Aerospace Med., 32(2):113-120, Feb. 1961.

ABSTRACT: A review of current experiments in respiratory physiology during forward acceleration is presented.

Dyspnea, inspiratory chest pain, tracheal tugging, paroxysmal coughing and a sensation of weight on the thorax are typical symptoms occurring during forward acceleration. Fine crepitant rales are sometimes heard over the posterior lung fields for several minutes after centrifugation if the acceleration has been prolonged and has been of considerable magnitude.

Hemoptysis lasting 6 hrs. has occurred on one occasion. There is, naturally, considerable variation among subjects and even in the symptoms experienced by the same subject from day to day.

No serious cardiac aberrations were noted during several experiments with levels of forward acceleration up to 16.5 g and with duration up to 3 minutes at 12 g.

865

Chernigovs'kyi, V. M. and K. O. Lange 1961 TOMORROW IN PHYSIOLOGICAL SCIENCE (Zavtrashnii Den'Fiziologichnoi Nauki). Trans of Nauka i Zhyttya (USSR) 11(4):44-47, 1961. (Joint Publications Research Service, New York, N.Y.)  
Sept. 21, 1961 JPRS: 10137

ABSTRACT: The urgent tasks of physiology and medicine are the development of recommendations for a schedule of activity for space flight, the careful and deep study of all factors acting on the organism during flight in space, and reliable training of the bodies of future astronauts. (Extract)

866

Chernov, V.N. and V.I. Yakovlev 1959 RESEARCH ON THE FLIGHT OF A LIVING CREATURE IN AN ARTIFICIAL EARTH SATELLITE.  
ARS J. 29(10):736-742, Oct. 1959.

ABSTRACT: This appears to be as complete a single report as is available in the English language on the experimental results of Laika's orbital flight of Nov. 3, 1957, in Sputnik II, Soviet technical and scientific accomplishments preceding the flight are included. Described and discussed in some detail with illustrations are the cabin for the animal, its equipment and experimental apparatus, and the preparation and training of experimental animals. Results of the experiment are examined with regard to three basic periods: the preflight period, the launching of the rocket and the satellite's escape into orbit, and the orbital flight of the satellite.

867

Chernov, V. N. and V. I. Yakovlev 1960 RESEARCH ON ANIMAL FLIGHT IN AN ARTIFICIAL EARTH SATELLITE.  
In L. V. Kurnosova, ed., Artificial Earth Satellites. (New York: Plenum Press, Inc., 1960) Vol. I, pp. 102-120.

ABSTRACT: This paper discusses the animal's cabin, equipment, preparation and training of the animals, and provides results of satellite tests. It is noted that unlike high-altitude rocket biological tests, work on satellites enables a study to be made of the effects of long-maintained accelerations, as well as noise and vibration, and maintained weightlessness. Experiments carried out on 14 dogs in training undergoing varying centripetal accelerations maintained for 6-15 minutes of 2-10 g showed little effects. An increase in salivary secretion was observed during rotation. At the start of rotation the heart rose to 1.5-2 times its initial value, and remained at this level, with some fluctuations, for the whole period of acceleration. Respiration generally rose 1.5-2 times the initial rate, but as acceleration increased and the animal's body became pressed against the floor breathing became more frequent and superficial, with respiration rate 1.5-3 times initial value. Arterial pressure rose to 50-80 mm Hg above initial value.

868

Chinn, H. I., B. A. Strickland, F. W. Oberst, S. S. Wilks and M. Tinkham 1950 EVALUATION OF SOME DRUGS IN MOTION SICKNESS.  
J. Aviation Med. 21(5):424-429.

SUMMARY: 1. A number of antihistaminic and antispasmodic drugs have been tested for their effectiveness in preventing motion sickness. Simulated turbulence in the airplane, training flights, and the swing have been utilized.

2. A mixture of 50 mg. of Benadryl with 0.65 mg hyoscine has been shown to be the most effective prophylaxis tested. Hyoscine aminoxide (Scopodex) is of the same order of effectiveness. Dramamine, Benadryl, hyoscine, and a mixture of half doses Benadryl plus hyoscine afford good prophylaxis. Artane and Perazil

give fair protection. Thephorin and Chlor-Trimeton exert only slight protection while Decapryn, Neoantergan, Panparnit, Phenergan and A-446 give no or questionable protection.

3. Anti-motion sickness effectiveness is not related to antihistamine potency.

4. The effective pharmacological action is discussed. It seems likely that the degree of central anticholinergic action determines in large part the effectiveness of the drug, although other actions cannot be excluded.

5. All strongly effective compounds in the antihistamine group have two carbocyclic rings attached directly to a common carbon.

869

Chinn, H. I., W. K. Noell, and P. K. Smith 1950 PROPHYLAXIS OF MOTION SICKNESS. EVALUATION OF SOME DRUGS IN SEASICKNESS. Arch. Int. Med., 86:810 ASTIA AD 101 265

ABSTRACT: Hyoscine, Benadryl, Dramine, Artane and Perazil were all markedly effective in decreasing the incidence of seasickness of normal, unselected soldiers during a transatlantic crossing aboard a U. S. Army Transport. Thephorin and Neoantergan were ineffective. Among known motion sick susceptibles, Thephorin showed a slight protective action, although less marked than hyoscine, Dramamine or Benadryl. Hyoscine and Dramamine were tested therapeutically and found not to be significantly effective. A lower, but nevertheless significant, incidence of relief was afforded with placebos alone.

Side effects were most frequent among those receiving 2.25 mg. hyoscine hydrobromide or 15 mg. Artane daily. Blurred vision and dry mouth were the most common complaints. One case of hallucinations was encountered with hyoscine and two with Artane. Tinnitus, insomnia and nervousness were also increased with Artane. Drowsiness was not increased with any medication.

Seasickness caused an activation of the alpha rhythm of the electroencephalogram and a slowing of the dominant wave frequency. A pattern of drowsiness was particularly evident in cases of persistent seasickness. No significant changes could be detected as a result of the drug administration.

870

Chinn, H. I. and F. W. Oberst 1950 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS. I. EFFECTS OF CHEMICAL COMPONENTS OF DRAMAMINE. (USAF School of Aviation Medicine, Randolph Field, Tex.) Project No. 21-32-014, Rept. No. 1, Aug. 1950; ASTIA ATI-98 534

SUMMARY: No significant difference was found between Benadryl (50 mg.) and Dramamine (100 mg.) in protecting subjects from airsickness during simulated turbulence in an airplane. 8-chlorotheophylline gave no significant protection. A combination of hyoscine-hydrobromide (0.65 mg.) and Benadryl (50 mg.) was found to be more effective than either drug alone. A combination of half doses

of hyoscine-hydrobromide (0.33 mg.) and Benadryl (25 mg.) gave an effectiveness equal to that of a full dose of hyoscine (0.65 mg.) but inferior to the full dose mixture. (Author)

871

Chinn, H. I., & B. A. Strickland 1950 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS. II. COMPARISON OF HYOSCINE WITH BENADRYLHYOSCINE MIXTURE DURING NAVIGATION TRAINING FLIGHTS. (School of Aviation Medicine, Randolph AFB, Texas) Project 21-32-041, Rept. No. 2. ASTIA AD-105596

ABSTRACT:

The incidence of nausea and vomiting among cadets undergoing actual navigator training flights was compared after they had received the following medications: 1) placebo; 2) hyoscine hydrobromide, 0.65 mg.; 3) hyoscine hydrobromide, 0.33 mg.; Benadryl, 25 mg.

No subject receiving the hyoscine-Benadryl mixture vomited or became severely nauseated, whereas 7.3 percent receiving hyoscine alone and 16.7 percent receiving placebo were affected in this fashion.

Among those who had been airsick at some previous time, the incidence of severe nausea and vomiting was: Benadryl-hyoscine mixture-0 percent, hyoscine alone- 9.0 percent, placebo- 20.6 percent.

The incidence of drowsiness was the same for all groups. Dry mouth was high in both the hyoscine and mixture groups. The occurrence of blurred vision, nervousness, excessive fatigue and headaches was lower in the mixture group than in the hyoscine group.

872

Chinn, H. I., F. W. Oberst, & S. S. Wilks 1950 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS. III. STUDY OF ADDITIONAL ANTIHISTAMINICS IN AIRPLANE AND SWING. (School of Aviation Medicine, Randolph Field, Texas) Project No. 21-32-014, Rept. No. 3, Aug. 1950; ATI-89 279

ABSTRACT: Object - To determine whether antihistaminic activity is related to protection against motion sickness. Summary and Conclusions - 1) The antihistaminics Decapryn and Chlor-Trimeton exert only a slight protection against airsickness induced by artificial turbulence. 2) Artane, an antispasmodic, protects against airsickness but to a lesser degree than hyoscine. 3) Chlor-Trimeton and Thephorin do not protect against swing sickness. 4) It is concluded that antihistaminic potency is not related to motion sickness prophylaxis. (AUTHOR)

873

Chinn, H. I., F. W. Oberst and S.S. Wilks, 1950 ANTIHISTAMINICS AND  
MOTION SICKNESS PROPHYLAXIS. Texas Rep. Biol. and Med., 8:320

874

Chinn, H. I., B. A. Strickland, Jr., O. H. Waltrip & S. H. Gainer 1951  
PREVENTION OF AIRSICKNESS BY BENADRYL-SCOPOLAMINE MIXTURES.  
U. S. Armed Forces Med. J. 2(3):401-404, March 1951.

ABSTRACT: A mixture of 0.33 mg. of scopolamine hydrobromide and 25 mg. of benadryl was compared with 0.65 mg. of scopolamine hydrobromide alone in the prevention of airsickness. No significant difference could be detected between the two groups when tested in the airplane using simulated turbulence for 1 hour. When actual navigator training flights were used for testing, the benadryl-scopolamine mixture gave greater protection against severe nausea and vomiting than did scopolamine hydrobromide alone. Among those who had been airsick at some previous time, the incidence of severe nausea and vomiting was: none with benadryl-scopolamine mixture; 9 percent with scopolamine hydrobromide alone; and 20.6 percent with the placebo. The incidence of drowsiness was the same for all groups. Dry mouth was common in both the group receiving scopolamine hydrobromide and in the group receiving the benadryl-scopolamine mixture. The occurrence of blurred vision, nervousness, excessive fatigue, and headaches was lower in the group receiving the mixture than in the group receiving scopolamine hydrobromide alone. (Author)

875

Chinn, H. I. 1951 MOTION SICKNESS  
(USAF Sch. Avn. Med., Randolph AFB, Tex)  
Special Report, December 1951, ASTIA ATI 128 351

ABSTRACT:

1. The incidence of sickness during aircrew training is discussed and methods for selection of motion-resistant personnel considered.
2. Evidence is presented to support the conclusion that the utricular maculae in the labyrinth are the chief structures responsible for motion sickness. Contributory factors in its etiology are visual disturbances, visceral stimulation, and psychic influences.
3. The efficacy of various drug preparations in preventing motion sickness is considered. The most promising preventive is Lergigan, a Swedish antihistaminic. Further studies are necessary, since the number of subjects tested to date is rather small. A mixture of Benadryl and hyoscine gives excellent results against airsickness but produces undesirable side effects when taken for 2 or 3 days. For this reason, it is less desirable against seasickness, where medication may be required for several days. Similarly, hyoscine alone or hyoscine aminoxide shows good protection against airsickness but produces side effects during frequent administration. The antihistaminics Dramamine, Trimeton, and Wellcome Preparation 47-83 all give good protection. The

antispasmodics Parsidol and Artane show fair protection. Thephorin, Chlor-Trimeton, Decapryn, Diatrin, Neoantergan, and Prantal all give slight or no protection.

876

Chinn, H.I. 1951 MOTION SICKNESS IN THE MILITARY SERVICE Mil. Surgeon  
108:20-29

877

Chinn, H.I., O.H. Waltrip and H.W. Massengale 1951 FURTHER STUDIES ON THE  
EFFECTIVENESS OF VARIOUS DRUGS AGAINST AIRSICKNESS.  
J. Aviation Med. 22(6):535-539

ABSTRACT: A mixture of 25 mg. of Benadryl and 0.35 mg of Scopolamine-Hydrobromide has been compared during navigation training flights and in routine C-54 flights with the following preparations: Perazil--50 mg.; Scopodex--2.0 mg.; Lergigan-- 25.0 mg.; Scopodex--1.0 mg.; Benadryl--25.0 mg. mixture. All preparations reduced the incidence of nausea and vomiting below the control groups, although the protection afforded by Perazil was not at a statistically significant level. From the studies reported here, the Benadryl--Scopolamine mixture and Lergigan were the most effective, Benadryl-Scopodex slightly less effective, Scopodex alone next, and Perazil the poorest. It is recommended that further comparison be made between the effectiveness and side effects of the Benadryl-Scopolamine mixture and Lergigan.

878

Chinn, H.I., H. Waltrip and W. Massengale 1951 EFFECTIVENESS OF VARIOUS  
DRUGS IN PREVENTION OF AIRSICKNESS V. COMPARISON OF ADDITIONAL PREPARATIONS  
IN AIRCRAFT. (School of Aviation Medicine, USAF Randolph AFB, Texas)  
Rept. No. 21-32-014-5, July 1951.

879

Chinn, H. I., et al 1952 THE EFFECTIVENESS OF VARIOUS DRUGS FOR THE  
PROPHYLAXIS OF SEASICKNESS  
(USAF Sch. Av. Med., Brooks AFB, San Antonio, Tex.)  
Proj. No. 21-32-014, Rpt. No. 6, March 1952. ASTIA AD 150 406

ABSTRACT: Lergigan, Trimeton, Benadryl-scopolamine mixture, and Wellcome Preparation No. 47-83 all provided approximately equal protection against seasickness. No preparation was significantly superior to that of diphenhydramine although the observed percentage of protection afforded by Lergigan was slightly greater.

No protection was given by the antihistaminic Diatrin or by the antispasmodics W-290 and Prantal. Slight protection, not significant at the 1 percent level, was obtained with Scopodex alone or with a mixture of Benadryl and Scopodex. Side effects were minimal in all cases except among those persons receiving the Scopodex. When 2.0 mg. doses of the latter were given three times daily, hallucinations, an increased incidence of nightmares, dry mouth, blurred vision, and ringing in the ears was observed. When 1.0 mg. was given combined with 25 mg. of Benadryl, there were no hallucinations but the incidence of nightmares, dry mouth, and blurred vision was still increased. There was an inverse relation between the incidence of vomiting and the age of the subject. No relation could be detected between the number sick and the compartments in which they were quartered nor with the degree and/or duration of motion therein under the conditions of these sea trials.

880

Chinn, H.I., W.R. Gammon, & M.E. Frantz 1952 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS: IX. PROTECTION OF AIRBORNE TROOPS (USAF School of Aviation Medicine, Randolph Field, Texas) Proj. No. 21-32-014, Rept. No. 9., December 1952

ABSTRACT: Airborne soldiers received placebo or medication during two flights of 5 to 7 hours' duration. The incidence of vomiting for the placebo group was 6.8 percent. The following drugs given immediately prior to take-off significantly lowered the incidence of vomiting: Wellcome 47-83 (50 mg.), Phenergan (25 mg.), Phenergan (12.5mg.), Trimeton (25 mg.), Pyrrolazote (50 mg.), and scopolamine (0.65 mg.). Postafene (50 mg.) given 24 hours prior to take-off also afforded significant protection. None of these medications was superior to the others.

881

Chinn, H. I., & L. J. Milch 1952 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS. VII. EVALUATION OF PHENERGAN AND TRIMETON (School of Aviation Medicine, Randolph Field, Texas) Project No. 21-32-014, Rept. No. 7, Aug. 1952; ATI-159 336

ABSTRACT: Object - To compare the effectiveness of various preparations against air sickness. Summary and Conclusions - 1) The following preparations were tested during simulated aircraft turbulence: (a) placebo; (b) Lergigan, 25 mg.; (c) Phenergan, 25 mg.; and (d) Trimeton, 25 mg. All three drugs reduced significantly the incidence of vomiting below that in the placebo group. Phenergan exhibited the greatest protection. 2) Side effects with each drug were slight, an increase in drowsiness being the most apparent effect. 3) The possibility that the effectiveness of Lergigan is due to an admixture with Phenergan is discussed. Recommendations - 1) That the optimum dosage and duration of action of Phenergan be investigated. 2) That a comparison of Phenergan and Lergigan be made with rigorously purified materials so that there is no question of a mixed preparation. (AUTHOR)

882

Chinn, H.I. and N.P. Plotnikoff 1952 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS: VIII. EVALUATION OF VARIOUS TECHNIQUES FOR SCREENING ANTI-MOTION SICKNESS DRUGS (USAF School of Aviation Medicine, Randolph Field, Texas) Project No. 21-32-014, Report No. 8.

ABSTRACT: Hyoscine, Benadryl, and Lergigan did not increase the vomiting threshold of dogs to apomorphine injection, nor did any of them protect dogs against swing sickness. Hyoscine protected human subjects on the swing, but Lergigan and Benadryl were without effect. The lack of correlation between these findings and the effectiveness of these preparations in air and seasickness are discussed.

883

Chinn, H. I. 1952 THE EFFECTIVENESS OF VARIOUS DRUGS FOR THE PROPHYLAXIS OF SEASICKNESS  
Am J. of Med. 12:433-439, Apr. 1952

884

Chinn, H.I., B.A. Strickland, Jr., 1953 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS: STUDIES DURING ROUTINE TRAINING FLIGHTS (USAF School of Aviation Medicine, Randolph Field, Tex.) Proj. No. 21-1208, Report No. 1. September 1953.

ABSTRACT: A mixture of 25 mg. of Benadryl and 0.35 mg. of scopolamine gave good protection against motion sickness both with and without the addition of 5 mg. of dexedrine. No significant difference in prophylaxis between the two groups could be detected. The following preparations failed to afford a significant protection: Parsidol (25 mg.) Wyeth 46062 (25 mg.), Schering 1667, and Wyeth 46062 (15 mg.) plus scopolamine (0.35 mg.). Side effects with all groups were slight. The significance of adding an analeptic drug to combat the sedation of motion-sickness preventives is discussed.

885

Chinn, H.I., A.J. Dugi, and L.J. Milch 1953 EFFECTIVENESS OF VARIOUS DRUGS IN PREVENTION OF AIRSICKNESS: COMPARISON OF SCOPOLAMINE, POSTAFENE, AND PHENERGAN (School of Aviation Medicine, USAF Randolph, AFB, Texas) Rept. No. 21-1208-0012-2, September 1953

886

Chinn, H.I. and N.P. Plotnikoff 1953 EVALUATION OF VARIOUS TECHNIQUES FOR SCREENING ANTI-MOTION-SICKNESS DRUGS. J. Appl. Physiol., 5: 392

887

Chinn, H.I., W.R. Gammon, and M.E. Frantz 1953 PREVENTION OF AIRSICKNESS  
AIRBORNE TROOPS. J. Appl. Physiol., 5(10):599-602

ABSTRACT: Air-borne soldiers received placebo and medication during 2 flights of 5-7 hr duration. The incidence of vomiting for the placebo group was 6.8%. The following drugs given immediately prior to take-off significantly lowered the incidence of vomiting: Wellcome 47-83(50 mg), Phenergan (25 mg), Phenergan (12.5 mg), Trimeton (25 mg), Pyrrolazote (50 mg) and scopolamine (0.65 mg). Postafent (50 mg) given 24 hr prior to take-off also afforded significant protection. None of these medications was superior to the others. The incidence of drowsiness, blurred vision, dry mouth and fatigue was increased by some of the drugs, while dizziness, sweating and headache were reduced. Almost 19 per cent of the paratroopers became sick during a 60 to 90-min flight prior to their jump.

888

Chinn, H. I. 1955 EVALUATION OF DRUGS EFFECTIVE AGAINST MOTION SICKNESS.  
(School of Aviation Medicine, Brooks AFB, Texas) Rept. No. 55-144, Oct. 1955

ABSTRACT: Twenty-six compounds have been tested against sea-sickness, using soldiers and airmen crossing the North Atlantic aboard troop transports. A total of 16,902 subjects was employed. Fourteen of the drug treatments gave significant protection at the 1 percent probability level. There was no apparent difference between British or American brands of hyoscine. Seasickness varied inversely with age. The highest incidence of side effects was observed with hyoscine.

889

Chinn HI, P.K. Smith 1955 MOTION SICKNESS Pharmacol. Rev 7:33-82, March 1955

890

Chinn, H. I., R. W. Hyde and L. J. Milch 1955 EFFECTIVENESS OF VARIOUS DRUGS  
IN PREVENTION OF AIRSICKNESS: TREATMENT BY INTERNAL MEDICATION.  
(USAF School of Aviation Medicine, Randolph AFB, Tex.)  
Rept. No. 56-6, November 1955

ABSTRACT: Scopolamine was administered to subjects aboard aircraft by nasal instillation (nose drops and spray) 15 to 20 minutes after take-off. The incidence of vomiting from airsickness during the subsequent 40 to 45 minutes was markedly reduced. Oral and sublingual administration under these conditions was ineffective. Considerable variations in the amount of drug instilled resulted when given by spray. The use of nose drops allowed more accurate medication. The significance of this mode of administration for treating motion sickness is discussed.

891

Chinn, H. I. 1956 EVALUATION OF DRUGS FOR PROTECTION AGAINST MOTION SICKNESS  
ABOARD TRANSPORT SHIPS. J. Amer. Med. Assoc. 160(9):755-760, 3 Mar. 1956

ABSTRACT: Twenty-six compounds were tested as to effectiveness in the prevention of motion sickness in 16,920 soldiers and airmen crossing the North Atlantic aboard troop transport ships. Best results were obtained by using 50mg. of meclizine once or thrice daily, 50 mg. of cyclizine thrice daily, or 25 mg. of promethazine thrice daily. Buclizine (Vibazine), benztropine methanesulfonate (Cogentin), Sandostene, and UCB 158 (N-benzhydryl-N-m-methylbenzylpiperazine) were demonstrated for the first time to be effective against motion sickness. Single doses of scopolamine hydrobromide were effective, but on continued use produced distressing side-effects. For continued use, meclizine was the most satisfactory. Motion sickness was twice as frequent in those having it before as in those with no previous history of it. It occurred less frequently in older men, and in those who had crossed before.

892

Chkhaidze, L. V. 1961 ON THE PHYSICAL TRAINING OF THE COSMONAUT  
Trans. of Teoriya i Praktika Fizicheskoi Kul'tury (USSR) 24(12):907-909,  
1961.  
(Joint Publications Research Service, New York, N. Y.)  
June 4, 1962 JPRS: 13996

893

Chkhaidze, L. V. 1962 COORDINATION OF HUMAN MOTOR HABITS IN HIGH GRAVITY  
FIELDS AS A METHOD FOR THE STUDY OF THE CONTROL OF VOLUNTARY MOVEMENTS.  
In Biofizika 7:80-85, 1962 (Russian)

894

Christensen, J. M. 1951 PSYCHOLOGICAL RESEARCH PROJECTS OF SELECTED BRITISH  
LABORATORIES AND ESTABLISHMENTS  
(USAF AMC, Wright-Patterson AFB, Ohio)  
USAF Memorandum Report WCRDP-694-24C, July 1951. ASTIA ATI 151 644

895

Christensen, J. M. 1952 RESEARCH PROJECTS OF CERTAIN BRITISH LABORATORIES  
AND ESTABLISHMENTS THAT RELATE TO AIR DEFENSE  
(USAF, AMC, Wright-Patterson AFB, Ohio)  
WCRD Technical Memorandum report 52-95, November 1952. ASTIA AD 5278

896

Christensen, J. M. 1960 PERFORMING MAN-SIZED TASKS IN SPACE  
1960 Proceeding of the Institute of Environmental Sciences, C-37--C-38

ABSTRACT: This is a commentary on a paper presented by S. N. Roscoe to the Institute of Environmental Sciences in April of 1960. The title of the paper was "Performing Man-sized Tasks in Space."

897

Christensen, K.K. & L.L. Johnson 1958 STUDY TO DETERMINE METHODS OF  
SIMULATING g EFFECTS.  
(Wright Air Development Center, Wright-Patterson AFB, Ohio)  
Contract No. AF33(600)-37276, WADC TN 58-314, ASTIA AD 211 849

ABSTRACT: Methods of simulating acceleration and deceleration sensations in aircraft flight simulators were determined. Significant sensations were ascertained, and studies were conducted of methods of mechanically inducing heaviness and immobility sensations, chemically inducing physiological effects, psychologically inducing effects of acceleration, and controlling the various simulated effects. Several devices that may indirectly induce acceleration effects were investigated.

Mechanical means of inducing and controlling heaviness and immobility are considered feasible, although all devices have a 1-g pressure sensation which cannot be eliminated. Visual effects can be simulated. Chemical simulation does not appear satisfactory because function with respect to g is lacking, added safety precautions are necessary, and detrimental effects are possible. A period of experimental development will be necessary to determine the optimum methods and to make a full evaluation of the effectiveness of the simulated sensations.

898

Christian, G.L. 1958 MILITARY BOOSTING ESCAPE PROGRAMS.  
Aviation Week, 68(9):181, 183, 187, and 189.

ABSTRACT: Development of aircraft crew stations, the heart of the entire vehicle, has threatened to lag--and sometimes has conspicuously lagged--behind the rapid strides being made to increase new planes' performance capabilities.

To combat this dangerous deficiency, Air Force's Wright Air Development Center here is attacking with increased vigor the manifold problems of making crew stations and escape systems compatible with new high performance aircraft and manned space vehicles. Dual purpose is to make crewmen comfortable, therefore capable of maximum efficiency during flight and to provide them with maximum chance of survival if escape becomes necessary.

899

Christy, R.L. 1949 THE NEW HUMAN CENTRIFUGE.  
Aviation Medicine 20(6):454-458

ABSTRACT: Because of technical difficulties and limitations encountered in aircraft during acceleration experiments, it was decided to construct a large, very high-performance centrifuge which would overcome the disadvantages or inabilities of present centrifuges or aircraft in conducting the necessary research. First, the new centrifuge has a rate of change of acceleration of 10 g per second, and can attain a maximum of 40 g. Second, the new centrifuge has a fifty-foot radius. Third, a decompression chamber 10 feet in diameter and 6 feet wide is mounted in the end of the arm of the new centrifuge. This chamber can be decompressed to a pressure altitude of 60,000 feet, and the temperature neither can be carefully regulated between 40° and 110° F. Fourth, the gondola, including the decompression chamber is mounted inside a pair of gimbels, which are powered by hydraulic motors mounted on the counter weight.

900

Christy, R.L. Jr. 1951 THE NAVY PROGRAM FOR AIRCRAFT ESCAPE.  
J. Aviation Med. 22(5):408-413

ABSTRACT: Conventional bailout will be used for low-speed escape, although it is believed that an ejection seat should be strongly considered where feasible for all one-place and two-place training and operational aircraft. The escape chute has particular value in relatively high performance two-place fighter and attack aircraft. Finally, the ejectable cockpit is considered to be the preferred method for the very high-speed, high-altitude fighter aircraft.

901

Christy, R.L. 1952 A SURVEY OF PRESENT TECHNIQUES FOR EMERGENCY ESCAPE FROM AIRCRAFT. In White, C.S., & O.O. Benson, Jr., eds., Physics and Medicine of the Upper Atmosphere, A Study of the Aeropause (Albuquerque, N. Mexico: Univ. of New Mexico Press, 1952) pp. 509-515.

ABSTRACT: The advantages and drawbacks of the following escape techniques are discussed: (1) ordinary bailout over the side of the airplane; (2) the escape chute, in which the pilot drops backward and downward; (3) the ejection seat, propelled by an explosive charge with sufficient upward velocity to clear the vertical stabilizer (two types are in use: one in which the seat is fired by the pilot reaching up and pulling a curtain down over his head and face, and the other fired by controls placed near the legs of the pilot); and (4) the ejectable cockpit capsule. Further studies are in progress on deceleration tracks, catapults, and human centrifuges to determine man's tolerance for acceleration and deceleration under various conditions.

902

Christy, R.L. 1961 EFFECTS OF RADIAL AND ANGULAR ACCELERATIONS.  
In H.G. Armstrong, ed. Aerospace Medicine (Baltimore: Williams and Wilkins  
Co., 1961)

903

Chu, C C., R.J. Coskren & H.M. Morgan 1960 INVESTIGATION OF THE HIGH SPEED  
IMPACT BEHAVIOR OF FIBROUS MATERIALS. PART I. DESIGN AND APPARATUS.  
(Fabric Research Labs., Inc., Boston, Mass) WADD TR 60-511 pt. 1,  
Contract AF 33(616)6321, Proj. 7320, Sept. 1960. ASTIA AD 247 493.

ABSTRACT: A high speed impact test machine has been designed, constructed,  
and calibrated to test parachute components at high rates of loading. This  
instrument is capable of rupturing materials of up to 10,000 pounds static  
breaking strength at velocities of from 200 to 750 feet per second. The  
impacting force is applied by a free flying missile launched by a gas gun  
utilizing either nitrogen or helium gas at moderately low pressures. The  
gun has a bore of 2.5 inches and fires missiles weighing up to 10 pounds.  
Pertinent data are obtained by means of multiple exposure photography using  
a multi-microflash lighting source which provides a maximum of fifteen separate  
flashes spaced at predetermined intervals of between 10 and 10,000 micro-seconds  
The resulting photograph records the specimen and the impacting missile before,  
during and after the impact. Measurement of the distances between successive  
exposures yields information such as the breaking strength, the extension to  
rupture, and the energy absorbed by the specimen. (Author)

904

Chu, Wen-Hwa 1960 ON THE DEVELOPMENT OF A MORE ACCURATE METHOD FOR CALCULATING  
BODY-WATER IMPACT PRESSURES (Department of the Navy, David Taylor Model Basin  
Fundamental Hydromechanics Research Program, Southwest Research Institute,  
San Antonio, Texas) Contract No. Nonr 2729(00), SwRI Project No. 23-834-2,  
30 September 1960, ASTIA AD 251 927

ABSTRACT: This paper presents the details of a theoretical investigation into  
the hydrodynamic forces and pressures developed during the early stages of water  
entry of a circular cylinder. The method employed is a numerical scheme developed  
from formulations of the governing equations and boundary conditions that are less  
restrictive than those usually employed, and is applicable to a wide class of  
body forms. Some comparisons with experimental data are made. It is concluded  
that the method is not yet suitable for general usage because of excessive  
requirements for computing machine time.

905

Chung, Sung Jang 1945 ELECTROCARDIOGRAMS OF MICE UNDER POSITIVE RADIAL  
ACCELERATION STRESS. ROK Air Force J. Avia. Med. 4:31

906

Chung, Sung Jang, & Yae Wee Choi 1956 STUDIES OF POSITIVE RADIAL ACCELERATIONS ON MICE AND MATHEMATICAL FORMULAE EXPRESSING HUMAN TOLERANCE TO ACCELERATION.  
(Fifth Semi Annual Medical Conference of the Far East Air Force, Baguio, Phillipines, Nov. 29, 1956)

907

Chung, Sung Jang 1956 PATHOLOGY OF MICE UNDER POSITIVE RADIAL ACCELERATION STRESS. ROK Air Force J. Avia. Med. 4:45

908

Chung, Sung Jang 1956 STUDIES OF POSITIVE RADIAL ACCELERATION ON MICE; BEHAVIOR, SURVIVAL CURVE, FATAL CURVE, DANGEROUS ZONE, MORTALITY, AND EFFECTS OF ANTI-G SUITS. ROK Air Force J. Avia. Med. 4:20

909

Chung, S.J. 1959 STUDIES OF POSITIVE RADIAL ACCELERATION ON MICE.  
J. Appl. Physiol., 14(1):52-54, Jan. 1959

ABSTRACT: One hundred and ninety-one mice were subjected to positive acceleration of from 3 to 85 g, for periods of 5 seconds to 80 minutes. Data on mortality and on pathologic findings are presented. No significant differences were observed in the resistance of male and female mice to positive g. ECG tracings from mice exposed to 8 g for 25 minutes were examined. Formulas are presented to express probability of survival of mice in terms of exposure and magnitude of acceleration stress.

910

Chung, Sung Jang 1960 STUDIES ON A MATHEMATICAL RELATIONSHIP BETWEEN STRESS AND RESPONSE IN BIOLOGICAL PHENOMENA.  
• Journal of the National Academy of Sci., Republic of Korea, Vol 2, Dec. 1960

911

Cicala, A., & G. Assensi 1956 ERNIA DEL DISCO INTERVERTEBRALE DA ACCELERAZIONE POSITIVA: OSSERVAZIONI SU DI UN CASO CLINICO. (HERNIA OF THE INTERVERTEBRAL DISK CAUSED BY POSITIVE ACCELERATION: CASE REPORT) Rivista di medicina aeronautica (Roma) 19(3):511-519, July-Sept. 1956

ABSTRACT: A case is reported of intervertebral disk hernia caused by positive

acceleration in a military diver pilot. Following surgery, the pilot returned to flight duty. Consideration is given to the anatomy and physiology of the intervertebral disk, and to the medico-legal aspects of the disorder.

912

Ciccione, R., & R.M. Richman 1948 THE MECHANISM OF INJURY AND THE DISTRIBUTION OF 3000 FRACTURES AND DISLOCATIONS CAUSED BY PARACHUTE JUMPING.  
J. Bone Joint Surg. 30A(1):77-97

ABSTRACT: In order to recapitulate our experience with fractures of the ankle mortise, the authors have reviewed the last 300 fractures of the ankle; correlated the clinical, roentgenographic, and operative findings; and tabulated the injuries according to the traumatic mechanism. As explained earlier, this arrangement depends upon the interpretation of circumstantial evidence, and one must beware of straining such evidence too far by postulating a theoretical sequence of trauma, or by intricate subclassifications, or tortured analogies with the laws of mechanics. The authors have tried to avoid these pitfalls of speculation. Table IV merely groups the fractures under well-recognized mechanisms, and it is with these mechanisms rather than with the minor variations in pattern that we are primarily concerned.

A comparison of this cross section of the series with other reported groups of ankle fractures indicates that it makes little difference whether the ankle is broken by falling downstairs, stepping off a curb, playing football, or parachute jumping: From the point of view of etiological stresses, the statistical distribution of fractures is much the same. There are certain minor variations, such as the high incidence of posterior marginal fractures of the tibia, and the relatively low incidence of vertical compression fractures in this series. These differences, however, are trivial; the fundamental point of similarity is the preponderance of external-rotation injuries. External rotation and abduction, taken together, account for 75 per cent of the fractures reported by Ashhurst and Bromer, Stevens, Moritz, and Bishop, as well as the present authors. This cannot be mere coincidence; the figures are consistently too high, and they are independent of the source of the patients or the circumstances of injury. One may reasonably conclude, therefore, that the vulnerability of the ankle to external rotation represents an inherent weakness of the joint, either a local structural weakness, or else a lack of adaptive resiliency of the leg as a whole. This latter possibility gains support from the fact that not only the ankle, but the entire lower extremity, shows a statistical preponderance of external rotation injuries.

913

Ciffrin, A., & W. A. Swenson 1959 STUDY AND DEVELOPMENT OF PARACHUTES AND SYSTEMS FOR IN-FLIGHT AND LANDING DECELERATION OF AIRCRAFT. PART II. DEVELOPMENT AND TEST EVALUATION OF THE RING SLOT PARACHUTE. (Wright Air Development Ctr., Wright-Patterson AFB, Ohio) WADC TR 57-566, Pt. 2; ASTIA AD-155 707

ABSTRACT: Based on German research in the development of the FIST ribbon para-

chute, Radioplane performed a development and test evaluation of a type of parachute known as the Ring Slot parachute. The purpose of the program was to determine the feasibility of replacing the FIST ribbon parachute with the Ring Slot parachute for aircraft deceleration. Tests consisted of drag tests, drop tests, and tests behind a taxiing aircraft. Test results indicate that the performance of a properly designed Ring Slot parachute is equal or superior to that of the FIST ribbon parachute for aircraft deceleration. In addition to an analysis of the performance, a suggested design procedure and cost analysis of the Ring Slot parachute are presented. (AUTHOR)

914

Cipriani, A. & D. McEachern 1942 MONTREAL MOTION SICKNESS MACHINE  
(NRC, Canada, Proc. Conf. Motion Sickness) Report No. C615

915

Cipriani, A. 1942 AN ANALYSIS OF THE FORCES ENCOUNTERED ON THE SIMPLE SWING  
USED IN THE STUDY OF MOTION SICKNESS.  
(National Research Council, Canada, Assoc. Comm. on Av. Med. Research)  
C-2246. 8 December 1942.

ABSTRACT: Radial acceleration, in the long axis of the body with the subject seated upright, is the principal vestibular stimulus encountered on the simple motion sickness swing. It is greatest at the lowest point of the arc. The magnitude of the stimulus is 0.7G for a maximum displacement of the swing from the vertical of forty degrees. This stimulus is repeated twice during each complete cycle of the swing, or usually about 30 times per minute. The radial component of acceleration can be changed in magnitude by changing the arc of swing. On the other hand, the magnitude can be kept constant and the frequency and duration of the stimulus varied by changing the length of the swing. There are three components of tangential acceleration. The first component is the tangential acceleration relative to stationary objects around the swing. This is the greatest at the ends of the arc and is about 0.64 G for an angular displacement of forty degrees from the vertical. This acceleration plays no part in stimulating the vestibular system since it affects equally the mobile and fixed portions of the vestibule. The second component of tangential acceleration is zero at the center of gravity of the swing and increases at points away from the centre of gravity. On the swings in use, this stimulus is about 0.1 G at the level of the ear of a subject sitting in the erect position. This acceleration may act as a small, probably subliminal, vestibular stimulus. It is effective due to constraint of the head in a tangential direction. Another component of tangential acceleration arises from the push or driving mechanism. Its magnitude is unknown and probably variable in swings pushed by hand. It may be an effective vestibular stimulus. The acceleration curves for the pitch motion of the roll-pitch rocker, show a maximum of 1.2 G with the carriage at its lowest point and a minimum G of 0.85, with the carriage elevated. The frequency of the pitch is about 8/min and the linear displacement 12 feet. This produces an effective acceleration of 0.35 G applied once

in each complete cycle, or about 8 times per minute.

916

Cipriani, A. 1942 A MECHANICAL DRIVE FOR THE SIMPLE SWING USED IN THE STUDY OF MOTION SICKNESS.  
(National Research Council, Canada, Assoc. Comm. on Av. Med. Research)  
C-2245. 8 December 1942.

ABSTRACT: A method of driving a swing by means of an electric motor and V belt reduction is described.

917

Clamann, H.G. 1937 CONCERNING INJURIES TO THE RETINA IN FLIERS.  
(Ueber Netzhautschadigungen bei Fliergern) Luftfahrtmed. 2:314-316

918

Clamann, H.G. 1941 ATMOSPHERIC PRESSURE DROP TESTS ON HUMANS.  
(Ueber Drucksturzversuche Am Menschen) ASTIA ATI-68 253, Jan 1941

919

Clamann, H. G. 1958 THE ENGINEERED ENVIRONMENT OF THE SPACE VEHICLE.  
AU Quarterly Review 10(2):53-64.

920

Clamann, H. G. 1960 MEDICINE AND SPACE FLIGHT: MAN IN CAPSULE (MEDIZIN UND RAUMFAHRT: DER MENSCH IN DER KAPSEL), Flugkorper, Wiesbaden  
2(1):16-18, Jan. 1960

ABSTRACT: This lecture reviewed current and projected areas of investigation in the medical problems of space flight: acceleration tolerance, weightlessness, the use of pressure suits, hazards of Van Allen belt radiations, the food requirements and techniques for space flight feeding, methods of re-cycling water and of CO<sub>2</sub> -O<sub>2</sub> exchange, isolation, and tolerance to high dry-heat temperatures.

921

Clamann, H.F. BIOLOGICAL EXPERIMENTS WITH SPACE PROBES In Konecni, E.B.,  
REVIEW OF JANUARY 1961 LECTURES IN AEROSPACE MEDICINE, SCHOOL OF AVIATION  
MEDICINE, Randolph AFB, Texas (Santa Monica, California: Douglas  
Aircraft Co., 1961)

ABSTRACT: In a major portion of this paper, the author defines more closely the criteria for selecting feasible biological specimens and biological space probes. One example of a biological space probe (Atlas ballistic shot of Oct. 13, 1960) is described in detail, and preliminary results of the three-mice experiment (Project MIA) are presented. The pulse-rate data of one mouse during the total flight is interpreted, viz., "As a certain surprise, the pulse rate is influenced much more by vibration and noise than by even the high G force at reentry. The pulse rate climbs directly after ignition of the rocket and decreases even before burnout. At reentry, the pulse rate climbs to a peak long before the G force reaches its maximum. During weightlessness, the pulse rate remains fairly constant and resembles the pulse rate found during sleep."

922

Clamann, H. G. 1961 HOW TO ADAPT BIO-EXPERIMENTS TO SPACE PROBES.  
Space Aeronautics 35(4):73-77, April 1961.

ABSTRACT: A discussion of the use of having biological specimens in space experimentation is presented. Criteria for specimens best suited to a given space probe are presented and illustrated by describing the use of three mice aboard the recoverable nose cone of an Atlas missile. The biopack design, life-cell atmosphere, recording equipment, and some results are reported. (Tufts)

923

Clare, V. R., D. R. Richmond, V. C. Goldizen, C. C. Fischer, D. E. Pratt, C. S. Gaylord, & C. S. White 1962 THE EFFECTS OF SHOCK TUBE GENERATED, STEP-RISING OVERPRESSURES ON GUINEA PIGS LOCATED IN SHALLOW CHAMBERS ORIENTED SIDE-ON AND END-ON TO THE INCIDENT SHOCK (Lovelace Foundation for Medical Education & Research, Albuquerque, N. Mex.) Technical Progress Report on Contract No. DA-49-146-XZ-055, May 31, 1962

ABSTRACT: A total of 308 guinea pigs were exposed to air blast in 4 close-fitting shallow, rectangular chambers mounted on the top, bottom and sides of an air-driven shock tube. With a reflecting plate at the downstream edge of the chambers the animals were exposed to "long"-duration, shock overpressures that initially rose in a single step. The  $LD_{50}$ -24-hr reflected pressure calculated from grouping all positions was  $36.2 \pm 0.8$  psi. By moving the reflecting plate to various distances downstream of the chambers, shock overpressures that initially rose in two steps were applied. The results were that the animals' tolerances to overpressure rose as the time between pressure steps was increased. Comparison of the  $LD_{50}$ 's obtained with animals in each chamber revealed that there was not a significant statistical difference in their tolerances, whether

they were "loaded" initially with the single-step pulse from their right, left, dorsal or ventral surfaces.

Animals that survived pressure-time conditions in the lethal range were considered as having been injured by the blast, and were all pooled for 30-day serial sacrifice. It was found that the lung hemorrhage "cleaned up," and the lung weights returned to normal in 7 to 10 days as did the submucosal hemorrhages in the stomach and intestines. The body-weight curve displayed an initial drop in 2 to 3 days, after which it rose to the starting level by the sixth day and then paralleled the controls. (AUTHOR)

924

Clark, B. & A. Graybiel 1946 VISUALLY PERCEIVED MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT.  
American Psychologist 1(7):238-239, 1946.

ABSTRACT: A method was designed to observe and report the effects of angular acceleration and variations in g on visual perception during flight. All of the data were obtained while the subject sat in the rear cockpit of an SNJ-6 aircraft, a single engine, two-place, advanced Navy trainer. The visual stimulus was a collimated "star" installed in such a fashion that observations could be made in complete darkness. All of the pilot's and observer's verbal reports were automatically inscribed onto the wire of an airborne wire recorder which also provided a time line. The recordings were transcribed in the laboratory and all analyses were made from these written protocols. Experiments were carried out on three subjects using 5 basic maneuvers in addition to control periods of straight and level flight. It was found that angular acceleration and g during flight induce illusory perception of motion and displacement of an objectively motionless object. The apparent displacements of the object may be great, the fixation object appearing to be displaced as much as 60° from its true position. The method is adaptable to a number of types of studies concerned with the influence of angular acceleration and g on visual perception.

925

Clark, B., A. Graybiel & K. MacCorquodale 1946 THE ILLUSORY PERCEPTION OF MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT. IV. ILLUSORY ROTATION OF A TARGET DURING TURNS.  
(U.S. Naval School of Aviation Medicine, Pensacola, Fla.)  
Rept. NM 001 059. 01. 16

ABSTRACT: This study was designed to collect additional data on illusory motion and displacement of a fixed target in the dark while the plane in which the observations were made executed turns at varying degrees of bank. Four subjects made observations in the rear cockpit of an SNJ-6 aircraft during flight. They followed a previously established procedure save in one regard. Instead of attempting to report all of the illusory motion present they confined their attention to a single aspect, namely, the apparent rotation of a collimated star about its central point.

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Clark, B., A. Graybiel, & K. MacCorquodale 1946 THE ILLUSORY PERCEPTION OF MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT. II. VISUALLY PERCEIVED MOVEMENT OF A FIXED TARGET DURING TURNS. (Naval School of Aviation Medicine, Pensacola, Fla.) MRO05.13-6001.1.8 16 Apr. 1946.

See also J. Exp. Psychol. 38(3):298-309, June 1948.

ABSTRACT: The oculo-gyral and oculo-gravic illusions were studied in flight using three trained subjects which served a fixed luminous target in the dark. All observations were made in the rear cockpit of a standard Navy training plane. The subject gave a running account of the apparent motion and displacement of the target while the pilot maneuvered the plane through different degrees of bank. All of the observers' reports and the pilot's signals were recorded on an airborne wire recorder and written transcriptions of these recordings were made in the laboratory. These written protocols served as a basis for the analyses of the data.

927

Clark, B., A. Graybiel, & K. MacCorquodale 1946 THE ILLUSORY PERCEPTION OF MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT. III. HABITUATION AND TECHNIQUE OF ASSUMING THE TURN AS FACTORS OF ILLUSORY PERCEPTION. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Rept. NM 001 059. 01. 11, 1 July 1946.

ABSTRACT: Additional data were obtained on the occurrence of the oculo-gyral and oculo-gravic illusions in a flight and compared with the results found in a previous study. The same three subjects observed a fixed luminous target in the dark. The subjects sat in the rear cockpit of an SNJ-6 aircraft while the pilot described turns with different degrees of bank. The chief purposes of the study were: (1) to compare the illusions observed during two methods of executing a turn, and (2) to determine whether habituation occurred during the experiment.

There was no consistent difference in the pattern of illusory response observed in the three series. This was true of the amount of illusory motion and displacement, the time relations, and the sequence of events. Therefore, there was no significant evidence of any difference in the illusory perceptions during the two types of banks nor was there evidence of habituation within the limits of this experiment.

928

Clark, B., & A. Graybiel 1947 LINEAR ACCELERATION AND DECELERATION AS FACTORS INFLUENCING NONVISUAL ORIENTATION DURING FLIGHT. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Rept. No. 18, NM 001 059.01.18, 25 Sept. 1947.

See also J. Aviation Med. 20:92-101, 1949.

ABSTRACT: This study was designed to determine the effects of linear acceleration and deceleration on the flyer's spatial orientation in the absence of visual

perception. All observations were made during flight in an SNJ-6 aircraft so equipped that all visual cues could be eliminated. During one series of trials the subject faced forward and in another series he faced to the left in the cockpit. He gave a running account of his perceptions of bodily position during each trial using a throat microphone which was connected to a wire recorder.

The accelerations and decelerations were produced by the pilot who changed the settings of power and flaps (brakes) to give a range of forces were measured by a three component accelerometer. The records showed that the forces built up quickly to a maximum and shortly thereafter began to drop off to zero. The net result of these linear accelerations was to change the magnitude and direction of the resultant force acting upon the body.

The subjective reports showed clearly that the observers did not merely have sensations of change in velocity, but they also reported that they perceived a strong sensation of tilt. These reports of tilt showed that the observer reorients himself to the resultant force acting on the body as if it were the true vertical, but the estimates of tilt in degrees, were substantially greater than the change in direction of the resultant force. The frequency of the reports of tilt during acceleration increased with the magnitude of the force while the observer faced both forward and to the side, the threshold being of the order of 0.02 G for forces acting in a direction fore and aft with respect to the plane. This involved a change in resultant force of approximately 0.0002G and a change in the direction of the force of approximately 1 degrees. The number of degrees of tilt reported and the duration of the perception of tilt also increased with the strength of the stimulus.

The reports during deceleration exhibited essentially the same characteristics as those during acceleration. The thresholds were somewhat higher and the degree and duration of tilt reported increased with the strength of the stimulus.

These results show that the perception of position in space is a function of the resultant of the force of gravity and the accelerative force acting on the body. The subjects reported clear perceptions of being tilted which would be interpreted as climbing or diving as far as the behavior of the aircraft is concerned. This is an added source of confusion in orientation resulting from accelerative forces acting on the body during normal flight. These confusions result in disorientation in space which have important implications for flying particularly when visual cues are lacking and the pilot must rely on the secondary cues presented by the instruments. (DACO)

929

Clark, B., A. Graybiel, & K. MacCorquodale 1948 THE ILLUSORY PERCEPTION OF MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT. IV. ILLUSORY ROTATION OF A TARGET DURING TURNS. Amer. J. Psychol. 61(1):50-58, Jan. 1948  
See also (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR005. 13-6001.1.16., 4 Sept. 1946

930

Clark, B. 1948 EFFECTS OF REPEATED ROTARY ACCELERATION ON THE OCULOGYRAL ILLUSION. (U.S. Naval School of Aviation Medicine and Research, Pensacola, Fla.) (Proj. X-148(AV-4-3) Rept. No. 20. ASTIA ATI 44558  
See also J. Exp. Psychol. 39(2):219-227

ABSTRACT: The effects of repeated angular acceleration and deceleration on visual perception were studied in three subjects to establish whether any change in the oculogyral illusion would occur. The subjects were rotated while they sat in a Link Trainer which rotated only about a vertical axis. The subjects were turned for ten successive trials at three rpm and then for ten successive trials at 20 rpm on ten successive days. On the following four days the subjects took 19 successive trials at 20 rpm. Measures of the angular accelerations and decelerations were available at the slower rotation speeds. The subjects observed a complex target in the dark and reported the onset and offset of the oculogyral illusion following both acceleration and deceleration for each trial. The duration of the effects was recorded in an adjacent room by the experimenter. The three subjects were familiar with the effects observed, but they had not been rotated for approximately one year so they were suitable for a study of habituation.

931

Clark, B., & A. Graybiel 1948 THE EFFECT OF ANGULAR ACCELERATION ON SOUND LOCALIZATION: THE AUDIOGYRAL ILLUSION.  
(U.S. Naval School of Aviation Medicine, Pensacola, Fla.)  
Proj. MR005.13-6001.1.21., ASTIA ATI 69 773.  
See also J. Psychol. 28:235-244, 1949.

SUMMARY: This study was undertaken as a preliminary investigation of the effects of strong stimulation of the semicircular canals on sound localization. Three observers made a series of judgments of the position of a 1024 cycle tone under two conditions: (1) While they sat quietly in a Barany chair which remained fixed, and (2) for 45 seconds following abrupt deceleration from rpm. The subjects showed a constant error in localization of the sound in a direction opposite to the postrotational sensations of rotation. The error was of the order of 14 degrees immediately following deceleration and gradually decreased to approach zero between 20 and 35 seconds after deceleration. This error was consistently greater than the errors during the stationary trials. Substantial individual differences were observed. When the data were analyzed in terms of the apparent shift in position during each trial, the average displacement was found to be approximately 17 degrees. The hypothesis is suggested that the errors in localization are to be attributed to the subjects' sensations of rotation. (Author)

932

Clark, B., A. Graybiel, & K. MacCorquodale 1948 THE ILLUSORY PERCEPTION OF MOVEMENT CAUSED BY ANGULAR ACCELERATION AND BY CENTRIFUGAL FORCE DURING FLIGHT. II. VISUALLY PERCEIVED MOVEMENT OF A FIXED TARGET DURING TURNS.  
J. Exp. Psychol. 38(3):298-309, June 1948  
See also (Naval School of Aviation Medicine, Pensacola, Fla.) MR005.13-6001.1.8., 5/16/46

933

Clark, B., and A. Graybiel 1948 THE EFFECT OF ANGULAR ACCELERATION ON SOUND LOCALIZATION (THE AUDIOGYRAL ILLUSION). ( U.S. Naval School of Aviat. Med. and Research, Pensacola, Fla.) Project X-148, Rept. 21, July 2, 1948. ASTIA AD- 35810

ABSTRACT: This study was undertaken as a preliminary investigation of the effects of strong stimulation of the semicircular canals on sound localization. Three observers made a series of judgments of the position of a 1024 cycle tone under two conditions: (1) while they sat quietly in a Barany chair which remained fixed, and (2) for 45 seconds following abrupt deceleration from 20 rpm. The subjects showed a constant error in localization of the sound in a direction opposite to the postrotational sensations of rotation. The error was of the order of  $14^{\circ}$  immediately following deceleration and gradually decreased to approach zero between 20 and 35 seconds after deceleration. This error was consistently greater than the errors during the stationary trials. Substantial individual differences were observed. When the data were analyzed in terms of the apparent shift in position during each trial, the average displacement was found to be approximately  $17^{\circ}$ . The hypothesis is suggested that the errors in localization are to be attributed to the subject's sensations of rotation.

934

Clark, B., A. Graybiel, & K. MacCorquodale 1948 ILLUSORY ROTATION OF A TARGET DURING TURNS IN AN AIRCRAFT.  
Amer J. Psychol. 61(1):50-58, Jan. 1948.  
NOTE: Reel 7, Flash 6, Item 32

SUMMARY: This study was designed to collect additional evidence on the apparent motion and displacement of a fixed target in the dark while the aircraft, in which four Ss observed, executed turns at varying degrees of bank. Instead of attempting to report all of the illusory effects present, S confined his report to a single aspect; namely, an apparent rotation of the collimated star about its central point. The verbal reports were inscribed on an airborne wire-recorder, and later analyzed. Laboratory observations were likewise made to clarify the stimulus-response relationships.

Both apparent motion and displacement of the target occurred at all degrees of bank from 10 degrees to 60 degrees. This happened both on entering a bank and during recovery to straight and level flight. The illusory motion was in the direction of the banking motion of the plane and the motion and displacement waned a few seconds after the plane had assumed the new direction.

The percental occurrence and the degree of apparent rotation increased with the angle of bank until there was great assurance of them at 40 degrees. Maximal rotary displacement reported was 15 degrees. Apparent rotation and displacement did not, however, necessarily occur concomitantly. Very frequently the target would appear to have a rotatory motion without an associated displacement, while occasionally the target suddenly appeared in a new position without rotatory motion. The lag in time from the beginning of a maneuver to the first report of

rotation averaged 4-6 sec. The average duration varied from 8.8 sec. during the 10 degree banks to 27.8 sec. during 60 degree banks.

Laboratory observations demonstrated similar illusory changes in the same target during turns in a Link Trainer when the head was so placed that stimulation of the anterior and posterior vertical semicircular canals produced a rotating nystagmus. They also occurred during Coriolis acceleration when a man, turning in a Link Trainer, tilted his head backward or forward while continuously observing the target.

The evidence both during flight and in the laboratory indicates that this illusory rotation of a fixed target is a special case of the oculo-gyral illusion. Effects such as these will occur in the air at night during maneuvers involving angular accelerations above the threshold. These results give further evidence of perceptual confusions in the air at night, particularly when visual cues are limited. (Author)

935

Clark, B. & A. Graybiel 1949 STUDIES OF HUMAN ADAPTATION TO CENTRIFUGAL FORCE. I. VISUAL PERCEPTION OF THE HORIZONTAL. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Rept. NM 001 059.01.22.

ABSTRACT: Four experienced subjects were exposed to a series of radial accelerations on a human centrifuge to test the hypothesis that adaptive processes occur in the perception of the horizontal during and following stimulation by radial acceleration.

936

Clark, B., & A. Graybiel 1949 LINEAR ACCELERATION AND DECELERATION AS FACTORS INFLUENCING NONVISUAL ORIENTATION DURING FLIGHT. J. Avia. Med. 20(2):92-101 See also (Naval School of Aviation Medicine, Pensacola, Fla.) Rept. No. 18, NM 001 059.01.18., 25 Sept. 1947

ABSTRACT: This study was designed to determine the effects of linear acceleration and deceleration on the flyer's spatial orientation in the absence of visual perception. All observations were made during flight in an SNJ-6 aircraft so equipped that all visual cues could be eliminated. During one series of trials the subject faced forward and in another series he faced to the left in the cockpit. He gave a running account of his perceptions of bodily position during each trial using a throat microphone which was connected to a wire recorder.

The accelerations and decelerations were produced by the pilot who changed the settings of power and flaps (brakes) to give a range of forces which covered those occurring in the normal operation of the aircraft. The forces were measured by a three component accelerometer. The records showed that the forces built up quickly to a maximum and shortly thereafter began to drop off to zero. The net result of these linear accelerations was to change the magnitude and direction of the resultant force acting upon the body.

The subjective reports showed clearly that the observers did not merely have sensations of change in velocity, but they also reported that they perceived a strong sensation of tilt. These reports of tilt showed that the observer reorients himself to the resultant force acting on the body as if it were the true vertical, but the estimates of tilt in degrees, were substantially greater than the change in direction of the resultant force. The frequency of the reports of tilt during acceleration increased with the magnitude of the force while the observer faced both forward and to the side, the threshold being of the order of 0.02 G for forces acting in a direction fore and aft with respect to the plane. This involved a change in resultant force of approximately 0.0002G and a change in the direction of the force of approximately 1 degrees. The number of degrees of tilt reported and the duration of the perception of tilt also increased with the strength of the stimulus.

The reports during deceleration exhibited essentially the same characteristics as those during acceleration. The thresholds were somewhat higher and the degree and duration of tilt reported increased with the strength of the stimulus.

These results show that the perception of position in space is a function of the resultant of the force of gravity and the accelerative force acting on the body. The subjects reported clear perceptions of being tilted which would be interpreted as climbing or diving as far as the behavior of the aircraft is concerned. This is an added source of confusion in orientation resulting from accelerative forces acting on the body during normal flight. These confusions result in disorientation in space which have important implications for flying particularly when visual cues are lacking and the pilot must rely on the secondary cues presented by the instruments. (DACO)

937

Clark, B., & K. MacCorquodale 1949 THE EFFECTS OF REPEATED ROTARY ACCELERATION ON THE OCULOGYRAL ILLUSION. J. Exp. Psychol. 39(2):219-227, Apr. 1949  
See also (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR005.13  
6001.1.20.; X-148 (Av-4-3); 3/18/48, ASTIA ATI-35810

ABSTRACT: The effects of repeated angular acceleration and deceleration on visual perception were studied in three subjects to establish whether any change in the oculogyral illusion would occur. The subjects were rotated while they sat in a Link Trainer which rotated only about a vertical axis. Measures of angular acceleration and deceleration were available at the slower speeds of rotation, and the subjects observed a complex target in the dark and reported the onset and offset of the oculogyral illusion following both acceleration and deceleration. Immediately after acceleration and deceleration, the subjects reported apparent motion of the target (first effect), and a reversal of this motion (second effect). A detailed analysis of the effects showed no reduction in any one of them for the duration of the apparent motion. The results support the theory that the mystagmus remained unchanged.

Clark, B., & A. Graybiel 1949 APPARENT ROTATION OF FIXED TARGET ASSOCIATED WITH LINEAR ACCELERATION IN FLIGHT. American J. Ophthalmology 32(4):549-557. NOTE: Reel 7, Flash 6, Item 22

ABSTRACT: The purpose of this study was to determine the effects of linear acceleration and deceleration on the visual perception of a target in the dark. Three subjects observed a collimated "star" in the dark while the pilot of an SNJ-6 aircraft executed various degrees of linear acceleration. The subjects gave a running account of the behavior of the "star" using a throat microphone connected to a wire recorder.

The forces produced represented the range of accelerations and decelerations occurring in the normal operation of the aircraft. The forces were measured by a three component accelerometer which showed that accelerative and decelerative forces built up to a maximum in approximately 5.5 seconds and within 2 to 3 seconds began to drop off slowly to zero.

The net result of these accelerations and decelerations was to change both the magnitude and the direction of the resultant force acting on the subject. The magnitude of the maximum resultant forces varied between 1.0004G and 1.0925G., and its change in direction varied between 1.7 degrees and 23.7 degrees.

~~When the subjects faced to the left in the aircraft, the radiating lines of the~~ star appeared to rotate about the central point to a new position. This rotation was clockwise during deceleration and counterclockwise during acceleration. As the force became smaller, the star appeared to rotate back to its normal position. This illusory rotation occurred at all stimulus levels.

The thresholds of linear deceleration for motion and displacement were 0.067G and 0.078G., respectively. All of the linear accelerations used were above threshold. The mean maximum rotation during deceleration increased as the decelerative force increased, the maximum estimated rotation reported being 15 degrees.

There was also a positive relation between the maximum force and the duration of the illusory effect. The accelerative effects did not show a consistent variation with the maximum change in the accelerative force.

The results are similar to those observed on a human centrifuge and show that linear acceleration and deceleration during flight have a marked influence upon visual perception in the dark. Although the observed rotations were small, they were clearly defined and may be considered to be factors contributing to disorientation in pilots. (AUTHOR)

Clark, B., & A. Graybiel 1950 STUDIES OF HUMAN ADAPTATION TO CENTRIFUGAL FORCE. I. VISUAL PERCEPTION OF THE HORIZONTAL.

ABSTRACT: Four subjects were rotated on a human centrifuge while facing the direction of rotation. They observed a horizontal line in the dark and reported its apparent rotation or maintained it in a horizontal position throughout the trials. The settings of the line closely approximated the deviation of the resultant force acting on the subject, but adaptation was not found. (The American Psychologist 5:465)

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Clark, .B. & A. Graybiel 1950 THE LAG EFFECT ASSOCIATED WITH STIMULATION OF THE SEMI-CIRCULAR CANALS AS INDICATED BY THE OCULOGYRAL ILLUSION. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Proj. Report No. NM 001 059.01.25, Nov. 17, 1950. ASTIA ATI 94153.

ABSTRACT: The purpose of this experiment is to measure the amount of inhibition of the oculogyral illusion produced by the lag effects of previous stimulation by angular acceleration. Each of six subjects observed the postrotational oculogyral illusion in a dark room for a series of 45 observations at three rates of rotation and for five intervals between acceleration and deceleration. The lag effect was observed for all subjects at the three rates of rotation used. The interference was most marked when the deceleration followed the acceleration by a short interval of time; in some cases the decelerative effects were completely eliminated. The curves showing the interference were all negatively accelerated leveling off between 30 and 60 seconds of delay. One subject on a special series of observations gave evidence to indicate that other factors than time may be significant in causing changes in the oculogyral illusion under these circumstances. In general these data show a marked lag effect between angular accelerations and illustrate a factor which tends to keep these after effects small in every day life. However, when these factors do not operate in flight at night, orientation may be impaired.

941

Clark, B., & A. Graybiel 1951 VISUAL PERCEPTION OF THE HORIZONTAL FOLLOWING EXPOSURE TO RADIAL ACCELERATION ON A CENTRIFUGE. J. Comparative and Physiological Psychology 44:525-534  
NOTE: Reel 7, Flash 7, Item 59

ABSTRACT: Three experienced subjects were exposed to a series of radial accelerations on a human centrifuge to test the hypothesis that changes in the perception of the horizontal will occur during and following stimulation by radial acceleration. The subjects observed a single, isolated, horizontal line in the dark while they rotated counterclockwise on a human centrifuge. In part I of the experiment the subject's task was to maintain the line at a horizontal position by means of a switch, during acceleration to a predetermined rate of rotation which was immediately followed by deceleration. In Part II the procedure was the same as in Part I except that the maximum radial acceleration was maintained for 15 mins. before deceleration began. In each experiment a comparison was made between the subject's judgment of the position of the line and the direction of resultant force determined from theoretical calculation.

Within the limits of measurement in this experiment significant changes which could be attributed to prolonged exposure to radial acceleration did not occur. ~~MEASURES OF THE THRESHOLD OF PERCEPTION SHOWED NO SIGNIFICANT CHANGE FOLLOWING~~ stimulation by the radial accelerations. Settings of the line to horizontal showed no change in constant or variable errors 1 min. following rotation. There were no significant differences between the accelerative and decelerative phases with

regard to the accuracy of setting the line, but the subjects tended to set the line at an angle from the horizontal which was greater than the deviation of the resultant force from gravity. Within the limits of the measures used and for the variables studied in this experiment, prolonged exposure to radial acceleration did not produce consistent aftereffects on the perception of the horizontal.  
(AUTHOR)

942

Clark, B., & A. Graybiel 1951 A DEVICE TO MANIPULATE AND TO INDICATE THE POSITION OF REMOTE TEST OBJECTS IN STUDIES OF VISUAL SPACE PERCEPTION (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) 6 Dec. 1951. ASTIA AD 144 336.

943

Clark, B. & A. Graybiel 1952 THE DURATION OF THE OCULOGYRAL ILLUSION AS A FUNCTION OF THE INTERVAL BETWEEN POSITIVE AND NEGATIVE ACCELERATION. (U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, Fla.) Rept. No. NM 001 059.01.28. 1 Feb. 1952. ASTIA ATI 149 274

ABSTRACT: The purpose of this investigation was to determine the nature of the effect of a preceding acceleration of the post-rotational oculogyral illusion and to determine the reliability of the test results of the oculogyral illusion in Naval aviators. Thirty-one subjects reported the duration of the oculogyral illusion during and following rotation for a series of trials with 6 different intervals of constant rotation between acceleration and deceleration. The inhibitory effect of the preceding acceleration was greatest when deceleration followed acceleration immediately; in some cases the post-rotational effect was eliminated completely. The inhibitory effect decreased rapidly up to approximately 30 seconds and very gradually beyond this up to 120 seconds.

The data indicate that the reliability of these measures is high, all reliability coefficients being 0.91 or higher. (From the authors summary)

944

Clark, B., & R. D. Malone 1952 TOPOGRAPHICAL ORIENTATION IN NAVAL AVIATION CADETS. (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR005.13-6001.1.30., 2 June 1952

945

Clark, B., & R. D. Malone 1952 THE RELATIONSHIP OF TOPOGRAPHICAL ORIENTATION TO OTHER PSYCHOLOGICAL FACTORS IN NAVAL AVIATION CADETS. (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR005.13-6001.1.32., 24 Sept. 1952

946

Clark, B. & A. Graybiel 1952 ILLUSORY PERCEPTION OF ROTATION FOLLOWING CONSTANT TURNS IN A LINK TRAINER. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) NM 001 059.01.31, Aug. 1952. ASTIA ATI 169 365.

ABSTRACT: Thirty-one flight students were rotated in a Link Trainer at 10 r.p.m. in a completely dark room, using six different intervals of constant turn. The subjects reported their perceptions of rotation both during and following the turns. The maximum illusory effects occurred when the constant turn was held for a relatively prolonged period of time. The duration of the illusion increased sharply as the period of constant turn increased up to approximately 30 seconds and, thereafter, increased slowly up to 60 seconds with a slight increase evident up to two minutes. In most cases the illusory effects were not observed when the period of constant turn was near zero. These results show that pilots who hold prolonged constant speed turns in an aircraft without adequate visual orientation are particularly susceptible to illusory perceptions of rotation. These illusory effects can be expected in normal Naval Aviators and they should be made familiar with the fact that such illusory perceptions are normal and may be expected following prolonged constant speed turns in flight. (From the author's summary)

947

Clark, B. and A. Graybiel 1960 HUMAN PERFORMANCE DURING ADAPTATION TO STRESS IN THE PENSACOLA "SLOW ROTATION ROOM".

Paper: 31st Annual Meeting of the Aerospace Medical Association, Americana Hotel, Bal Harbour, Miami Beach, Fla., May 9-11, 1960.

ABSTRACT: In a previous report the symptoms experienced by human subjects living in a slow rotation room for periods up to two days were briefly summarized. It was pointed out that the significant stimulus was the aperiodic angular accelerations associated with movements of the head out of the plane of the constant rotation. The cardinal subjective symptoms included headache, dizziness, sleepiness, depression, visual illusions, nausea, and vomiting. The cardinal signs were pallor, sweating, difficulty in walking and oliguria. Because these symptoms had their origin in stimulation of the semi-circular canals, the term canal sickness was considered to be a useful and proper designation. Adaptation occurred after a period of hours to days, and the symptoms either disappeared or were reduced in severity. Following cessation of rotation, certain after-effects appeared, but these were neither as severe nor as long lasting as the symptoms during rotation. The present report deals with a number of physical, psychological, and psychomotor tasks which these persons carried out before, during, and after rotation. At angular velocities of 5.44 or lower, any initial decrement in performance disappeared in the course of their adaptation to the stress. However, subjects exposed to rotation at 10 rpm were severely handicapped, and over a period of two days, their general fitness declined despite some degree of adaptation. The application of these findings to space medicine is brought out.

948

Clark, B., & A. Graybiel 1960 HUMAN PERFORMANCE DURING ADAPTATION TO STRESS IN THE PENSACOLA SLOW ROTATION ROOM. (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MRO05.13-6001.1.52., 18 May 1960; ASTIA AD-244 935  
See also Aerospace Medicine 32(2):93-106, Feb. 1961

ABSTRACT: One control subject with effectively no vestibular function and five healthy subjects were subjected to constant rotations varying from 1.71 to 10.00 rpm for two days to determine any changes in performance on a variety of tasks. The control subject showed insignificant changes in performances associated with rotation. The most prominent change in the normal subjects was a change in motivation toward the tasks. Performance on tests of walking and body steadiness decreased substantially both during and immediately following rotation. No significant decrement was observed for strength of grip, ball throwing, dart tossing, head steadiness, card sorting, and dial setting. These findings have practical implications inasmuch as the angular velocities used were within the range proposed to generate artificial gravity on space platforms. (ASTIA)

949

Clark, B. and A. Graybiel 1960 VISUAL PERCEPTION OF THE HORIZONTAL DURING PROLONGED EXPOSURE TO RADIAL ACCELERATION ON A CENTRIFUGE (Naval School of Aviation Medicine, Pensacola, Fla.) ASTIA AD 262 778  
Proj. MRO05.13-6001, Subtask 1, Report No. 54, 1960  
Also see J. Exp. Psychol. 63:294-301, March 1962

ABSTRACT: Four subjects were studied in a special seat in the Pensacola Slow Rotation Room to determine whether any change in the visual perception of the horizontal would occur. The method involved maintaining a constant change in magnitude and direction of force on the subjects throughout the experimental period. No significant, systematic changes in the visual perception of the horizontal occurred during this experimental period. It is concluded that adaptation to this experimental situation does not occur.

950

Clark, B. and A. Graybiel 1961 HUMAN PERFORMANCE DURING ADAPTATION TO STRESS IN THE PENSACOLA SLOW ROTATION ROOM (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR 005.13-6001, Subtask 1, Rept. no. 52, 18 May 1960.  
ASTIA AD 244 935  
Also see; Aerospace Med. 32(2):93-106, Feb. 1961.

ABSTRACT: Tests of performance on simple motor tasks were conducted on five normal subjects and on one subject with no vestibular function during and after rotation in a centrifuge room for two days at speeds from 1.71 to 10 r.p.m. Insignificant changes in performance were observed in the subject with bilateral destruction of the inner ears. The most prominent change in per-

formance of normal subjects was in motivation toward the tasks; when symptoms of canal sickness were reduced, however, most tests were performed adequately. Performance on tests of walking and body steadiness decreased substantially during and immediately after rotation. No significant decrement in performance was observed for strength of grip, ball throwing, dart tossing, hand steadiness, card sorting, and dial setting.

951

Clark, B., & A. Graybiel 1961 PERCEPTION OF THE POSTURAL VERTICAL AS A FUNCTION OF PRACTICE IN NORMAL PERSONS AND SUBJECTS WITH LABYRINTHINE DEFECTS. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) BuMed Project MR005.13 6001, Subtask 1, Rept. No. 63, NASA Order No. R-37, 15 Nov. 1961.

ABSTRACT: The effects of practice on ability to set themselves to the postural vertical were compared in nine normal subjects and ten subjects with defective vestibular function. All of the latter had lost the function of the semicircular canals and 6 did not perceive the oculogravic illusion, a test of otolith function. The normal subjects exhibited smaller average error than those with vestibular defects. It was concluded that pressure cues appear to be adequate to produce good performance, but the nonacoustic labyrinth also contributes to the judgment in normal subjects. The data also support the notion that the tilt chair, as used in this study, is not useful in identifying subjects without otolith function. (Author)

952

Clark, B., & A. Graybiel 1961 ANTECEDENT VISUAL FRAME OF REFERENCE AS A CONTRIBUTING FACTOR IN THE PERCEPTION OF THE OCULOGRAVIC ILLUSION. (USN, SAM, Pensacola, Fla.) BuMed Project MR005.13-6001, SubTask 1, Rept. No. 56, and NASA Order No. R-1; 8 February 1961

ABSTRACT: A study is made of the effect of an antecedent visual frame of reference on the perception of the horizontal when direction and magnitude of the gravitational force acting on the body are changed. Changes in the amount of oculogravic illusion serve as the criterion of change in perception of the horizontal. Observations are made following prolonged exposure and following varied short exposures to a visual frame work. Results show deviation of the perceived horizontal from the static line-of-subjective-horizontal increases fairly rapidly to about sixty seconds and more slowly for an equal time thereafter under each observation condition. A gradual, though not a simple, continuous, change occurs in the frame of reference from visual to gravitational cues.

953

Clark, B., & A. Graybiel 1961 HUMAN PERFORMANCE DURING ADAPTATION TO STRESS  
IN THE PENSACOLA SLOW ROTATION ROOM. Aerospace Medicine 32(2):93-106,  
Feb. 1961

See also (Naval School of Aviation Medicine, Pensacola, Fla.) Proj. MR005.  
13-6001.1.52., 18 May 1960; ASTIA AD-244 935

ABSTRACT: One control subject with effectively no vestibular function and five healthy subjects were subjected to constant rotations varying from 1.71 to 10.00 rpm for two days to determine any changes in performance on a variety of tasks. The control subject showed insignificant changes in performances associated with rotation. The most prominent change in the normal subjects was a change in motivation toward the tasks. Performance on tests of walking and body steadiness decreased substantially both during and immediately following rotation. No significant decrement was observed for strength of grip, ball throwing, dart tossing, head steadiness, card sorting, and dial setting. These findings have practical implications inasmuch as the angular velocities used were within the range proposed to generate artificial gravity on space platforms. (ASTIA)

954

Clark, B. and A. Graybiel 1962 VISUAL PERCEPTION OF THE HORIZONTAL  
DURING PROLONGED EXPOSURE TO RADIAL ACCELERATION ON A CENTRIFUGE.

In J. Exp. Psychol. 63:294-301, March 1962

Also see Naval School of Aviation Medicine, Pensacola, Fla.  
Proj. MR005.13-6001, Subtask 1, Report No. 54, 1960

955

Clark, B. & J. Stewart 1962 PERCEPTION OF ANGULAR ACCELERATION ABOUT THE YAW  
AXIS OF A FLIGHT SIMULATOR: THRESHOLDS AND REACTION LATENCY FOR RESEARCH  
PILOTS. (Paper presented at 33rd annual meeting of the Aerospace Medical  
Association, 9-12 April 1962, Atlantic City)

ABSTRACT: Thresholds for the perception of angular acceleration and reaction latencies for accelerations in the region of the threshold were determined using the Ames Three-Degrees-of-Angular-Freedom Simulator. The simulator was controlled by an analog computer signal and each angular acceleration was measured throughout its ten second duration by an angular accelerometer. A forced choice procedure was used for angular acceleration and reaction latencies for angular acceleration from  $0.06^{\circ}/\text{sec.}^2$  will be reported and compared with earlier studies. (Aerospace Med. 33(3):333, March 1962)

956

Clark, B. & A. Graybiel 1963 CONTRIBUTING FACTORS IN THE PERCEPTION OF THE  
OCULOGRAVIC ILLUSION.

Amer. J. Physiol. 76:18-27, March 1963.

957

Clark, C.C. & R.J. Crosbie 1957 CENTRIFUGE SIMULATION OF FLIGHT ACCELERATIONS: OPEN-LOOP COMPUTER CONTROL AND CLOSED-LOOP SUBJECT COMPUTER CONTROL OF THE HUMAN CENTRIFUGE. (U.S. Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-LR30, Sept. 17, 1957.

ABSTRACT: This report explains a new technique of flight simulation under acceleration which has been developed at AMAL by utilizing the human centrifuge in hook-up with the large Typhoon analog computer at the aeronautical Computer Laboratory. With this increased capability, the subject undergoing acceleration can serve not only as a passenger during a simulated flight but as the pilot of a simulated flight through a specified flight maneuver. The pilot-aircraft interactions can be evaluated under G for the first time on a centrifuge, thus providing a more realistic assessment of the pilot performance and physiological changes during flight. The closed-loop system works in this manner: the control stick, rudder pedal, and throttle settings made by the subject in the gondola of the centrifuge are transmitted as electrical signals over telephone lines connecting the centrifuge with the computer. The centrifuge control signals are returned to AMAL through the special telephone lines to drive the centrifuge and gimbals and provide the accelerations that would have been provided by similar control setting changes in the particular aircraft represented by the analog circuit.

958

Clark, C.C. & R.J. Crosbie 1957 ACCELERATION PROBLEMS ASSOCIATED WITH PROJECTED RESEARCH AIRCRAFT; INVESTIGATION OF HUMAN TOLERANCES AND PERFORMANCE CONCERNING (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR18, Feb. 25, 1957

ABSTRACT: This report details some preliminary considerations affecting the centrifuge program for the X-15 research aircraft. The purpose of this program is to: (1) compare tracking performance during the simulation of the flight pattern associated with the projected research aircraft using a floor control stick with that using a right hand control stick, (2) determine the extent of involuntary pilot input to the control system with the proposed restraint and arm rest, and (3) determine whether physiological tolerances are surpassed.

959

Clark, C. C. 1958  
PROPOSED STUDY OF ACCELERATION PATTERNS IN FLIGHT  
(Naval Air Development Ctr., Johnsville, Pa.) Letter Rept. TED ADC AE1410,  
Serial 3072, 18 Apr. 1958

ABSTRACT: A listing is presented of projects being carried out at AMAL in which accelerations, measured or predicted in flight are reproduced on the ground. Sources of the flight acceleration measurements and recent AMAL reports are given. The importance of obtaining both linear and angular accelerations of flight (three components of each) in order to make possible an optimum simulation is emphasized.

960

Clark, C.C. 1958 PLANS FOR THE JUNE CENTRIFUGE SIMULATION OF THE X-15  
(U.S. Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-LR56  
May 27, 1958. (Confidential)

961

Clark, C.C. 1959 FILM REPORT ON NAVY CENTRIFUGE STUDIES FOR THE NASA PROJECT  
MERCURY, PROGRAM 1, AUGUST 1959  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6014.

ABSTRACT: This letter report contains a scene description of the film "Navy  
Centrifuge Studies for NASA Project Mercury, Centrifuge Program 1, August,  
1959" as an enclosure, along with the film itself.

962

Clark, C. C. 1959 NAVY CENTRIFUGE SIMULATION OF THE NASA PROJECT MERCURY  
VEHICLE PROGRAM I (Naval Air Development Ctr., Johnsville, Pa.) Letter  
Rept. No. TED ADC AE-1412, Serial 0890, 7 Oct. 1959

963

Clark, C.C. 1959 JOHNSVILLE CENTRIFUGE BRACKET FOR ATTACHING THE NASA MERCURY  
CAPSULE  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR87, May 28, 1959

ABSTRACT: This report discusses the possibility of mounting an actual Mercury  
capsule on the arm of the AMAL centrifuge for use in high acceleration training of  
the Mercury astronauts. A special bracket and a third gimbal drive is proposed  
to mount the capsule on the centrifuge.

964

Clark, C.C., and R.F. Gray 1959 RESTRAINT AND PROTECTION OF THE HUMAN EXPERIENCING  
THE SMOOTH AND OSCILLATING ACCELERATIONS OF PROPOSED SPACE VEHICLES (Naval  
Air Development Center, Johnsville, Pennsylvania, Paper presented at the  
AGARD Aeromedical and Flight Panels, Athens, Greece) 11-15 May 1959.

965

Clark, C. C., J. D. Hardy, and R. J. Crosbie 1959 A SUGGESTED STANDARD  
ACCELERATION TERMINOLOGY. (USN, Air Dev. Ctr., Aviat. Med. Accel. Lab.,  
Johnsville, Pa.) 10 July 1959.

Clark, C.C. & J.D. Hardy 1959 PREPARING MAN FOR SPACE FLIGHT  
Astronautics 4: 18

ABSTRACT: A discussion of the various aspects of space flight on biological systems is presented with special emphasis on the effects of acceleration and methods of protection against it. The NASA contour couch studies performed at AMAL and the water fill G-capsule studies are described in relation to tolerance limits for acceleration stress. The use of the centrifuge in conjunction with electronic computers to form a dynamic simulator is discussed and some of the recent simulations described. As an example of this kind of research, the author tells about his experience riding the centrifuge at 2 G for 24 hours to study the consequences of long duration acceleration, which had been determined before. During this time, he cooked, ate, slept, stood up, wrote and typed, and made medical observations on himself.

967

Clark, C.C., & R.F. Gray 1959 A DISCUSSION OF RESTRAINT AND PROTECTION OF THE HUMAN EXPERIENCING THE SMOOTH AND OSCILLATING ACCELERATIONS OF PROPOSED SPACE VEHICLES. (U.S. Naval Air Development Center, Johnsville, Pa.)  
NADC-MA-5914, Oct. 1959. ASTIA AD 234 597.

ABSTRACT: The thesis of this paper is that it is not the forces generated by acceleration or deceleration (at least to somewhat beyond 30 G) which damage man, but rather the body distortions which can result from an unbalanced action of these forces. By proper "packaging" of the human tolerance will depend on the consequences of local tissue compression or extension rather than on the consequences of gross tissue and organ displacements or distortions. The acceleration time histories to accelerate to and decelerate from the velocities suitable for space travel are presented with emphasis that presently attained velocities are only a beginning. Minimum travel time involves acceleration for half the trip and deceleration for the other half. Techniques of centrifuge simulation of these accelerations are presented. The dependence on vehicle configuration of vehicle deceleration by reentry into an atmosphere is noted. Vehicle oscillations induced by motor and by lift misalignments are described. The ability of the human to make body motions while under acceleration determines the minimum necessary restraint for the head and limbs. To minimize involuntary pilot control inputs, a simultaneous designing of restraints and controls is necessary. A moulded body form "contour couch" provides a broadened support and reduces body distortion. In such a couch a man has reached +25Gx (chest-to-back) as the peak acceleration of a versine waveform with a 40-second period. Tight bandaging of the body and particularly training in techniques of complete body straining are important aspects of these experiments.

968

Clark, C.C., & C.H. Woodling 1959 CENTRIFUGE SIMULATION OF THE X-15 RESEARCH AIRCRAFT. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5916, 10 Dec. 1959. ASTIA AD 233 340.

ABSTRACT: In the period March 1957 to July 1958, three X-15 centrifuge programs were carried out as a cooperative effort of the North American Aviation, Inc., the NASA, the USAF, and the USN. The first program involved 168 runs under cam control, with the subject receiving accelerations predicted for the X-15 as if he were a passenger. For the other two programs, the newly developed technique of pilot-computer "closed-loop" control of the centrifuge, or centrifuge dynamic control flight simulation, was utilized with the pilot receiving accelerations computed for the X-15 under his own control while he carried out the assigned flight mission, involving re-entries at various angles of attack and peak normal loads with and without speed brakes, and with or without control augmentation (dampers). During these two programs, 991 "static" flights (centrifuge at rest) and 433 "dynamic" flights (centrifuge in motion) were made on the centrifuge simulator. Pilots who were properly fitted into the seat and restraints; had at least 10 hours of static simulator practice; and had previous high acceleration experience could control the X-15 centrifuge simulator through parts of the design missions (computed aircraft speeds greater than Mach 2) while receiving the accelerations greater than 1 G continuously computed in magnitude and direction as a consequence of their control and used as centrifuge drive signals. Pilots who did not meet these specifications did notably less well dynamically than statically, a consequence attributed to their incorrect control responses while under acceleration or to their less rapid detection of a correction for the involuntary pilot inputs produced by the flight loads. Even the pilots who were scheduled to first fly the X-15 "crashed" the centrifuge simulator on their first experiences with certain of the more difficult flight conditions involving unaugmented controls. During these programs, improvements in instrument arrangement, kinematic design and grip of the right hand console control stick, and pilot restraint, notably a head support and seat design, were made. The final cockpit configuration and the dynamic control characteristics were acceptable to the pilots who will first fly the X-15. (Author)

969

Clark, C.C. & J.D. Hardy 1960 GRAVITY PROBLEMS IN MANNED SPACE STATIONS (In, Institute of Aeronautical Sciences, NASA, and The Rand Corporation, Proceedings of the Manned Space Station Symposium, Los Angeles, Calif., April 20-22, 1960, pp. 104-113.

ABSTRACT: If man is to live in space stations, the problems of living in a weightless environment must be resolved. First, restraint systems must be developed. Next, movements of the head must be kept to low magnitude to avoid disorienting illusions and nausea. Third, normal repair of bone and muscle may require artificial gravity. And last, it may be necessary to develop exercises to use prior to changes of acceleration level.

970

Clark, C., & J. Hardy 1960 GRAVITY PROBLEMS IN MANNED SPACE STATIONS.  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-6033,  
29 March 1961. ASTIA AD 255 592.

ABSTRACT: Unpowered flight above an atmosphere will produce weightlessness throughout a non-rotating space vehicle or along the axis of rotation of a rotating vehicle and if man is to live in space stations the relative merits and problems of living in a gravitational or in a weightless environment must be resolved. Four points concerning this problem are emphasized: (1) restraint systems, both for man and for moveable objects will have to be developed for use in the weightless (zero G) state; (2) in a rotating space station, velocities of linear or angular motions of the head may have to be kept of low magnitude by using restraints and possibly eye prism devices, mirror walls, etc., to reduce the need for head motions, to avoid disorienting illusions and nausea; (3) normal growth of the embryo and the young and normal repair of adult tissues, such as bone and muscle, which are affected in cellular patterns by force distributions, may require artificial gravity; and (4) it may be necessary to develop exercises and other procedures to use prior to changes of acceleration level to restore or develop tolerance to the new level in spite of acclimatization to the old level. (Author)

971

Clark, C.C. 1960 OBSERVATIONS OF A HUMAN EXPERIENCING 2G FOR 24 HOURS.  
(Paper presented at 31st annual meeting of the Aerospace Medical Assoc.,  
9-11 May 1960, Miami, Fla.)

ABSTRACT: Details particulars concerning a subject's 24-hour ride on the Johnsville centrifuge. Acceleration was 2 g, mostly in the direction chest to back, though direction varied when subject moved from couch or walked. Subject cooked, ate, slept, and made observations of his pulse rate, blood pressure and temperature, and looked for handwriting and speech changes. Subject experienced some mild discomfort from dimming of peripheral vision and nausea during the first two hours, and an anesthesia sensation in the ring and little fingers of the left hand which began in the sixteenth hour and which left some tingling sensation for about 2 months after the experiment. During the run, the white blood cell count increased from 11,300 to 22,000 per cu. mm. A feeling of lightness persisted for thirty minutes after the centrifuge stopped. An abrupt head motion thirty minutes after the run induced retching, but other recovery seemed uneventful.

972

Clark, C.C. 1960 NAVY CENTRIFUGE SIMULATION OF LOW ALTITUDE FLIGHT OF THE  
A2F, PROGRAM 1; REPORT ON THE CENTRIFUGE PROGRAM AND THE CONFERENCES OF.  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6005, March 29, 1960  
CONFIDENTIAL

973

Clark, C. C. and J. D. Hardy 1960 GRAVITY PROBLEMS IN MANNED SPACE STATIONS  
In: Proceedings of the MANNED SPACE STATIONS SYMPOSIUM, Los Angeles,  
Calif. (Publ. by IAS, New York, 1960)  
Also: Naval Air Development Center, Aviation Medical Acceleration Lab.,  
Johnsville, Pa. Rept. No. MA-6033 ASTIA AD 255 592

ABSTRACT: Unpowered flight above an atmosphere will produce weightlessness throughout a non-rotating space vehicle or along the axis of rotation of a rotating vehicle and, if man is to live in space stations, the relative merits and problems of living in a gravitational or in a weightless environment must be resolved. Four points concerning this problem are emphasized: (a) Restraint systems, both for man and for moveable objects, will have to be developed for use in the weightless (zero G) state; (b) In a rotating space station, velocities of linear or angular motions of the head may have to be kept of low magnitude by using restraints and possibly eye prism devices, mirror walls, etc., to reduce the need for head motions, to avoid disorienting illusions and nausea; (c) Normal growth of the embryo and the young and normal repair of adult tissues, such as bone and muscle, which are affected in cellular patterns by force distributions, may require artificial gravity; (d) It may be necessary to develop exercises and other procedures to use prior to changes of acceleration level to restore or develop tolerance to the new level in spite of acclimatization to the old level.

974

Clark, C. C., & R. F. Gray 1961 A DISCUSSION OF RESTRAINT AND PROTECTION OF THE HUMAN EXPERIENCING THE SMOOTH AND OSCILLATING ACCELERATIONS OF PROPOSED SPACE VEHICLES. In Bergeret, P., ed., Bio-Assay Techniques for Human Centrifuges and Physiological Effects of Acceleration. (London, New York, Paris: Pergamon Press, 1961) AGARDograph 48. Pp. 65-95

ABSTRACT: The authors discuss the acceleration times necessary for achieving either acceleration or deceleration in the case of the velocities required in space travel; they emphasize the fact that the speeds actually attained are only a start. In order to reduce to a minimum the duration of the journey, it is important to achieve an acceleration during the first half and a deceleration during the second half. The authors describe methods of reproducing these accelerations by means of centrifuges. They emphasize that the deceleration at the moment of re-entry into the atmosphere depends on the shape of the vehicle. They also describe the oscillations caused by a fault in the adaptation of the propulsion system to provide lift.  
So that man may be able to move when he is subjected to acceleration, the constraints on the head and limbs must be reduced to a minimum. In order to minimize an involuntary action by the pilot on the controls, the study must be conducted

simultaneously of the attachments and the controls. A couch moulded to the shape of the body constitutes a support and reduces distortions. Due to a couch of this kind, a subject was able to withstand 25g (in the chest-back direction) as a peak value of a sinusoidal variation of acceleration having a period of 40 sec. Bandaging fastened to the body and especially adequate training in the technique of general muscular tension are important aspects of these experiments. Immersion in water can contribute to a reduction of the body distortions during the acceleration phase especially if the lungs are pressurized. In an anti-g capsule cast in aluminum and filled with water, a subject was able to withstand up to 31 g (in the back-chest direction) as the peak value of a sinusoidal variation of acceleration having a period of 25 sec., the peak value being held, moreover, for 5 sec. Thanks to these protective methods, the visual indications afforded by the greyout or the blackout of the limit or tolerance to acceleration are not observed. The subject's experiencing of pain is not sufficient to predict exactly the advent of trouble. Additional tests are actually being perfected on the physiological, psychological and biochemical aspects with the aim of observing the effects of acceleration both immediately and later. Work on the effects of long duration accelerations continues; a human being was able to withstand 2g for 24 hours. (Editors Summary)

975

Clark, C. 1961 ACCELERATION AND BODY DISTORTION. (The Martin Company, Baltimore, Md.) Rept. ER 12138

ABSTRACT: I urge the point of view that tolerance to acceleration depends more on the extent of body distortion as a consequence of the interaction of the reactive forces due to the acceleration and the opposing forces due to tissue displacements and to the restraint system than on the reactive force due to acceleration alone.

976

Clark, Carl 1961 PHYSIOLOGICAL ASPECTS OF LOW ALTITUDE FLIGHT.  
(Paper, Panel on Acceleration Stress of the Armed Forces-NRC Committee on Bio-Astronautics, 6-11 March 1961, NASA Ames Research Ctr., Moffett Field, Calif.)

977

Clark, Carl 1961 CENTRIFUGE SIMULATION OF THE X-15 RESEARCH AIRCRAFT  
(Paper, Panel on Acceleration Stress of the Armed Forces-NRC Committee on Bio-Astronautics, 6-11 March 1961, NASA Ames Research Ctr., Moffett Field, Calif.)

978

Clark, C.C. 1961 SOME BODY DISPLACEMENTS AND MEDICAL EFFECTS OF LATERAL ACCELERATIONS DURING NAVY CENTRIFUGE SIMULATION OF EJECTION CAPABILITIES FROM THE ARMY AO AIRCRAFT. (Aviation Medical Acceleration Lab., Naval Air Development Center, Johnsville, Pa.) Final Report. NADC-MA 6044, 11 April 1961. ASTIA AD 257 371.

ABSTRACT: For steadily applied lateral loads in the Martin-Baker Mark J5 Ejection Seat and restraint system in use in the YAO-1 aircraft, lateral displacement of the pilot is such as to make questionable safe ejection at 2 G past the canopy beam located 12.5 in from the seat center, even with the restraint harness tighter than would be the case in general flying. With additional equipment on the pilot inside of the restraint harness, lateral displacements will probably be increased. For steadily applied lateral loads above 2 G, this study indicates that lateral displacements of the pilot would preclude safe ejection. The theoretical discussion in the previous section indicates that either body motion damping effects, reducing displacements, or resonance overshoot effects, increasing displacements might occur for the shorter duration acceleration pulses of aircraft in-flight accidents.

979

Clark, C.C. & J.D. Hardy 1961 MAN UNDER ACCELERATION: A PHYSIOLOGICAL ACCELERATION TERMINOLOGY. (Aviation Acceleration Lab., U.S. Naval Air Development Ctr., Johnsville, Pa.). A Brochure.

ABSTRACT: As man attains increasing speeds as he is borne into the vast expanses of space, having cracked out from his nurturing shell of earth atmosphere, his real or potential accelerations increase. In connection with the work of the Acceleration Panel a "physiological acceleration terminology" has been developed to insure an adequate acceleration description of these experiences. A detailed discussion is presented in the work "Reports on Human Acceleration: Future Magnitudes, Medical Safety, An Indexing Method for Bibliography, and Terminology", edited by Dr. James D. Hardy, Chairman of the Acceleration Panel, to be published for the panel by the National Research Council. (See Bates, George, et al. NAS-NRC Publication 913, 1961). This brochure summarizes the recommended physiological acceleration terminology. (1) The unit for the physiological acceleration shall be G to distinguish this acceleration from the "true" displacement acceleration, generally designated by aerodynamicists with the unit g. The physiological acceleration represents the total reactive force divided by the mass, and hence includes both displacement and resisted gravitational acceleration effects. (2) The physiological acceleration axes represent directions of the reactive displacements of organs and tissues with respect to the skeleton. The Z axis is down the spine, with +Gz (unit vector) designations for accelerations causing the heart, etc. to displace downward (caudally). The X axis is front to back, with +Gx designations for accelerations causing the heart to be displaced to the left. (3) Angular accelerations which cause the heart to rotate (roll) to the left within the skeleton shall be specified by the Rx unit vector, representing radians/sec<sup>2</sup> about the X axis. Angular velocities in the same sense shall be specified by the +Rx unit vector, representing radians/sec about the X axis.

Similarly,  $+R_x$  represents an angular acceleration producing a pitch down of the heart within the skeleton, and  $+R_z$  represents yaw right of the heart within the skeleton. (4) Whenever rotations accompany linear accelerations, the reference point for the linear accelerations should be specified, and the time histories of the angular velocities and angular accelerations should be specified, and the time histories of the angular velocities and angular accelerations should accompany the time histories of the linear accelerations, to allow the computation of linear accelerations at other points. (Author)

980

Clark, C.C., J.D. Hardy & R.J. Crosbie 1961 A PROPOSED PHYSIOLOGICAL ACCELERATION TERMINOLOGY WITH AN HISTORICAL REVIEW. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-6118. Also in George Bates et al. Human Acceleration Studies (National Academy of Sciences - National Research Council, Washington, D.C.) Publication 913, 1961. Pp. 7-65.

981

Clark, C. C. 1961 SOME BODY DISPLACEMENTS AND MEDICAL EFFECTS OF LATERAL ACCELERATIONS DURING NAVY CENTRIFUGE SIMULATION OF EJECTION CAPABILITIES FROM THE ARMY AO AIRCRAFT. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-6044; ASTIA AD-257 371 11 April, 1961

SUMMARY: A Martin-Baker Mark J5 seat, used in the Army YAO-1 "Mohawk" prototype aircraft, was mounted facing tangentially on the Navy Johnsville Human Centrifuge at a radius of 41 feet from the centrifuge center. A beam was installed 12.5 inches laterally from a plane through the seat center to the subject's upper right, simulating the canopy beam of the aircraft past which the pilot must clear on an ejection. Motion picture cameras centered in the vertical plane through the beam viewed the subject from the front and from the top (Bureau of Medicine and Surgery Technical Film Report Med. 7-60). Centrifuge runs with four subjects, one wearing a life vest and one a heavy flight jacket and life vest were filmed at 2 G, 3 G, 4 G (3 subjects), and 5 G (1 subject) of radial acceleration. Seat pan heights were not adjusted for the individual subjects. The restraint harness was worn in a very tight condition. The Martin-Baker leg restraint was worn in the flight condition, providing some lateral leg restraint. For steadily applied lateral loads, lateral displacement of the pilot is such as to make questionable, safe ejection past the canopy beam at 2 Gy. With additional equipment on the pilot inside of the restraint harness, lateral displacements will probably be increased. For steadily applied lateral loads above 2 Gy, lateral displacements of the pilot would preclude safe ejection. Except when bulky equipment is worn, shoulder displacements are minimally damped, reaching maximum values essentially synchronously with peak G. At 4 Gy the head may be tipped involuntarily under the canopy beam after several seconds at peak G. At 5 Gy the head is further tipped involuntarily; the one subject experienced a scleral hemorrhage on this run. (AUTHOR)

982

Clark, C.C. & W. Augerson, 1961 HUMAN ACCELERATION TOLERANCE WHILE BREATHING 100 PER CENT OXYGEN AT 5 PSIA PRESSURE.  
(Paper presented at 32nd annual meeting, Aerospace Medical Association, 24-27 April 1961, Chicago, Ill.)

ABSTRACT: Low pressure gas provides less support against collapse of the chest under acceleration than atmospheric pressure gas. When breathing pure oxygen, the collapsed lung structures may not reinflate as rapidly after acceleration. Preliminary low pressure studies indicate individual variations in response to  $+G_x$  or  $+G_x$  tumbling to  $-G_x$  acceleration, ranging from severe chest pain, to temporary post-run dyspnea, to no unusual sensations but with minor atelectasis detectable by x-rays or moderate temporary post-run vital capacity reduction, to no detectable responses. Injury may be more severe at lower G for longer duration, with respiration, than at higher G for shorter durations, with straining, including the valsalva maneuver with an inflated chest above  $+8G_x$ . With training in the breathing and straining procedure, no subject was incapacitated by acceleration at low pressure. (Aerospace Med., 32(3):226, March 1961)

983

Clark, C.C. 1961 MOTION PICTURES, SCENE DESCRIPTIONS, AND SAFETY PROCEDURES OF NAVY, CENTRIFUGE SIMULATIONS OF THE X-15 RESEARCH AIRCRAFT: PROGRESS REPORT CONCERNING (Naval Air Development Center, Johnsville, Pa.)  
NADC-MA L6126, 26 July 1961. ASTIA AD 271 927.

ABSTRACT: This is a series of memorandums concerning the progress of the Navy centrifuge simulations of the X-15 research aircraft.

984

Clark, C.C. and D. Faubert 1961 A CHRONOLOGICAL BIBLIOGRAPHY ON THE BIOLOGICAL EFFECTS OF IMPACT  
(The Martin Co., Baltimore, Md.) Engineering Report no. 11953, Sept. 27, 1961

ABSTRACT: This bibliography (with items covering the period between 1914 and 1961) has been compiled as a preliminary effort to develop a more complete bibliography on the biological effects of acceleration. A chronological index (sequenced within each year alphabetically by author) is the principal index; however, author and organizational indexes are also included. Works selected for inclusion were limited to those with accelerations greater than 10 g and rates of accelerations greater than 20 g/sec.

985

Clark, C.C. 1961 ADDITIONS TO A CHRONOLOGICAL BIBLIOGRAPHY ON THE BIOLOGICAL EFFECTS OF IMPACT

(The Martin Co., Baltimore, Md.) Engineering Report No. 11953-Appendix, Nov. 22, 1961. 55 p.

ABSTRACT: These additions to the bibliography were submitted by several authors and organizations participating in the Symposium on Impact Acceleration Stress at San Antonio, Texas, November 27-29, 1961.

986

Clark, C.C., D. Faubert & B. Cooper 1962 A CHRONOLOGICAL BIBLIOGRAPHY ON THE BIOLOGICAL EFFECTS OF IMPACT.

In Impact Acceleration Stress: Proceedings of a Symposium With a Comprehensive Chronological Bibliography, National Academy of Sciences, National Research Council Publication No. 977, pp. 373-458.

ABSTRACT: A chronological bibliography on the biological effects of impact acceleration is described. Achronological index, an author index and an organization index is included.

987

Clark, C.C. 1962 TECHNICAL FILM REPORTS AND SCENE DESCRIPTIONS ON CENTRIFUGE STUDIES OF HUMAN ACCELERATION TOLERANCE AND PROTECTION ( MED 9-61) AND FLIGHT SIMULATION AND TRAINING WITH THE NAVY CENTRIFUGE, 1957-1960 (MED 8-61). (U.S. Naval Air Development Center, AMAL, Johnsville, Pa.) NADC-MA-L6127. 22 Jan. 1962.

988

Clark, C.C. 1962 HUMAN CONTROL PERFORMANCE AND TOLERANCE UNDER SEVERE COMPLEX WAVEFORM VIBRATION WITH A PRELIMINARY HISTORICAL REVIEW OF FLIGHT SIMULATION.

(The Martin Co., Baltimore, Md.) Engineering Report no. 12406, April 1962.

ABSTRACT: Problems of terminology of acceleration and flight simulation are reviewed, with a preliminary historical review of particularly moving base flight simulation. The capabilities and limitations of the Navy Johnsville human centrifuge and the North American Aviation (Columbus) "G-seat" for jostle simulation are presented; the latter is more realistic. Potential developments of restraints, displays, and controls for use in severe jostle environments are noted. A "relative jostle biological effectiveness" concept is suggested for test as a means of comparing the biological effects of jostle environments with different frequency components.

989

Clark, C., B. Cooper, & C. Blechschmidt 1963 HUMAN VIBRATION AND IMPACT ISOLATION WITH A PROTOTYPE FULL LENGTH AIR BAG RESTRAINT SYSTEM. (Life Sciences & Structures Departments, Martin Company, Baltimore, Md.) Engineering Rept. No. 12799, Feb. 1963.

ABSTRACT: A preliminary air bag restraint system has been developed, with the subject supported in front and back by full length air bags inflated within a box container of 22 x 34 x 84 inches at pressures up to 10 inches of water. An opening through the top bag and box allows respiration. By November 1, 1962, 95 vibration tests and 68 impact tests with three subjects had been carried out. With a box vibration of  $1G_x + 3G_x$  (sine wave) at 11 cps and a lower bag pressure of 3.5 inches of water, the subject experienced  $1G_x + 0.4G_x$  (sine wave) at 11 cps, for five minutes with only slight discomfort. To prevent waist flexure during impact, the subject lay on a back board. With a box impact into sand from four feet up, hitting at 16 feet per second with a peak deceleration recorded of  $310G_x$ , and with the lower air bag at 10 inches of water pressure and the upper at 7 inches of water pressure, the accelerometer on the hip of the subject peaked at  $17.2G_x$ . A valve system for dumping the bag pressure at maximum displacement, to prevent rebound, is under development. Technical developments of means of control to prevent "bottoming" and to vary resonance frequencies warrant further exploration of acceleration isolation restraint systems. (Aerospace Medicine 34(3):250, March 1963)

990

Clark, Carl & Carl Blechschmidt 1963 HUMAN VIBRATION AND IMPACT ISOLATION WITH A PROTOTYPE FULL LENGTH AIR BAG RESTRAINT SYSTEM  
Paper: 34th Annual Meeting of the Aerospace Medical Association, Statler-Hilton Hotel, Los Angeles, Calif., April 28 - May 2, 1963

ABSTRACT: A preliminary air bag restraint system has been developed, with the subject supported in front and back by full length air bags inflated within a box container of 22 x 34 x 84 inches at pressures up to 10 inches of water. An opening through the top bag and box allows respiration. By November 1, 1962, 95 vibration tests and 68 impact tests with three subjects had been carried out. With a box vibration of  $1G_x + 3G_x$  (sine wave) at 11 cps and a lower bag pressure of 3.5 inches of water, the subject experienced  $1G_x + 0.4G_x$  (sine wave) at 11 cps, for five minutes with only slight discomfort. To prevent waist flexure during impact, the subject lay on a back board. With a box impact into sand from four feet up, hitting at 16 feet per second with a peak deceleration recorded of  $310G_x$ , and with the lower air bag at 10 inches of water pressure and the upper at 7 inches of water pressure, the accelerometer on the hip of the subject peaked at  $17.2G_x$ . A valve system for dumping the bag pressure at maximum displacement, to prevent rebound, is under development. Technical developments of a means of control to prevent "bottoming" and to vary resonance frequencies warrant further exploration of acceleration isolation restraint systems.

991

Clark, D.C. - 1960 THE TURNING BEHAVIOR OF ARTICULATED TRACK-LAYING VEHICLES.  
(Ordnance Tank-Automotive Command, Detroit, Mich.) Rept. no. RR-16  
March 1960. ASTIA AD 256 336.

ABSTRACT: The turning behavior of articulated vehicles was investigated to determine the optimum configuration for a two-unit articulated vehicle performing on hard ground at low centrifugal accelerations. It was found that for these conditions, vehicle response is linear and a function of geometry only.  
(Author)

992

Clark, E. 1960 NEW METHODS PROBE SPACE FLIGHT HAZARDS.  
Aviation Week and Space Technology 72(21):54-59, 23 May 1960.

ABSTRACT: Current and projected investigations on the effects of radiation and weightlessness on humans in space are discussed. Results obtained from altitude studies of the effects of heavy particles on bread mold (*Neurospora crassa*) promise a more detailed understanding of the effects of radiation damage to living tissue. Shielding studies, to date, still indicate the need for very heavy shielding to protect a manned space vehicle against heavy solar and galactic radiation. The development of a null-gravity simulator, which allows test subjects to be suspended in a spinning tank of water, is expected to promote further understanding of the effects of weightlessness by depriving the subject of proprioceptive cues from the muscles, cues from the vestibule of the ear, and any visual indication of vertical or horizontal. The physiologic effects resulting from a 24-hour exposure to a constant acceleration force of 2 g in the human centrifuge are also summarized, as well as preliminary data from noise tests and experimental life support systems.

993

Clark, R. T. et al 1960 BASIC RESEARCH PROBLEMS IN SPACE MEDICINE:  
A REVIEW  
Aerospace Medicine 31(7):553-577 July 1960

ABSTRACT: This article contains information on the following subjects: Studies of the Subgravity State During Parabolic Flight; Bio-Packs for Satellites; Disorientation in Pilots; Photosynthetic Gas Exchangers and Recyclers in Closed Ecological System Studies; Survival of Terrestrial Organisms under Extreme Environmental Conditions; and Physiological Aspects of Training and Selection for Manned Extraterrestrial Flights.

994

Clark, W.G., J.P. Henry, & D.R. Drury 1944 DETERMINATION OF THE MOST SATISFACTORY SINGLE CONSTANT PRESSURE WITH WHICH TO INFLATE THE STANDARD GRADIENT PRESSURE SUIT. (National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM No. 366. 1 Sept. 1944.

ABSTRACT: (a) A quantitative measure in terms of "g" units of the protection offered by the Navy Gradient Pressure Suit (inflated to uniform constant pressures of 1 to 10 psi) against visual symptoms was made by 400 centrifuge runs on 14 subjects. (b) These protections were contrasted with subjective estimations of comfort at rest, at 2.5 "g", and at maximum acceleration. (c) The highest single pressure throughout the suit which was comfortable to the average subject during acceleration at 2.5 "g" was 5 psi. (d) The average protection afforded by 5 psi was 1.3 "g". (e) Protections of 1.85 "g" are obtainable by using pressures of 7 to 10 psi.

995

Clark, W.G., J.P. Henry, P.O. Greeley and D.R. Drury 1945 STUDIES ON FLYING IN THE PRONE POSITION. (National Research Council, Committee on Aviation Medicine) Contract No. OEMcror-288, CAM Report No. 466, 20 August 1945.

ABSTRACT: Seven subjects in a prone position installation on the centrifuge were exposed to high dorso-ventral acceleration. Five of them experienced 12 g for from 10 to 30 seconds. The unsupported head cannot be lifted above 9 g. The body, legs, and arms cannot be lifted at 8 g. At 12 g there is little or no impairment of, 1) vision, 2) muscular ability to pull against controls with the arms, 3) ability to flex and extend the ankles against rudder pedals, 4) movements of the forearms, hands, and fingers, such as in removing and replacing an object hanging on a hook, adjusting an oxygen mask, and pushing or pulling controls and signal buttons. A padded chin rest is uncomfortable above 6 g. When it alone is employed, speech is impossible above 8 g except through clenched teeth. Breathing can be maintained at 12 g. A counter-weighted headgear is described which permits free head movements and speech at 12 g, and which believes pressure on the chin. Visual symptoms including blackout, occur at 10-12 g if the head is lifted 4-6 inches above the chin rest.

A body rest described which consists of a laced canvas hammock. With the counter-weighted headgear described, and this bed installed in a wooden prone position mockup, 10 subjects tested up to 2 hours experienced no discomfort which theoretically could not be relieved by proper modifications of the devices. It is concluded that the prone position is quite feasible for flights of at least two hours duration.

996

Clark, W.G. & H. Jorgenson 1945 EFFECT OF INGESTION OF FOOD AND FLUID ON TOLERANCE OF HUMAN SUBJECTS TO POSITIVE ACCELERATION.  
(National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept. No 502  
See also Fed. Proc. 5:17. 1946.

ABSTRACT: The effects on g tolerance of the ingestion of 1.5-2.0 liters of water or milk, or a heavy meal were studied in eight centrifuge-trained subjects during the course of 200 centrifuge runs. The centrifuge attained maximum acceleration at the rate of 3 g's per second and maintained it for 15 seconds. Tolerance to g was determined from recorded responses to visual and auditory signals and to changes in ear opacity (blood content of the ear). In addition, intrarectal pressure changes were recorded.

A small increase in g tolerance was induced by a full stomach which averaged 0.3-0.4 g (range from 0.0 to 1.1 g). In relaxed subjects with an empty stomach, the average increase per g in intrarectal pressure was 18.5 mm. Hg. The increase due to fluid ingestion is slightly greater, being 7-9 mm. Hg at 3 and 4 g, respectively. The intrarectal pressure increase induced by voluntary muscular and respiratory straining is of the order of 40 mm. for 1 g protection. When divided into 7-9 mm., this gives 0.2 protection at this level of g, which is good agreement.

From the work of others, blood pressure increases due to fluid or food ingestion are too slight to explain the effect. Fluid and food ingestion has been shown by others to increase cardiac output without evoking vasomotor mechanisms or causing displacement of blood from the somatic tissues to the visceral organs. Increase in intra-abdominal pressure caused by the ingestion seems the logical explanation of the effect, just as g tolerance can be enhanced 0.5-0.8 g by increasing intra-abdominal pressure by pressurized abdominal belts and bladders in anti-blackout suits.

997

Clark, W.G., K.D.R. Gardiner, A.K. McIntyre, & H. Jorgenson 1945 THE EFFECTS OF POSITIVE ACCELERATION ON FLUID LOSS FROM BLOOD AND TISSUE SPACES IN HUMAN SUBJECTS ON THE CENTRIFUGE.  
(National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept. No. 468. Oct. 1945.  
See also Fed. Proc. 5:17. 1946.

ABSTRACT: As estimated by hematocrits and plasma protein determinations, fluid loss from blood to tissue spaces occurred in six seated human subjects on the centrifuge. At near blackout levels of G (3.5 to 5.0 G) maintained for 3-5 minutes, a significant loss of fluid (3.6-4.5 cc./100 cc. blood; or 216-270 cc. total) was found. The loss in four subjects exposed to 4 G for 5 minutes was reduced by anti-G suits to an average of 75% (ranges 28-96%) of their loss when unprotected. In two cases subjected to 3.5 G for 5 minutes, the loss was less than that of the four subjects exposed to 4.0 G for 5 minutes. In one subject submitted to 5 G for 3 minutes, the loss was less than that he obtained at 4 G for 5 minutes, although after-effects were noticed in vision. A smaller loss (132 cc. total) occurred in one of the subjects who had 30 runs of 4.7 G for 10 seconds with a 2 minute interval between runs, than occurred in the same subject after a 5 minute uninterrupted run at 4.0 G (288 cc.).

At 4.0G, the fluid losses observed were much less than those reported elsewhere for centrifuged dogs, but recovery occurred more rapidly. The losses also were less than those reported elsewhere for postural changes of humans from the recumbent to the upright positions. It is unlikely that fluid losses due to G contribute to any fatiguing effects or detrimental residual effects possibly resulting from positive acceleration experienced by test pilots or fighter pilots in combat.

998

Clark, W.G. & H. Jorgenson 1945 STUDIES OF SELF-PROTECTIVE ANTI-BLACKOUT MANEUVERS. (National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept. No. 488, Oct. 1945.

999

Clark, W.G., I.D.R. Gardiner, A.K. McIntyre & H. Jorgenson 1945 EFFECT OF HYPERGLYCEMIA AND INSULIN HYPOGLYCEMIA ON MAN'S TOLERANCE TO POSITIVE ACCELERATION.  
(National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept. No. 486. 29 Oct. 1945.  
See also: Fed. Proc. 5(1):17, 1946.

ABSTRACT: Hyperglycemia induced by the ingestion of two grams of sugar per kilogram body weight, and insulin hypoglycemia at a level of 50-55 mg.% blood sugar concentration, had no significant effect on the g tolerance of three trained centrifuge subjects, studied during the course of 43 centrifuge runs. The centrifuge attained maximum acceleration at the rate of 3 g's per second and maintained it for 15 seconds. The sugar or insulin was administered after a 12 hour fast. The centrifuge assays of g tolerance were performed during the normal state after a 12 hour fast, followed by the hyperglycemic state. The average units of plain insulin injected subcutaneously per kilogram per hour averaged 0.17. Tolerance to G was determined during a series of centrifuge runs at levels of g which kept vision clear, up through those which caused blackout, by changes in recorded responses to visual and auditory signals and by changes in ear opacity (blood content of the ear).

1,000

Clark, W. G., I.D.R. Gardiner, A. K. McIntyre & H. Jorgenson 1946 THE EFFECT OF POSITIVE ACCELERATION ON FLUID LOSS FROM BLOOD TO TISSUE SPACES IN HUMAN SUBJECTS ON THE CENTRIFUGE.  
Fed. Proc. 5:17-18

ABSTRACT: As estimated by hematocrits and plasma protein determinations, fluid loss from blood to tissue spaces occurred in six seated human subjects on the centrifuge. At near blackout levels of G (3.5 to 5.0 G) maintained for 3-5 minutes, a significant loss of fluid (3.6-4.5 cc./100 cc. blood; or 216-270

cc. total) was found. The loss in four subjects exposed to 4 G for 5 minutes was reduced by anti-G suits to an average of 75% (range 28-96%) of their loss when unprotected. In two cases subjected to 3.5 G for 5 minutes, the loss was less than that he obtained at 4 G for 5 minutes, although after-effects were noticed in vision. A smaller loss (132 cc. total) occurred in one of the subjects who had 30 runs of 4.7 G for 10 seconds with a 2 minute interval between runs, than occurred in the same subject after a 5 minute uninterrupted run at 4.0 G (288 cc.).

At 4.0 G, the fluid losses observed were much less than those reported elsewhere for centrifuged dogs, but recovery occurred more rapidly. The losses also were less than those reported elsewhere for postural changes of humans from the recumbent to the upright positions. It is unlikely that fluid losses due to G contribute to any fatiguing effects or detrimental residual effects possibly resulting from positive acceleration experienced by test pilots or fighter pilots in combat.

1,001

Clark, W.G., I.D.R. Gardiner, A.K. McIntyre, and H. Jorgenson 1946 EFFECT OF HYPERGLYCEMIA AND INSULIN HYPOGLYCEMIA ON MAN'S TOLERANCE TO POSITIVE ACCELERATION. Fed. Proc. 5(1):17  
See also (National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept No. 486, 1945.

ABSTRACT: Hyperglycemia induced by the ingestion of two grams of sugar per kilogram body weight, and insulin hypoglycemia at a level of 50-55 mg.% blood sugar concentration, had no significant effect on the g tolerance of three trained centrifuge subjects, studied during the course of 43 centrifuge runs. The centrifuge attained maximum acceleration at the rate of 3 g's per second and maintained it for 15 seconds. The sugar or insulin was administered after a 12 hour fast. The centrifuge assays of g tolerance were performed during the hypoglycemic state and were repeated after return to normal; and during the normal state after a 12 hour fast, followed by the hyperglycemic state. The average units of plain insulin injected subcutaneously per kilogram per hour averaged 0.17. Tolerance to G was determined during a series of centrifuge runs at levels of g which kept vision clear, up through those which caused blackout, by changes in recorded responses to visual and auditory signals and by changes in ear opacity (blood content of the ear).

1,002

Clark, W.G. and H. Jorgenson 1946 EFFECT OF INGESTION OF FOOD AND FLUID ON TOLERANCE OF HUMAN SUBJECTS TO POSITIVE ACCELERATION.  
Fed. Proc. 5:17  
See also (National Research Council, Committee on Aviation Medicine, Washington, D.C.) CAM Rept. 502, 1945.

ABSTRACT: The effects on g tolerance of the ingestion of 1.5-2.0 liters of water or milk, or a heavy meal were studied in eight centrifuge-trained subjects during the course of 200 centrifuge runs. The centrifuge attained maximum

acceleration at the rate of 3 g's per second and maintained it for 15 seconds. Tolerance to g was determined from recorded responses to visual and auditory signals and to changes in ear opacity (blood content of the ear). In addition, intrarectal pressure changes were recorded.

A small increase in g tolerance was induced by a full stomach which averaged 0.3 - 0.4 g (range from 0.0 to 1.1 g). In relaxed subjects with an empty stomach, the average increase per g in intrarectal pressure was 18.5 mm. Hg. The increase due to fluid ingestion is slightly greater, being 7-9 mm. Hg at 3 and 4 g, respectively. The intrarectal pressure increase induced by voluntary muscular and respiratory straining is of the order of 40 mm. for 1 g protection. When divided into 7-9 mm., this gives 0.2 g protection at this level of g, which is good agreement.

From the work of others, blood pressure increases due to fluid or food ingestion are too slight to explain the effect. Fluid and food ingestion has been shown by others to increase cardiac output without evoking vaso-motor mechanisms or causing displacement of blood from the somatic tissues to the visceral organs. Increase in intra-abdominal pressure caused by the ingestion seems the logical explanation of the effect, just as g tolerance can be enhanced 0.5-0.8 g by increasing intra-abdominal pressure by pressurized abdominal.

1,003

Clark, W.G., & R.L. Christy 1946 USE OF THE HUMAN CENTRIFUGE IN THE INDOCTRINATION OF A NAVY FIGHTER SQUADRON IN THE USE OF ANTIBLACKOUT EQUIPMENT. J. Aviation Med. 17:394-398

ABSTRACT: Tests were conducted to determine if the use of human centrifuges would be practicable and useful for selecting and testing pilots with respect to their inherent "G tolerance," and for indoctrinating them in the use of anti-blackout equipment and self-protective maneuvers. The studies failed to show any significant difference in G protection on the centrifuge between the z-1 and z-2 suits. An increase in suit pressurization up to the limits of comfortably tolerable pressures, gave more protection both on the centrifuge and in the airplanes. The majority of the pilots liked the centrifuge indoctrination and tests. None of the pilots tested could point out any of their member who blacked out more or less easily in dog-fights and section tactics in spite of the fact that individual inherent blackout thresholds on the centrifuge varied from 3.0 G to 5.5 G. Apparently this was a result of compensation by self-protective maneuvers. Pilots wearing the suit report that they are not straining as much as without the suit, and that they are able to fly two to three times as much in combat tactics and gunnery practice as formerly because of the anti-fatigue benefits of the suit. For this reason, centrifuge indoctrination and training would seem to be important in order to assure that each pilot has a normal G tolerance and that he receives an adequate protection from antiblackout suits.

1,004

Clarke, A.C. 1950 INTERPLANETARY FLIGHT. AN INTRODUCTION TO ASTRONAUTICS  
(New York: Harper)

ABSTRACT: Ch. 6, Interplanetary flight; ch. 7, The atomic rocket; and ch. 8, Space ships and space stations.

1,005

Clarke, A.E. & R.L. Maltby 1954 THE VERTICAL SPINNING TUNNEL AT THE NATIONAL AERONAUTICAL ESTABLISHMENT, BEDFORD (Royal Aircraft Establishment Gt. Brit.)  
September 1954, ASTIA AD-48 610

ABSTRACT: The Spinning Tunnel at the National Aeronautical Establishment is described. The choice of size and type of tunnel as well as some of the more interesting features of the design are discussed. The description has been made before the tunnel was completed and some of what has been written may need revision in the light of experience.

1,006

Clarke, N.P. & S. Bondurant 1958 HUMAN TOLERANCE TO PROLONGED FORWARD AND BACKWARD ACCELERATION.  
(Aero Medical Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio) WADC TR 58-267. ASTIA AD 155 749.  
CF: J. Aviation Med. 30(1):1-21, 1959.

ABSTRACT: The imminence of manned space flight necessitated studies of human tolerance to the anticipated accelerations of exit and reentry. This report extends previous observations by defining optimal body positions for both forward and backward acceleration. Using a rate of onset of 0.5 g per second, plateaus between 2 and 12 g were maintained with subjects optimally positioned, until subjective loss of a critical faculty occurred. Forward acceleration of the seated subject with trunk inclined 25 degrees in the direction of acceleration was limited above 10 g by blackout. Below 10 g, tolerance was defined by inspiratory dyspnea and substernal pain. Using an especially designed restraint suit, backward acceleration of the seated subject with trunk and head erect was limited above 10 g by discomfort of restraint and increases in vascular pressure in the legs. Below 10 g, these same factors along with dyspnea defined tolerance. Three-stage rocket-like profiles of forward acceleration, using constant rates of onset calculated to give orbital velocity at the termination of the third stage, were found tolerable by selected subjects at peak accelerations of 8, 10, and 12 g. Spatial vector cardiography, respiratory rate, changes in functional residual capacity and pulmonary compliance were observed during both forward and backward acceleration. (Author)

1,007

Clarke, N.P., S. Bondurant, S.D. Leverett & P. Yudkofsky 1958 PHYSIOLOGIC RESPONSE TO "BACK TO CHEST" G FORCES ON SEATED HUMAN SUBJECTS. (Paper, 1958 Meeting of Aero Medical Association, Statler Hotel, Washington, March 24-26, 1958)

ABSTRACT: Transverse G patterns have previously been studied on human subjects in the standing, prone, supine and semi-supine positions. The present study involves an evaluation of the effects of prolonged back to chest G (longer than 5 seconds) acting on seated subjects on the human centrifuge. This attitude differs in that, with the arms and legs extended, there will be a pooling of blood in the extremities which simulates the effects of positive G loadings. Subjective symptoms, performance ability and bioelectric measurements were used as criteria for evaluation of changes occurring during a series of experiments in which both the magnitude and duration of acceleration were varied. Human tolerance to G of this type is limited by the development of petechial hemorrhages in the extremities, subject fatigue, tachycardia and dyspnea. Tentative tolerance limits for the unprotected subject appear to be on the order of 2 G for 30 minutes, 3 G for 7 minutes and 5 G for 7 to 10 seconds. Protective devices may significantly increase human tolerance to this type transverse G force. (J. Aviation Med. 29(3):233)

1,008

Clark<sup>e</sup>, N.P. 1959 STUDIES OF PRIMATE TOLERANCE TO SOME COMPLEX ACCELERATIONS. (Paper, Meeting of Aero Medical Association, Statler Hilton Hotel, Los Angeles, April 27-29, 1959)

ABSTRACT: Theoretical calculations and preliminary experiments have shown that stabilized ejection seat and capsule escape systems as well as other aerodynamically unstable bodies reentering the denser portion of the atmosphere will oscillate during the early stages of deceleration. To stimulate a portion of the acceleration pattern, experiments were done in which small primates were subjected to oscillations of up to 40° amplitude about their center of gravity at frequencies up to and including five cycles per second. The animals were exposed to simulated linear decelerations of up to 20g during the oscillation. Calculations show the animals sensed alternating headward footward accelerations of 6.8 g (at head level) and alternating backward accelerations of 34 g and 3.5 g during maximum amplitude and frequency of the unanesthetized subjects and later post mortem examination revealed no changes of magnitude to indicate permanent damage. (J. Aviation Med. 30(3):179-178, March 1959.)

1,009

Clark, N. P. 1959 HUMAN ACCELERATION EFFECTS FOR ROCKET FLIGHT.  
(Paper presented at ARS semi-annual meeting, 8-11 Jun.'59, San Diego)  
ARS paper no. 804-59, June 1959

ABSTRACT: This paper summarizes a portion of recent research pertinent to these acceleration forces, particularly of the prolonged accelerations which can be simulated with large centrifuges. The paper reviews subjective tolerance limits to prolonged acceleration and human response to prolonged acceleration using net support.

1,010

Clarke, N. P., & R. N. Headley 1959 STUDIES OF PRIMATE TOLERANCE TO SOME COMPLEX ACCELERATIONS. Aerospace Medicine 30(11):825-831  
See also WADC TR 59-630; ASTIA AD 233 464  
See also (Paper, Symposium on Biomechanics of Body Restraint and Head Protection, Naval Air Material Center, Philadelphia, Pa., June 14-15, 1961)  
See also (Paper, 30th Annual Meeting of Aero Medical Association, Los Angeles, Calif., April 29, 1959)

ABSTRACT: Satellite vehicles during unstable re-entry into the denser portions of the earth's atmosphere may be subjected to complex accelerations. Five primates were exposed to simulated deceleration in the forward facing position of up to 20 G combined with sine wave pitch oscillations through half amplitudes of 20 degrees at 3 and 5 cps. Accelerometer readings from the skull of one animal revealed maximum resultant backward acceleration of 40 G, footward acceleration of 10 G, and headward acceleration of 15 G. All animals were able to make coordinated movements almost immediately after centrifugation. Post-mortem examinations were made and are reported. (AUTHOR)

1,011

Clarke, N. P., A. S. Hyde and N. S. Cerniack, F. Lindberg 1959  
A PRELIMINARY REPORT OF HUMAN RESPONSE TO REARWARD FACING RE-ENTRY ACCELERATIONS. (Wright Air Development Center, Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio)  
WADC Tech Note 59-109 Proj. 7222 ASTIA AD 231 651

ABSTRACT: Tidal volume, electrocardiographic changes, tracking performance ability, and subjective response were evaluated during an acceleration profile designed to encompass several possible rearward facing re-entry patterns. A maximum acceleration of 16.5 g and a total time of 170 seconds were employed. Subjects faced the center of rotation with the trunk and head inclined 12° in the direction of the centrifuge axis. The subjects were supported with a contoured net system. Two of seven subjects repeated the experiments wearing the MC-2 full pressure suit, both pressurized and unpressurized.

1,012

Clark, N. P. 1963 BIODYNAMIC RESPONSE TO SUPERSONIC EJECTION.  
(Paper, 34th Annual Meeting of the Aerospace Medical Association, Statler-Hilton Hotel, Los Angeles, Calif., April 28 - May 2, 1963)

ABSTRACT: Six supersonic test ejections of the B-58 escape capsule were made from a specially modified Hustler. Five black bears and one chimpanzee were used as subjects. Ejection altitude was between 35,000 feet and 47,000 feet and speed varied between Mach 1.3 and 2.0. In the second test ejection, made from 45,000 feet at Mach 1.6, excessive positive pitching of the capsule induced unstable flight producing cyclic high amplitude lateral acceleration associated with oscillation in yaw. The bear subject sustained bilateral complete fractures of the acetabular branch of the ischium. In the following ejections, a change in orientation of the rocket thrust vector to prevent excessive pitching was tested and shown to be successful. In addition to the supersonic ejections, three subsonic ejections using bear subjects, one from 40,000 feet at Mach 0.8, one from 5,100 feet at Mach 0.9 and one rolling runway ejection at 100 knots were done to validate satisfactory performance of the capsule over the flight envelope of the aircraft after the change in rocket thrust vector. The results of these ejections will be discussed using engineering test motion pictures to illustrate capsule performance and to relate capsule motions and acceleration to the response of the subjects.

1,013

Clemedson, C.J., H. Hartelius & G. Holmberg THE EFFECT OF HIGH EXPLOSIVE  
BLAST ON THE CEREBRAL VASCULAR PERMEABILITY.  
Acta Pathologica et Microbiologica Scandinavica 40:89-95

1,014

Clemedson, C-J. 1949 EXPERIMENTAL STUDY ON AIR BLAST INJURIES.  
Acta Physiol. Scand. Vol. 18; Suppl. 61, pp. 1-200

1,015

Clemedson, C.J. & S.A. Granstom 1950 STUDIES ON GENESIS OF "RIB MARKINGS"  
IN LUNG BLAST INJURY Acta physiol. scand. 21:131-144.

1,016

Clemedson, C.J. & H. Petterson 1953 GENESIS OF RESPIRATORY AND CIRCULATORY  
CHANGES IN BLAST INJURY Amer. J. Physiol. 174:316-320

1,017

Clemedson, C-J., H. Hultman & B. Gronberg 1953 RESPIRATION AND PULMONARY  
GAS EXCHANGE IN BLAST INJURY. J. Appl. Physiol. 6:213-220

ABSTRACT: Pulmonary ventilation and gas exchange capacity in blast injury were studied in urethane-anesthetized rabbits which had been exposed to high explosive shock waves in a detonation chamber.

In slight as well as in severe lung blast injury the respiratory minute volume usually is considerably increased, and in lethally injured animals the hyper-ventilation is generally maintained until just before death. The oxygen consumption will at first decrease a little, but then it increases gradually except in lethally injured animals, where it is greatly lowered from the very beginning after the exposure. The arterial oxygen saturation rapidly declines after the explosion in both slightly and severely injured rabbits but it can, in the early phase, usually be normalized by having the animal breathe pure oxygen. In slightly injured animals there is an increased carbon dioxide elimination and a shift to alkalinity in the arterial blood. Severe lung blast injury on the other hand causes a decrease in carbon dioxide elimination and lowering of the blood pH.

1,018

Clemedson, C-J., & H. Hultman 1954 AIR EMBOLISM AND THE CAUSE OF DEATH  
IN BLAST INJURY.  
The Military Surgeon 114(6):424-437.

ABSTRACT: The occurrence of air embolism and the cause of death in blast injury has been studied in anesthetized rabbits exposed to high explosive blast in the open field and in a specially constructed detonation chamber.

Intravascular air was found in a fairly great number of animals that died within 15 to 20 minutes after the exposure. Air embolism was rare in animals dying later on.

By recompressing the animals to 4 atm. overpressure, immediately after the detonation, it was possible to reduce considerable the occurrence of intravascular air bubbles.

The electrocardiographic tracings in animals dying in close connection with the explosion show signs of severe damage to the myocardium. This can be due to an air embolism or a mechanical lesion to the heart muscle. The changes are often transitory. Animals dying later on generally have severe changes in the ECG which can well explain the lethal outcome.

1,019

Clemedson, C-J. 1954 CORRELATION BETWEEN RESPIRATORY PHASE AND EXTENT  
OF LUNG DAMAGE IN AIR BLAST INJURY.  
J. Appl. Physiol. 7(1):38-42.

ABSTRACT: In rabbits exposed to high explosive shock waves in a detonation

chamber, no correlation could be found between the respiratory phase, i.e. the quantity of air in the lungs and the extent of lung injury. Exposure to a shock wave of long duration causes an expulsion of air from the lungs, that is greatest if the lungs are filled, when the animal is struck by the shock wave but is seen even if the lungs are in maximal expiration. A shock wave of very short duration causes only a slight or no expulsion of air. These findings are discussed as are the differences in the development of the lung injuries in air blast injury and in explosive decompression.

1,020

Clemedson, C-J., H. Hultman, L. Lundberg & B. Lundell 1954 REFLECTION OF A HIGH EXPLOSIVE SHOCK WAVE AGAINST A LIVING BODY. J. Aviation Med. 25:289-294

ABSTRACT: The reflection of a high explosive shock wave against the body of a living rabbit has been studied with the aid of a schlieren photography technique. Irregularities of the body surface will cause disturbances in the reflections are, however, caused by interior bone structures such as the ribs.

Photographs taken on the side of the animal turned away from the charge failed to reveal any shock wave transmission through the body.

1,021

Clemedson, C-J. & C.O. Criborn 1955 A DETONATION CHAMBER FOR PHYSIOLOGICAL BLAST RESEARCH. J. Aviation Med. 26:373-381

ABSTRACT: A detonation chamber for physiological blast injury research is described. This chamber produces great pressure and impulse forces with only very small charges of high explosive. The pressure and impulse values and the general shape and duration of the shock wave, produced under various conditions, are given, and the results discussed from a physiological point of view.

1,022

Clemedson, C-J., L. Deffet, L. Fornaeus, R. Rucquoi & P. van de Wouwer 1955 HIGH SPEED RADIOGRAPHIC VISUALIZATION OF A HIGH EXPLOSIVE SHOCK WAVE IN MUSCULAR TISSUE. J. Appl. Physiol. 7(6):604-608

ABSTRACT: With the aid of the high speed x-ray technique it has been possible to visualize a high explosive shock wave in muscular tissue. Pieces of ox or horse meat were exposed to the shock wave from a detonating fuse or from cylindrical charges of Tetryl. A zone of increased density is seen in the meat corresponding to the shock wave. The shock wave must be very strong, if it shall be able to cause an increase in density great enough to be detectable by this method.

1,023

Clemedson, C-J. & C.O. Criborn 1955 MECHANICAL RESPONSE OF DIFFERENT PARTS OF A LIVING BODY TO A HIGH EXPLOSIVE SHOCK WAVE IMPACT.  
Amer. J. Physiol. 181(3):471-476

ABSTRACT: The mechanical response of different parts of a living rabbit body to the impact of a high explosive shock wave has been studied.

Two different types of shock waves were employed, one short lasting generated by a TNT charge in an open field, and one multi-peak and of very long duration generated by a PETN charge in a detonation chamber. The response was recorded by means of a pencil-line strain gauge recorder. The parts of the body studied were over the thorax, on one rib, between two ribs over the abdomen and on a hind leg (femur region).

Different parts react very differently but two general types of response are found, one usually long lasting indentation caused by the impulse of the shock wave and one with short-lasting deflections or oscillations caused by the pressure variations of the shock wave. The tissues in the costal interpaces and the abdomen display a typical impulse response whereas the rib and the hind leg show a more or less pure maximum pressure type curve. The curve obtained the whole thoracal wall is an intermediary between the maximum pressure and the impulse type.

The relationship between the response type of a tissue and its susceptibility to blast damage is discussed.

1,024

Clemedson, C-J. & A. Nelson 1955 EFFECTS OF COMBINED WHOLE BODY ROENTGEN IRRADIATION AND HIGH EXPLOSIVE BLAST INJURY IN MICE.  
Acta Radiologica 43:161-172

1,025

Clemedson, C-J & H. Petterson 1956 PROPAGATION OF A HIGH EXPLOSIVE AIR SHOCK WAVE THROUGH DIFFERENT PARTS OF AN ANIMAL BODY.  
Amer. J. Physiol. 184(1):119-126, Jan. - March 1956.

ABSTRACT: Anesthetized rabbits were exposed to high explosive shock waves in a detonation chamber and in a blasting range. A barium titanate crystal pressure transducer inserted into the skull, right thorax cavity, upper part of abdomen and femoral musculature was used for the recording of the pressure pattern of the tissue transmitted blast wave. Relatively homogeneous tissues such as those of the brain, abdomen, and thigh musculature were found to modify the incident shock wave only little and are not significantly affected by it. The thoracal structures, especially the lungs on the other hand, due to their elastic and damping properties, cause a marked distortion of the incident wave. Only the main pressure peaks but not the more rapid, smaller pressure oscillations of a complex multipeak shock wave are transmitted through the lung. Generally, the peak pressure is but little changed by the passage through a tissue or

organ. An exception constitutes the thorax when exposed to a short-lasting pressure peak such as that obtained in the blasting range experiments. In this case the peak pressure was considerably reduced. (Author)

1,026

Clemedson, C-J. 1956 SHOCK WAVE TRANSMISSION TO THE CENTRAL NERVOUS SYSTEM  
Acta Physiologica Scandinavica 37:204-214

1,027

Clemedson, C-J., A. Jonsson & H. Petterson 1956 PROPAGATION OF AN AIR-  
TRANSMITTED SHOCK WAVE IN MUSCULAR TISSUE.  
Nature 177:380-381

ABSTRACT: As part of an investigation of the biophysics and physiology of blast injury, experiments were conducted in order to determine the velocity and damping of a high-explosive shock wave during propagation through a layer of muscular tissue.

Rectangular pieces of ox thigh muscles were exposed to a high-explosive shock wave in a detonation chamber. The time it takes for the wave to cover a known distance was measured. With the low-peak over-pressure used in these experiments, the mean velocity of the pressure wave in a covered muscular layer of 170-220 mm. was found to be 650 m./sec., the range being 590-710 m./sec. The relative great variations are due partly to the inhomogeneous microstructure of the muscular tissue but also to difficulties in determining exactly the arrival of the shock wave at the distal transducer owing to the gradual rise of the pressure curve. The velocity of the incident air shock wave immediately before its impact on the front surface of the meat was  $510 \pm 10$  m./sec.

1,028

Clemedson, C-J. & A. Nelson 1957 THE EFFECTS OF A HIGH EXPLOSIVE BLAST  
IN MICE WITH RADIATION INJURY.  
Acta Radiologica 47:79-85

ABSTRACT: Changes in respiration and heart rate were studied in rabbits which were exposed to high explosive shock waves in a detonation chamber after bilateral cervical vagotomy, or after pulmonary vagal denervation with the innervation of the sinoarortic region and heart left intact. The rapid shallow breathing occurring after the detonation in nondenervated animals was almost completely absent after cervical vagotomy or pulmonary vagal denervation. Sometimes an often very long period of apnea preceded the tachypnea after the detonation in the control animals. In the denervated animals, especially in the pulmonary vagally denervated ones, apnea was rare or of only short duration. The bradycardia that can be prevented by bilateral cervical vagotomy, was not elicited by reflexes from the lungs, as the heart rate was lowered to the same

extent in the lung vagus denervated as in the control animals. A cardiac standstill or severe distortions of the ECG waves during the first 1-3 seconds after the detonation were common in the nondenervated and in the lung vagus denervated animals but were rare in animals in which bilateral cervical vagotomy had been made.

1,029

Clemenson, C. J. 1958 SOME BIOPHYSICAL AND MEDICAL PROBLEMS INVOLVED IN MANNED SPACE FLIGHT: A REVIEW  
(Astronautik (Stockholm), 1(1):9-36 1958)

ABSTRACT: Medical and biological problems which have to be solved before space flight will be possible are reviewed. Among those reviewed are the following: the effects of loss of life-sustaining properties of the terrestrial atmosphere; the effects of gravitational stress; the problems of food and water supply and of waste disposal during long trips; and effects of the physical stresses of confinement in a narrow cabin under adverse physical conditions. If the crew is properly trained, they will be able to tolerate the necessary acceleration during flight. Although zero gravity causes no abnormal physiological functions of the body, orientation and co-ordination may make the performance of tasks difficult. To solve the problem of storing oxygen and air-purification chemical as well as food and water, photosynthetic air purification and food synthesis from algae material may become necessary. Another risk faced by men in space is exposure to the heavy components of primary cosmic radiation and hits by meteorites.

1,030

Clemenson, C-J. & H. Hultman 1958 CARDIAC OUTPUT IN EARLY PHASE OF BLAST INJURY IN RABBITS. Amer. J. Physiol. 194(3):601-606

ABSTRACT: Changes in cardiac output measured by the direct Fick method were studied in rabbits which had been exposed to high explosive shock waves in a detonation chamber. The maximum reflection overpressure in the shock waves ranged between 3.5 and 11 atm. for the different weights of charge used. In all exposed animals there was a decrease in cardiac output already 5 minutes after the detonation. The degree of reduction of the output of the heart is directly proportional to the weight of charge used, i.e. of the force of the detonation. The cardiac output and the lung hemorrhages seem to be two parallel effects of the pressure of the shock wave with no mutual interference between the two. The cause of the reduction seem to be complex, but the direct action of the shock wave on the heart is supposed to play a significant role. The bradycardia existing during the 1st minute after the detonation was found to be of no importance for the reduction of the output of the heart.

1,031

Clemedson, C-J. & E. Heilbronn 1958 PAPER ELECTROPHORETIC STUDIES ON SERUM PROTEIN CHANGES IN BLAST INJURY IN RABBITS.  
Acta Physiol. Scand. 43:216-227.

1,032

Clemedson, C-J. 1958, 1959-60. SOME BLAST STUDIES WITH APPLICATION TO EXPLOSIVE DECOMPRESSION.  
J. Brit. Interplanetary Soc. 17:279-285.

1,033

Clemedson, C-J. & A. Jonsson 1961 TRANSMISSION AND REFLECTION OF HIGH EXPLOSIVE SHOCK WAVES IN BONE.  
Acta Physiol. Scand. 51:47-61

1,034

Clemedson, C-J and J Arne 1961 TRANSMISSION OF ELASTIC DISTURBANCES CAUSED BY AIR SHOCK WAVES IN A LIVING BODY J. Appl. Physiol., 16:426-430, 1961

1,035

Clement, H. 1918 BIOLOGICAL EFFECTS OF CENTRIFUGAL ACTION. A STUDY OF THE CAUSES OF DISTURBANCE OF EQUILIBRIUM.  
Sci. Amer. Suppl. 85:258-259.

1,036

Clentano, J. T. and H. S. Alexander 1961 THE USE OF TOOLS IN SPACE - AN EMPIRICAL APPROACH.  
(Institute of the Aerospace Sciences, New York, N. Y.)  
Paper 61 145 1839, June 1961.

ABSTRACT: In order to predict certain aspects of man's performance in space with respect to the use of hand tools, personal propulsions devices, and other equipment for his use, the moment of inertia of man was determined experimentally. The method used was to compare the angular deceleration of objects with known moments of inertia to the deceleration of human Ss under the same conditions. Several Ss were measured about two axis: center of head through pelvis and lower abdomen through small of back. Some measures of torques applied by Ss on an air-bearing platform and the resulting reaction velocities were made and correlated with the above determinations. (Tufts)

1,037

Coakley, J. D., & J. E. Barmack 1948 A METHOD OF INCREASING THE MANEUVERABILITY OF HIGH SPEED AIRCRAFT WITHIN THE LIMITS OF HUMAN TOLERANCE TO G FORCES. (The Psychological Corporation, New York, N.Y.) Project No. 20-M-1b, 28 Feb. 1948; ATI-41 255

SUMMARY: 1) A maneuver involving a coordinated turn of 180 degrees in a horizontal plane is selected as a standard for evaluating other maneuvers. This turn is effected at constant speed and at specified, constant, radial g. The path so defined is circular in form and the end point is directly abeam at the moment the maneuver begins. This path, designated as Flight Path I, is thus semicircular and the radius of the path is determined by the elected velocity and radial g. In Flight Path II, the same velocity, radial g, and endpoint or objective are employed. The difference introduced in Flight Path II is that the craft is permitted to slow down at a specified rate before beginning the turn. After deceleration, the turn is made at a lower specified speed. When the turn is completed, the plane moves toward the objective by first accelerating to its original speed and then by flying the remaining distance at constant speed. Flight Path III differs from II in that turning commences at the beginning of the maneuver and continues throughout the period of deceleration. Thereafter, turning is completed at a reduced constant speed and the flight then continues just as described for Flight Path II. The point of termination is identical for all these pathways. 2) The required specifications for Flight Path I are velocity and radial or centrifugal g. The additional specifications for II and III are minimal speed and decelerative and accelerative g. The parameters of g (radial, decelerative, and accelerative) are selected so as to cover the range of human tolerance from low to medium high levels. The velocity parameters are assigned arbitrary values. The maximum velocities are 900, 1800, and 3600 mph and the minimal velocities are submultiples of these speeds. The several parameters are arranged in a variety of combinations to provide over 100 different paths which have been analyzed, and the results are presented for consideration. 3) Within the range of conditions studied, it was found that there was no increase in the distance to be travelled resulting from decelerations prior to or during a turn. On the contrary, flight distance to the objective was always shortened by employing deceleration. In general, there is a saving of about 25% in the flight distance. 4) Generally, there was no loss in time required to fly to the objective but rather a small saving in flight time. Savings in time of the order of 10% are found except when decelerative g does not exceed radial g. 5) Perhaps the most dramatic advantage of the pathways employing deceleration is the shortening of time of exposure to g forces and particularly exposure to radial g. For pilots seated upright in a plane banked for turning, radial g implies a force along the long axis of the body for which tolerance is not so high as for a force across the body (Tg). Thus the reduction in exposure time to radial g is especially important. The substitution of more tolerable decelerative and accelerative forces, which will appear as Tg forces to the seated pilot, makes possible a shortening of the total time of exposure to g forces. This advantage is measured by the percentage of flight time during which no g forces are present. This saving is of the order of 70% of the total time. 6) The pathways involving deceleration bring the plane to the objective from a direction different from the approach of the standard path. Whether this is an advantage or disadvantage will depend, in part, upon the subsequent course to be taken by the plane. 7) Quite generally, Flight Path III provides somewhat greater savings than Flight Path II. These advantages, however, are counterbalanced by exposure of the occupants to the vector sum of two g forces during the first part of the flight. This vector operates at a different angle and is somewhat larger than either of its components. 8) The proportion of savings

in flight time and distance and in duration of exposures is not dependent upon velocity or acceleration per se. Rather the savings depend upon (1) the ratio of maximal to minimal velocity, (2) the ratio of decelerative to radial g, and (3) the ratio of accelerative to radial g. Accordingly, proportionate savings are to be expected at any speed and this proportion represents absolute distances and times which are of greater and greater practical importance as speed is increased. Furthermore, even though the proportion of the savings increases as speed is reduced to lower and lower values, the rate of increase becomes less. Thus some of the most valuable savings may result from very modest reductions in speed. 9) The "standard pathway" is examined to make sure that its use as a standard does not exaggerate the advantages of the decelerative pathways. This examination reveals that the comparisons are fair and representative. Thus the quantitative estimates of the advantages of deceleration may be considered as representative and even conservative for a wide variety of situations. 10) It is suggested that consideration be given to the development of flight maneuvers in which deceleration is utilized to permit the pilot to turn on a smaller radius at reduced speed and remain within desired limiting values of g. Many problems must be solved before such a procedure may be considered practical. Among the problems raised are: (a) The extent to which the rate of deceleration can be controlled through either cutting power or other devices. (b) The development of means whereby a horizontal spiral flight path can be effected easily or automatically in conjunction with appropriate rates of deceleration and turn. (c) The need for more information on human tolerance to the vector sums of forces and on tolerance to the varying directions of the vectors which would develop from such spiral flight paths. (AUTHOR)

1,038

Cobb, D.B. 1959 THE TECHNIQUE OF MEASURING THE FORCE EXERTED BY A PARACHUTE DURING OPENING.  
(Royal Aircraft Establishment, Farnborough) Tech. note no. Mech. Eng. 301.  
ASTIA AD 232 601.

1,039

Coburn, K.R. 1959 FINAL REPORT ON EVALUATION OF FRANKENSTEIN ANTI-BLACKOUT SUIT  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR98, Dec. 7, 1959

ABSTRACT: The Frankenstein suit was statically evaluated in accordance with MIL-C-5085A (Aer) and the specifications were met satisfactorily. G protection was evaluated by subjects on the centrifuge and was found to be comparable to the Z-2 and Z-3 anti-G suits. The suit appeared to be more comfortable under G stress than the Z-2 and Z-3 suits, which was due to the small belly bladder which made respiration easier during the inflation period of the suit.

Coburn, K.R. 1960 COVERALLS, ANTI-G STANDARDIZATION STUDY  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6022, July 7, 1960

**ABSTRACT:** Air CSU-3/P anti-G suits were distributed to operational U.S. Navy attack and fighter squadrons for service testing and questionnaires concerning pilot acceptance were evaluated at AMAL. A high proportion of pilots indicated a preference for the suit which reflected the subjective comfort offered by the suit while inflated under G. This is due to the bladder design. Many of the pilots felt that the suit was too hot, heavy, and bulky. The most serious and frequently mentioned objection was that the suits were poorly constructed and would give way after a few wearings.

1,041

Coburn, K.R. 1960 ANTI-BLACKOUT PROTECTION, DEVELOPMENT, TEST, EVALUATION AND SERVICE ENGINEERING  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6011, April 18, 1960

**ABSTRACT:** Four anti-G coverall garments, three made of cotton-fortisan and one from HT-1 material, were tested at AMAL. All garments satisfactorily met the static and dynamic test requirements of MIL-C-5085A (Aer). Preliminary tests indicated that the cotton-fortisan was considerably warmer than the HT-1 material.

1,042

Coburn, K.R., P.H. Craig & E.L. Beckman 1961 EFFECTS OF POSITIVE G ON CHIMPANZEES IMMERSSED IN WATER. (Paper presented at 32nd annual meeting, Aerospace Medical Association, 24-27 April 1961, Chicago, Ill.)

**ABSTRACT:** This report deals with the physiological responses of fourteen experimental and three control chimpanzees exposed to increased G loading ranging from five to thirty-one positive G while immersed in water. Three general physical configurations of the G capsule were utilized in an attempt to determine the degree of protection offered. Arterial, venous, esophageal and endotracheal pressures were measured continuously, as were the internal capsule pressures. The physiological responses and the pathological changes observed are discussed in relation to the physical parameters used in this experiment. From the data it would appear that experimental procedure utilized produces overpressures in the pulmonary system of sufficient magnitude to cause loss of lung tissue integrity with the subsequent production of mediastinal emphysema and, further, that exposure to increased G under the experimental conditions utilized produces hydrostatic pressure gradients which favor the migration of air bubbles from the region of the mediastinum towards the head. (Aerospace Med. 32(3):226, March 1961)

1,043

Coburn, K.R., E.L. Beckman & T.D. Duane 1963 LIMITATION OF OCULAR MOTILITY UNDER ACCELERATION: AN OBJECTIVE ENDPOINT FOR USE WITH HUMAN CENTRIFUGE SUBJECTS. Aerospace Medicine 34(9):824-825

ABSTRACT: More than 50 subjects, male and female, ranging from 18 to 50 years of age, participated in more than 350 separate centrifuge runs in the 37 foot radius AMAL centrifuge. Since subjective endpoints of greyout and blackout have long been a problem, it was found that by using LOMA (limitation of ocular motility) these difficulties are eliminated and a much more accurate assessment of the human centrifuge subjects' true physiological state can be made. (CARI)

1,044

Cochran, L.B. 1953 STUDIES ON THE EASE WITH WHICH PILOTS CAN GRASP AND PULL THE EJECTION SEAT FACE CURTAIN HANDLES. J. Aviation Med. 24(1):23-28

SUMMARY AND CONCLUSIONS: 1. Thirty naval fighter pilots, of various anthropometrical measurements, from NAAS, Cabaniss Field, Texas, VR-31, and VF-71, Com Air-Lant, were tested on the Pensacola Human Centrifuge in their ability to actuate the Martin-Baker type ejection seat mechanism. For these tests the subjects, protected by anti-blackout suits, were subjected to levels of positive radial acceleration about 2.0 g above their relaxed blackout tolerance level.

2. The results suggest that, unless extremely fatigued, most suit-protected pilots should be able to perform the arm movements necessary to actuate the Martin-Baker type ejection seat at 2.0 g above their control blackout level IF THE G WERE A CONSTANT ONE. There were no means available by which their ability could be tested under conditions of fluctuating g-levels.

3. A marked degree of success would appear to depend on the pilot's pre-knowledge of the effects of such forces on him and his plane, and proper instructions as to procedure and techniques employed which facilitate his ability to actuate the ejection seat under high accelerative forces. This portion of success could be made available through lecture training and centrifuge indoctrination.

1,045

Cochran, L. B. 1954 A STUDY OF THE HALF-PRESSURE ANTI-BLACKOUT SUIT (Naval School of Aviation Medicine, Pensacola, Fla.) Research Rept. No. NM 001 059.15.03; ASTIA AD-44 403

ABSTRACT: A half-pressure antiblackout suit was designed to provide evenly distributed pressure over the total body area from the waist downward. Tests conducted on the human centrifuge indicated significantly greater protection of vision by the half-pressure antiblackout suit than is afforded by service antiblackout suits; the suit was also considered more comfortable than the service antiblackout suit in spite of frequent complaints by the subjects. The laboratory tests revealed certain unexplainable pulse rate response and irregularity of cardiac rhythm induced by pressurization which made it inadvisable to determine the absolute protection afforded by the suit. The suit gave promise of being easily incorporated into a combination exposure and anti-G suit.

1,046

Cochran, L.B., P.W. Gard, & M.E. Norsworthy 1954 VARIATIONS IN HUMAN G TOLERANCE TO POSITIVE ACCELERATION. (U.S. Naval School of Aviation Medicine, Pensacola, Fla.) Project No. NM 001 059.02.10, 31 Aug. 1954. ASTIA AD 50 297.

SUMMARY: It has been determined in the Naval Air Training Program that a relatively high percentage of instructors and students frequently experience episodes of blackout and unconsciousness. Due to these findings, the Acceleration Unit has been actively engaged in this study in an effort to determine human G tolerance and some of the variations. This study reports the findings obtained on 1000 individuals tested on the human centrifuge composed of the following groups: (1) master control, (2) naval Aviators, (3) referral groups, (4) naval aviation cadets, and (5) Miscellaneous.

The differences in mean G tolerance for all groups tested for loss of peripheral vision, blackout, and unconsciousness were not significant. Also, a great range in human G tolerances for these symptoms was determined, each having approximately the same variations.

It was found that neither the time required to attain "peak G" nor the G level had any significant effect on the time required to produce loss of peripheral vision, blackout, and unconsciousness in individuals experiencing these symptoms at various G stresses. A comparative study may be done to ascertain the effect of varying rates of onset and varying magnitudes of G stress loads on the time required to produce loss of vision and consciousness. (DACO)

1,047

Cochran, L.B., P.W. Gard, & M.E. Norsworthy 1955 G x TIME FLIGHT PATTERNS IN THE NAVAL AIR TRAINING COMMAND PHASES IV AND V: AEROBATIC AND GUNNERY MANEUVERS AS FLOWN IN ADVANCED TRAINING UNITS 300 AND 301. (U.S. Naval School of Aviation Medicine, Naval Air Station, Pensacola, Fla.) Research Report No. NM 001 100 103.03. 21 Feb. 1955. ASTIA AD 66 701.

ABSTRACT: Flight students in the Naval Air Training Program have been exposed to sufficient positive radial accelerations during various flight maneuvers to frequently produce symptoms of greying, black-out, and unconsciousness. This study reports the findings of G x time flight patterns as flown by personnel in Advanced Training Units 300 and 301 in the AD-1 and F6F-5 aircraft. It was found that the magnitudes and durations of G stresses imposed were sufficient degree to frequently produce undesirable physiologic impairment. These findings confirm the importance of repeated indoctrination of all flight personnel on the protection provided by anti-blackout equipment in an endeavor to improve both efficiency of flying and flight safety.

1,048

Cochran, L. B., P. W. Gard, & M. E. Norsworthy 1956 Gx TIME FLIGHT PATTERNS IN THE NAVAL TRAINING COMMAND. VI: AEROBATIC AND GUNNERY MANEUVERS AS FLOWN IN ADVANCED TRAINING UNIT 201. (Naval School of Aviation Medicine, Pensacola Fla.) Research Proj. NM 001 100 103, Rept. No. 4; MR005.15-0100.1.4., 6/21/56; ASTIA AD-119 598

ABSTRACT: The magnitudes and particularly the durations of positive accelerative stresses to which personnel of advanced training unit 201 are frequently exposed are of sufficient degree to produce such undesirable effects as: excessive fatigue visual impairment, or loss of consciousness, particularly in the low g tolerant individual. In view of the durations of exposure, the proper use of anti-blackout equipment unquestionably has made a significant contribution to flight safety and efficiency in the Naval Air Training Command. Proper maintenance and use of anti-blackout equipment together with thorough indoctrination of all flight personnel on the protection provided are vitally important in the Naval Air Advanced Training Command. (AUTHOR'S SUMMARY)

1,049

Cochran, R., & L. E. Morehouse 1948 THE ABILITY OF MAN TO REACH UPWARD DURING POSITIVE G. (University of Southern Calif., Los Angeles, Calif.) Contract N6ori77, Task Order 1; ASTIA ATI-208 697

SUMMARY: 1) The hands can be raised above the head under conditions of 8 positive G and a simulated Martin-Baker ejection seat released with a resistance of 30 lbs. can be operated with ease. 2) A loss of visual fields in one subject was not accompanied by either losses in kinesthetic or touch sensations, or the ability to control learned movements with accuracy. 3) A reach above the head during positive G can be accomplished easier and more accurately if the elbows are first flexed and then the hands are drawn upward past the ears, than if the reach is performed with the arms raised upward in extension. (AUTHOR)

1,050

Cochran, R. and L. E. Morehouse 1948 THE ABILITY OF MAN TO REACH UPWARD DURING POSITIVE G. (University of Southern Calif., School of Medicine, San Francisco, Calif.) June 28, 1948 ASTIA TIP U5329

ABSTRACT: The Martin-Baker ejection seat requires the pilot to reach upward and behind his head in order to grasp the protective face curtain which, when pulled downward, triggers the release mechanism. In level flight the handle can be easily reached but in an emergency under high acceleration it is not known if the pilot would be able to free himself from the aircraft. A release bar simulating the ejection seat mechanism was constructed and 3 subjects tested it. The hands could be raised above the head under conditions of 8 positive g and a simulated Martin-Baker ejection seat release with a resistance of 30 lb. could be operated with ease. A loss of visual fields in 1 subject was not accompanied by losses in either kinesthetic or touch sensations or in the ability to control learned movements with accuracy.

A reach above the head during positive g can be accomplished more easily and more accurately if the elbows are first flexed and then the hands drawn upward past the ears, than if the reach is performed with the arms raised upward in extension. (ASTIA)

1,051

Code, C. F., E. H. Wood, & E. J. Baldes Aug. 1943 THE PROTECTION AGAINST THE EFFECTS OF ACCELERATION AFFORDED THE HUMAN BY IMMERSION IN WATER AND BY A WATER FILLED SUIT (THE F.F.S.). (Submitted to the Nat'l. Research Council and Aero Medical Lab., Wright Field.

1,052

Code, C.F., E.H. Wood, and E.J. Baldes 1945 HYDROSTATIC ANTI-BLACKOUT PROTECTION THE PROTECTION AFFORDED MAN AGAINST THE EFFECTS OF POSITIVE ACCELERATION BY IMMERSION IN WATER Federation Proceedings 4:15

1,053

Code, C. F., E. H. Wood, & E. H. Lambert 1945 THE LIMITING EFFECT OF CENTRIPETAL ACCELERATION ON MAN'S ABILITY TO MOVE. (Committee on Aviation Medicine, National Research Council) CAM Rept. No. 436, May 1945; ASTIA AD-132 084 See also J. Aero Science 14(2):117-123, Feb. 1947  
NOTE: CARI P&S 2.1mp

ABSTRACT: A study designed to give an estimate of the restrictions placed on man locomotive ability by the application of radial g (centrifugal force) was made on the human centrifuge. Five subjects were studied. The results were as follows:

1. Movement in the same direction as the radial force. Movement in this direction was easy but hazardous. Falling one foot at 2 g was sufficient to knock the wind out of subjects. It was concluded that falls of greater distances at slightly higher accelerations would often cause injury.
2. Movement at right angles to the radial g. (a) On the average the time required to crawl across the end of the centrifuge, a distance of 7½ feet, was increased 2½ times by 1 radial g, 5 times by 2 radial g, and 10 times by 3 radial g. Three of five subjects tested could not accomplish this task at 4 g. (b) The time required to round a barrier which projected 22 inches from the back of the centrifuge was increased 2½ times by 1 radial g, 6 times by 2 radial g, and 18 times by 3 radial g. The subjects stated they could not accomplish the task at 4 g. The results indicate the tremendous increase in time required to perform..... simple movements of the body under radial g. At 4 g even these simple movements became impossible for most subjects.
3. Movement against the radial g. Against a force of 2 to 3 g it became impossible for the subjects to crawl, walk, climb a rope or a ladder or rise from a bomber seat. The results indicate that escape maneuvers of a flyer directed against the accelerative forces may often be ineffective if this force is in the neighborhood of 3 g.
4. Donning a parachute when exposed to radial g. The average time required for

three subjects to don a standard back parachute was 17 seconds at 1 g gravity. This was increased to 21 seconds at 1 g radial, 41 seconds at 2 g radial and 1 minute 15 seconds at 3 g radial. One of the three subjects was unable to complete the task at 3 g. It was uniformly agreed that at an acceleration slightly above 3 g the parachute could not have been donned by any of the subjects.

5. Concluding statement. Although the number of subjects studied in these tests is small, the results are sufficiently striking and definite to call attention to the serious limitations radial acceleration may place on a flyer's ability to escape from his aircraft. At accelerations above 2.5 or 3 g the flyer may need assistance or conveniences in the aircraft which at present are not provided. The study gives strong support to the contention that the following facilities demand further development: (a) Convenient escape exits at all pilot and battle stations; these placed as pairs on opposite sides of the plane. (b) Automatic mechanical or explosive mechanism to open all escape exits. Mechanism activated by a simple procedure such as pressure on a button. Button placed near exit and covered with luminous paint. Exit should preferably be forced outward--although sliding mechanism might be satisfactory if sufficient force were provided to overcome g and jamming. (c) Automatic ejection of man in seat at pilot or battle station from plane. Mechanical or explosive mechanism. Parachute could be part of light seat assembly and chute open with man sitting in seat. (AUTHOR)

1,054

Code, C. F., E. H. Wood, R. E. Sturm, E. H. Lambert, & E. J. Baldes 1945  
SEQUENCE OF PHYSIOLOGICAL EVENTS IN MAN DURING EXPOSURES TO POSITIVE  
ACCELERATION. (Wright Air Development Ctr., Wright-Patterson AFB, Ohio)  
WADC TR 58-635; ASTIA AD-208 151  
See also Abstract: Federation Proceedings 4(1):14, 1945

ABSTRACT: There is a definite sequence to the physiologic events that occur in the comfortably seated human being during exposure to positive acceleration. This sequence is divided into two distinct periods: the period of progressive failure and the period of compensation.

During the period of progressive failure, the pulse rate progressively increases, the amount of blood in the ear maybe gradually reduced or abruptly lost, the blood pressure at the level of the base of the brain declines and reductions of vision and consciousness, if they occur, become evident. As accelerations of greater intensity are experienced, the extent of these changes is increased. The period of progressive failure is usually terminated by compensatory reactions, which become effective about six to eleven seconds after the onset of acceleration. During the period of compensation, the blood pressure rises, the ear pulse may return or increase, the amount of blood in the ear pulse may return or increase, the pulse rate increase is checked and the pulse may slow and, if these compensatory changes are sufficiently effective recovery from symptoms (both loss of vision and consciousness) will occur.

This consistent pattern has been observed in a total of more than 250 subjects. Measurement of the magnitude of the changes has allowed the development of an accurate quantitative assay procedure for the determination of man's g tolerance and for the measurement of the efficiency of any device designed to prevent or offset these physiologic changes. (Federation Proceedings 4(1): 14, 1945)

1,055

Code, C.F., E.H. Wood, R.E. Sturm, E.H. Lambert & E.J. Baldes 1945 THE  
SEQUENCE OF PHYSIOLOGICAL EVENTS IN MAN DURING EXPOSURE TO POSITIVE  
ACCELERATION. Federation Proc., 4(1):14

ABSTRACT: There is a definite sequence to the physiologic events that occur in the comfortably seated human being during exposure to positive acceleration. This sequence is divided into two distinct periods: the period of progressive failure and the period of compensation.

During the period of progressive failure, the pulse rate progressively increases, the amount of blood in the ear maybe gradually reduced or abruptly lost, the blood pressure at the level of the base of the brain declines and reductions of vision and consciousness, if they occur, become evident. As accelerations of greater intensity are experienced, the extent of these changes is increased.

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This consistent pattern has been observed in a total of more than 250 subjects. Measurement of the magnitude of the changes has allowed the development of an accurate quantitative assay procedure for the determination of man's g tolerance and for the measurement of the efficiency of any device designed to prevent or offset these physiologic changes.

1,056

Code, C. F., E. J. Baldes, E. H. Wood, & E. H. Lambert 1946  
THE EFFECT OF ENVIRONMENTAL TEMPERATURE UPON MAN'S G TOLERANCE  
(Acceleration Lab., Mayo Aero Medical Unit, Rochester, Minn.)  
See also Federation Proc. 5(1):18

ABSTRACT: The g tolerance (capacity to withstand increased positive accelerative forces) of fifteen normal men has been studied in a cool environment (average: 63 degrees F., 72 per cent relative humidity) and contrasted with that obtained in the same subjects in a warm humid environment (average: 89 degrees F., 77 per cent relative humidity). The g tolerance was determined on the human centrifuge (accelerator) by means of an assay procedure based upon the recognition and recording of the subjective visual symptoms and the objective measurement of changes in ear opacity (blood content of ear), ear pulse and heart rate during exposures to acceleration (g). As determined by these criteria the g tolerance of the group was uniformly lower in the warm than in the cool environment. The visual symptoms, ear opacity, ear pulse and heart rate changes of the group showed average reductions in tolerance of 0.9, 0.7, 0.8, and 0.7 g. respectively, indicating that in the warmer environment the overall g tolerance of the subjects was lower on the average by 0.8 g.

1,057

MOTION PICTURE

Code, C. F., E. H. Wood, & E. J. Baldes 1946 HYDROSTATIC ANTI-BLACKOUT PROTECTION; THE PROTECTION AFFORDED MAN AGAINST THE EFFECTS OF POSITIVE ACCELERATION BY IMMERSION IN WATER. (Acceleration Lab., Mayo Aero Medical Unit, Rochester, Minn.)

ABSTRACT: The motion picture shows the methods used in this study and illustrates the average protections afforded man against the effects of positive acceleration by immersion in water.

The study was carried out on the human centrifuge. A specially constructed bath tub was placed in the gondola or cockpit of the centrifuge. The subjects sat in this tub in the same position as that assumed by a pilot in a fighter airplane. Each test included the determination of the subject's g tolerance while sitting in the tub--first, without water, then with water added to various body levels, and finally again without water as a re-check of the control determinations. On the average, immersion in water to the xyphoid gave 0.9 g protection and immersion in water to the level of the third rib gave 1.7 g protection. (Federal Proceedings 5(1):18, 1946)

1,058

Code, C. F., Williams, M. M. D., Baldes, E. J. & Ghormley, R. K. 1947  
ARE THE INTERVERTEBRAL DISKS DISPLACED DURING POSITIVE ACCELERATION  
J. Aviat. Med. 18(3):231-236, 296

SUMMARY: Anteroposterior and lateral roentgenograms were made of the lower part of the spinal columns of four subjects before and during positive accelerations of 2 to 6 G.

Measurements were made of the lumbar intervertebral spaces and of the length of the lumbar part of the spinal column. No significant changes in these measurements were observed during the accelerations tested. It is concluded that in these normal subjects there was no compression or displacement of the intervertebral disks.

1,059

Code, C. F., E. H. Wood, & E. H. Lambert 1947  
THE LIMITING EFFECT OF CENTRIPETAL ACCELERATION ON MAN'S ABILITY TO MOVE. J. Aero Sci. 14(2):117-123 February  
See also (Committee on Avia. Med.) CAM Rept. No. 436, May 1945  
ASTIA-DSC AD-132 084

ABSTRACT: Instances have been recorded in which fliers were unable to bail out of spinning aircraft because of the centrifugal force generated by the spin. A study designed to give an estimate of the restrictions placed on man's locomotive ability by exposure to radial g was made on the human centrifuge. Five subjects were studied. The average time required to don a parachute was increased from 17 sec. at 1 g to 1 min. and 15 sec. at 3 g,

it being uniformly agreed by the subjects tested that they could not don the parachutes at accelerations slightly above 3 g. The ability of the subjects to move against the force or at right angles to the force was seriously restricted when the magnitude of the force was 2 to 3 g. Progress against the force became impossible at 3 g. Moving the body at right angles to the force became impossible in the neighborhood of 4 g. The study demonstrated that under conditions at which accelerations of 3 g or more develop, fliers will need help if they are to escape from their aircraft. Emphasis is therefore given to the need, recognized for some time by others, of further consideration and development of devices designed to assist the flier when escaping from his aircraft.

1,060

Coermann, R. 1938 UNTERSUCHUNGEN UBER DIE EINWIRKUNG VON SCHWINGUNGEN AUF DEN MENSCHLICHEN ORGANISMUS (Investigations Regarding the Effect of Vibrations on the Human Organism)  
Jahrbuch der Deutschen Versuchsanstalt für Luftfahrt (Berlin) Pt. 3; 111-142.  
See also: Air Corps, Trans. No. 349, 19 May 1941.

1,061

Coermann, R. 1939 DIE WIRKUNG VON ERSCHUTTERUNG UND LARM AUF DER MENSCHLICHE ORGANISMUS. (THE EFFECTS OF VIBRATION AND NOISE ON THE HUMAN ORGANISM.) R.A.E. Library Translation No. 121.  
From Ringbuch der Luftfahrttechnik, Part VF1. GDC. 10/7686. 1946

1,062

Coermann, R. 1961 TO WHAT EXTENT CAN DUMMIES INSTEAD OF MEN BE USED IN IMPACT TESTING?  
(Paper, Symposium On Impact Acceleration Stress, Brooks Air Force Base, San Antonio, Texas, November 27-29, 1961)

1,063

Cofer, F. S., H. M. Sweeney, & C. E. Frenier 1946 HISTORY OF DEVELOPMENT SINCE 1941: USAF EJECTION SEATS (Air Material Command, Wright Field, Dayton, Ohio) Rept. No. TSEAC 11-45341-1-2, Aug. 1946

1,064

Cohen, S.I., A.J. Silverman, G. Zuidema & A. Caton 1957 NEUROHORMONAL  
ASPECTS OF G TOLERANCE.  
(Paper, Meeting of Aero Medical Association, Denver, Colorado,  
May 6-8, 1957)

ABSTRACT: The threshold for blackout appears to be ultimately dependent on cardiovascular reflex activity. However, catechol amine production from the adrenal medulla and sympathetic neural endings seems to play an important role in determining the level of compensation possible. It was observed that under centrifugal stress a substantial production of noradrenaline occurred in subjects who withstood exposure to high G levels. Subjects blacking out at lower G levels secreted less noradrenaline and more adrenaline. Hypertensive responses to a hypotensive drug were associated with high noradrenaline levels and hypotensive responses with lower noradrenaline and higher adrenaline levels. The inter-relationship of emotional factors, catechol amine levels and G tolerance indicated that high levels of anxiety were associated with high levels of adrenaline and lower levels of noradrenaline and lowered G tolerance. Overt anger was associated with lower levels of adrenaline and high levels of noradrenaline and high G tolerance. (J. Aviation Med. 28(2):196, April, 1957)

1,065

Cohen, S.I., A.J. Silverman, G.D. Zuidema, & G.E. Johnson 1958 SKIN  
RESISTANCE CHANGES DURING ACCELERATION.  
(Wright Air Development Center, Wright-Patterson AFB, Ohio)  
WADC TN 56 397, ASTIA AD 97 275.

ABSTRACT: To investigate basal skin resistance changes (gradual drifts or changes) during acceleration stress, a series of experiments were performed on the human centrifuge. Basal resistance changes were measured 1) during acceleration with and without G-suit protection, 2) with rapid and gradual acceleration, and 3) with progressively increased rapid acceleration. The role of blood volume changes and compensatory sympathetic vasoconstrictive activity, the primary determinant of decreases in skin resistance during acceleration was investigated with hemisymphactomized dogs. The use of basal resistance changes as a rapid indicator of changes in the psychophysiological state during acceleration is discussed. Basal skin resistance level changes are felt to be due primarily to changes in over-central nervous system activity. Human subjects exposed to centrifugal forces demonstrated decreases in skin resistance. Rapid onset acceleration produces greater decreases in skin resistance than gradual onset acceleration or rapid onset acceleration demonstrated decreases in skin resistance. Rapid onset acceleration produces greater decreases in skin resistance than gradual onset acceleration or rapid onset acceleration of subjects protected by anti-G suits. The role of blood volume changes and compensatory sympathetic vasoconstrictive activity as the primary determinant of skin resistance decreases during acceleration was investigated in dogs which were hemisymphactomized and exposed to accelerative forces. The intact side showed a considerably greater decrease than the sympathectomized side. (Author)

1,066

Cohen, E., and G. B. Simon 1961

THE SIMULATION OF MOTION FOR TRAINING AND FOR RESEARCH

(Presented at Meeting of the Panel on Acceleration Stress of the Armed Forces-NRC Committee on Bioastronautics, National Aeronautics and Space Administration, Ames Research Center, Moffett Field, California, March, 1961.

1,067

Cohen, H.N. & L.D. Dubrow 1955 METHOD FOR CALCULATING MAXIMUM IMPACT LOAD IN DESIGNING A PARACHUTE SUSPENSION SYSTEM (Samuel Feltman Ammunition Labs., Picatinny Arsenal, Dover, N.J.) Proj. No. TA2-4004; Technical rept. no. 2158 April 1955; ASTIA AD-60 623

ABSTRACT: A method for calculating the maximum pull in the parachute lines,  $P_{max}$ , has been derived which takes into account the deceleration of the load and the drag effect on the parachute just before the lines tighten must be known.

In order to calculate the maximum impact load in the lines of a parachute, it is assumed that the pull in the lines is equal to a known spring constant multiplied by the elongation.

It is possible to substitute in the equation  $F = \frac{mdV}{dt}$  and then to convert the time variable to a stretch variable. The equation is integrated and solved for  $P_{max}$ .

1,068

Colajanni, G. 1931 UN CASO DI EMORRAGIA RETINICA PER LANCIO NEL VUOTO CAN PARACADUTE. (A case of hemorrhage in the retina while dropping with a parachute) Ann. di ottal. e clin. ocul., 59:1017-1020

ABSTRACT: The author stated that he found only one similar case reported by the Italians. His case concerns a pilot, aged 32, who lost control of his plane in a cloudbank and had to jump. The jump was uneventful and he landed on his feet without mishap. However, a few hours later he noticed a dark spot in his right eye. Examination revealed nothing unusual in the right eye except a hemorrhagic spot with large axis horizontal, situated between the macula and papilla, and other small spots in the superotemporal region near the papilla. For possible causes, the author cited: sudden barometric changes, the impetuous action of the wind, the increase in the thoracic pressure due to sudden pull of parachute belt, and the emotive state. He states that since many jumps without such effects have been made from even higher altitudes, it is probably that this individual had a predisposition, due perhaps to a profound endocrine imbalance, that had not been revealed by the various tests required in the examinations of pilots.

1,069

Cole, D.M. & D.E. Muir 1958 AROUND THE MOON IN EIGHTY HOURS.  
(The Martin Company, Denver, Colorado) M-M-P-58-42, Aug. 1958.

ABSTRACT: A conceptual design of a manned circumular vehicle for the early 1960's is presented, showing how early availability and low cost can be achieved by making maximum use of ICBM hardware and facilities. Results of orbit, space medicine, and re-entry studies critical to the circumular flight are included.

1,070

Cole, W. H., J. B. Allison, T. J. Murray, A. A. Boyden & J. H. Leathern 1944  
COMPOSITON OF BLOOD OF RABBITS IN GRAVITY SHOCK.  
Am. J. Physiol. 141(2):165-171, April 1944.

ABSTRACT: (1) Rabbits suspended head up, without anesthesia, became unconscious in from 20 to 120 minutes, even though breathing continued at a rate about one-half that of normal. Thirty per cent of the animals died within 24 hours although all external symptoms appeared normal.

(2) Other changes resulting from suspension were: a, marked reduction of blood pressure; b, suppression of urine flow; c, metabolic acidosis (pH = 7.0); d, decreased blood carbon dioxide and venous oxygen; e, increased plasma lactate, phosphate, pyruvate, potassium and non-protein nitrogen; f, increased or decreased plasma glucose; g, decreased plasma chloride in well-fed animals.

(3) There were no constant or significant changes in hematocrit, plasma specific gravity, protein, sodium or calcium or in the blood cell counts.

(4) Hemoconcentration did not occur.

(5) Suspension resulted in a peripheral circulatory deficiency leading to tissue hypoxia. Altered concentrations of certain blood metabolites occurred, which were useful in determining the severity of shock, and the course of recovery when the rabbits were returned to the horizontal position.

1,071

Coleal, Ernest 1960 TRACK FACILITIES GUIDEBOOK.  
(Air Force Flight Test Center, Edwards Air Force Base, Calif.)  
ASTIA AD-253 717

ABSTRACT: General and detailed information is presented concerning the Air Force Flight Test Center 20,000 Foot High Speed Track Facility at Edwards Air Force Base, California. The general capabilities of the 20,000 foot track range are discussed in terms of speed, acceleration, propulsion, recovery and testing techniques. Prominent features of the various facility components are discussed and described. These are categorically presented under topic headings of 20,000 foot track, instrumentation, photography, propulsion and simulated rainfall range. Test program types are reviewed including: (a) missile fuse and warhead systems tests, (b) rain erosion testing, (c) airscrew escape systems,

(d) parachute recovery systems, (e) airfoil and empennage flutter tests, and (f) structural and acceleration tests. Development areas discussed are: (a) waterbrake recovery systems, (b) track slippers and bearing design, (c) shock and vibration isolation systems, and (d) acoustical environment study and control. (Author)

1,072

Colehour, J. K., & A. Graybiel 1963 URINARY EXCRETION OF CORTICOSTEROIDS AND CATECHOL AMINES IN NORMAL PERSONS (NON-PILOTS) AND DEAF SUBJECTS WITH BILATERAL VESTIBULAR DEFECTS SUBJECTED TO ACROBATIC FLIGHT STRESS. (Paper, 34th Annual Meeting of the Aerospace Medical Association, Statler-Hilton Hotel, Los Angeles, Calif., April 28 - May 2, 1963)

ABSTRACT: This report is one of a series dealing with comparative studies between normal subjects and deaf persons with bilateral labyrinthine defects (L-D subjects) exposed to identical or nearly identical force environments. In this instance all of the subjects were exposed to a standardized series of acrobatics in an AD-5 Skyraider. The total daytime and nighttime urinary excretions were collected the day prior to flight and on flight day. The activities of the subjects were standardized insofar as possible. Adrenalin and nor-adrenalin were measured according to the method of Crout, 17-hydroxycorticosteroids according to the method of Kornel and uropepsin according to the method of Anson. On the day of the flight compared to the control day, the excretion of catechol amines and corticosteroids was significantly higher for the normal but not the L-D group. Other interesting intergroup differences were noted as well as individual variance. Some of the differences were clearly attributable to the vestibular organs but other differences were either related to basic personality trait or unexplained.

1,073

Coleman, T. L., et al. 1954 MANEUVER ACCELERATIONS EXPERIENCED BY FIVE TYPES OF COMMERCIAL TRANSPORT AIRPLANES DURING ROUTINE OPERATIONS. (National Advisory Committee for Aeronautics, Washington, D. C.) NACA TR 3086, April 1954

1,074

Coles, C.H. 1945 ABRUPT DECELERATION OF ANIMALS. (AAF Air Technical Service Command, Wright Field, Dayton, Ohio) Memorandum Report Serial No. TSEAL-6F-181, July 1945.

1,075

Collar, A.R. 1954 ON THE STABILITY OF ACCELERATED MOTION (Aeronautical Research Council (Gt. Brit.) ARC rept. no. 16831; May 1954; ASTIA AD-48 604

ABSTRACT: In a previous note, the author has discussed some of the difficulties of dealing with the stability of systems governed by linear differential equations with variable coefficients. In general, this problem is difficult even for a single second-order equation. The problem of dealing with a set of coupled equations is naturally very much more difficult. In the case of certain sets of equations such as arise in problems of aircraft stability, however, the coefficients vary with speed in related ways. It is shown in this report that in such systems a particular form of acceleration enables a general solution to be obtained; the result may be regarded as a generalization of the treatment of sets of equations with constant coefficients.

1,076

Collins, C.C., J.L. Brown & C.F. Fischer 1957 A FLIGHT SIMULATOR  
INCORPORATING ACCELERATION FORCES.  
(Paper, Meeting of Aero Medical Association, Denver, Colorado,  
May 6-8, 1957)

ABSTRACT: It is proposed to use the Johnsville centrifuge to add the forces of acceleration to flight simulation. This realism can be made possible by allowing the pilot to control his own acceleration through an analogue computer simulating aerodynamic performance on the centrifuge. Transfer functions have been developed which will enable the transformation of control stick displacements into the appropriate centrifuge motions. The measured dynamic responses of the centrifuge will allow simulations of most high G aircraft maneuvers. This simulator will not only provide a facility for investigation which has heretofore been possible only in actual flight testing, but also will extend the measurements to the vital area not before realizable with safety, i.e., to the limits of both aircraft and human performance. (J. Aviation Med. 28(2):196, April 1957)

1,077

Collins, C.C. 1958 SOME ENGINEERING PROBLEMS IN SPACE MEDICINE  
(U.S. Naval Air Development Center, Johnsville, Pa. (Pennsylvania Triangle, published by the University of Pennsylvania) March, 1958.

ABSTRACT: This paper presents a discussion of some of the problems to be encountered in sending a man into space and maintaining him in that environment. Some of the factors which must be considered in the design of a capsule environment for a space flight of considerable duration where space, weight, and power limitations are significant are presented. Oxygen supply in a closed system and methods and materials for absorbing carbon dioxide are discussed. Other areas considered include: simulation of cabin environments on earth, capabilities of pilots during reentry, and kinesthetic sensations of pilots under stress conditions.

1,078

Collins, C.C., R.J. Crosbie, & R.F. Gray 1958 PILOT PERFORMANCE AND TOLERANCE STUDIES OF ORBITAL REENTRY ACCELERATION.  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR 64, Serial 7856, 19 Sept. 1958.

ABSTRACT: This report concerns a preliminary study of human tolerance to the re-entry accelerations expected in zero life vehicles. The study was undertaken to ascertain whether a human subject would tolerate orbital reentry acceleration patterns associated with the National Advisory Committee for Aeronautics (NACA) manned space capsule. The first phase of this study involved the expected reentry G-time histories supplied by NACA. These were carried up to 12 G peak. The second phase of the study probed the area up to 20 G. Three subjects rode the AMAL centrifuge open loop in the semi-supine position in the NACA contour couch. Subjects wore Z-a anti-blackout suits and strained during runs. Two subjects rode to 12 G in Phase I and two rode to 20 G in Phase II. One subject rode at 17° supination but, at this level, the other subject blacked out. By adjusting the angle of supination to 10°, this second subject was able to continue to 20 G without blackout. Apparently supination to 80° afforded the most protection. The subjects were able to operate a right-hand control stick with no apparent impairment due to the high G forces. It is concluded that a human subject can tolerate the acceleration associated with specific reentry patterns into the atmosphere from orbit with no physiological damage.

1,079

Collins, C.C., R.M. Herrick, & R.W. Lawton 1958 STATUS REPORT ON ANIMAL SATELLITE (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR73, Dec. 15, 1958

ABSTRACT: This report details the present status of the subject project. The equipment has been designed for use with rats and with modification, can be used with other animals. The animal behavior laboratory has been instrumented and is presently in use training rats to perform specified tasks according to a fixed routine. Spin studies, behavioral studies and diet studies are currently underway. Engineering requirements for orbital animal experiments have been studied, calculations have been performed and the proposed environment is described

1,080

Collins, C.C. & R.F. Gray 1959 PILOT PERFORMANCE AND TOLERANCE STUDIES OF ORBITAL REENTRY ACCELERATION  
(U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-LR90 Sept. 16, 1959

ABSTRACT: This study was undertaken to ascertain whether a human subject could tolerate orbital reentry acceleration patterns associated with emergency conditions in a manned space capsule. The study evaluated the second model of a space couch which was fabricated at the NASA Langley Research Center, with changes incorporated as suggested by the staff of AMAL. The object of this study was to determine the maximum acceleration which could be tolerated by a human subject protected by the NASA human support system and to explore the limiting factors

of non-liquid G protective systems. The support system was molded directly to the body of the test subject in the semi-supine position. The subject wore a standard Navy Z-2 G-suit and strained during the runs. At a back angle of 17°, the subject rode the centrifuge up to 20 G where blackout occurred. At a back angle of 14°, the limit was established by blackout at 23 G. No pain was experienced in any of these runs. At a back angle of 8°, the subject was able to withstand a peak acceleration of 25 G, the highest yet tried with solid support. Blackout did not occur during this run but the subject was not able to continue holding his breath. No pain was experienced.

1,081

Collins, W. E., G. H. Crampton, & J. B. Posner 1960 THE EFFECT OF MENTAL SET UPON VESTIBULAR NYSTAGMUS AND THE ELECTROENCEPHALOGRAM. (Army Medical Research Lab., Ft. Knox, Ky.) Rept. No. 439

ABSTRACT: Simultaneous recordings of horizontal nystagmus and EEG were obtained during vestibular stimulation. Six subjects were given tasks involving attention to the stimulus, mental arithmetic, and reverie. Attending to the stimulus was not necessary to maintain nystagmic output, although reverie states considerably reduced it. The degree of general "alertness" seemed to be the important factor. The vestibular stimulation did not block the alpha rhythm and more alpha was produced during states involving mental arithmetic.

1,082

Collins, W.E. 1960 FURTHER STUDIES OF THE EFFECTS OF MENTAL SET UPON VESTIBULAR NYSTAGMUS. (U.S. Army Medical Research Lab., Ft. Knox, Ky.) Rept. No. 443, December 1960. ASTIA AD 249 113L.

ABSTRACT: During rotational stimulation subjects were instructed in different test sessions, to: (1) do mental arithmetic, (2) make estimates of subjective velocity, (3) reproduce durations of sound stimuli, and (4) assume a state of reverie. The reverie state resulted in significantly less recorded nystagmus than the other tasks while mental arithmetic was the most efficacious means of obtaining a response. A factor of alertness seems to be an important condition for the maintenance of nystagmus. Simultaneous recordings of EEG were analyzed for amount of alpha production. No differences were evident among the conditions. The vestibular stimulation, however, did not block ongoing alpha activity.

1,083

Collins, W.E., F.E. Guedry, Jr. & J.B. Posner 1961 CONTROL OF CALORIC NYSTAGMUS BY MANIPULATING AROUSAL AND VISUAL FIXATION DISTANCE.  
(U.S. Army Medical Research Laboratory, Ft. Knox, Ky.) Rept. No. 485.  
ASTIA AD 263 256.

ABSTRACT: Groups of "naive" and "experienced" subjects were given a series of aural irrigations under various conditions. Variables manipulated included instructions designed to alert or relax the subjects, fixation distance, and illumination vs. total darkness. The alert condition produced nystagmus of greater amplitude and longer duration and yielded a smoother graphed function than the reverie condition. Near fixation (30.5cm.) yielded greater response than ceiling fixation, and two subjects showed no observable reaction to the latter condition. These findings are of importance in clinical situations and in theoretical formulations of vestibular functioning. Instructions which influence arousal and visual fixation distance should not be matters of inadvertent variation in clinical examination procedures.

1,084

Collins, W.E., G.H. Crampton, & J.B. Posner 1961 EFFECTS OF MENTAL ACTIVITY ON VESTIBULAR NYSTAGMUS AND THE ELECTROENCEPHALOGRAM.  
Nature (London) 190(4771):194-195

ABSTRACT: The present work was undertaken to ascertain how nystagmus, produced by a standard vestibular stimulus, is modified by different sets of instructions and, further, to determine the effects of these conditions on the electroencephalogram.

1,085

Collins, W. E. and F. E. Guedry, Jr. 1961 AROUSAL EFFECTS AND NYSTAGMUS DURING PROLONGED CONSTANT ANGULAR ACCELERATION. Report on Psychophysiological Studies.  
(Army Medical Research Lab., Fort Knox, Ky.)  
Report No. 500 29 August 1961 ASTIA AD 264 979  
Also see Acta Otolaryng (Stockholm) 54:349-362, March-April 1962.

ABSTRACT: When tasks were assigned to insure heightened mental activity, vestibular nystagmus did not decline during constant angular acceleration. With the same vestibular stimulus but with a task not conducive to heightened mental activity, nystagmus declined (or was of very low magnitude) during the stimulus. It is suggested that previously reported losses of subjective velocity during constant angular acceleration, may be an indicator of reduced corticofugal feedback to the reticular system and hence, as subjective velocity declines in this situation, nystagmus also declines except for extraneous sources of arousal. (Author)

1,086

Collins, W. E. & F. E. Guedry, Jr. 1961 AROUSAL EFFECTS AND NYSTAGMUS DURING PROLONGED CONSTANT ANGULAR ACCELERATION  
Acta Oto-laryngol. 54(3):349-362.

ABSTRACT: Six subjects were given a series of 10 rotary trials in which accelerations of  $1.0^{\circ}/\text{sec}^2$  and  $1.8^{\circ}/\text{sec}^2$  were employed for durations of 84 and 50 seconds respectively. Subjective states of arousal were manipulated by instructions. Duration and slow-phase velocity of nystagmus were measured. Qualitative as well as quantitative differences were observed as a function of arousal level.

Results indicated: (1) during mentally active states, no decline of nystagmus was evident during stimulation nor was there an abrupt cessation of nystagmus accompanying stimulus termination; (2) during states of mental relaxation, the nystagmic response was reduced, declines during stimulation appeared, and the response occasionally ended prior to, or at the moment of, stimulus termination.

Theoretical implications of the findings are discussed.

1,087

Collins, W. E., F. E. Guedry, Jr. and J. B. Posner 1961 CONTROL OF CALORIC NYSTAGMUS BY MANIPULATING AROUSAL AND VISUAL FIXATION DISTANCE.  
(U.S. Army Medical Research Lab., Fort Knox, Ky.)  
Proj. 6X95 25 001, Task. 04, Rept. 485. August 1961.

ABSTRACT: The effects of arousal state and visual fixation distance on calorically induced vestibular nystagmus were studied. Horizontal eye movements of naive and experienced Ss were recorded during aural irrigation (30 degrees C for 40 sec.) under different conditions: arousal (alerting or relaxing instructions), fixation distance (30.5cm, 1.63m), and illumination (total darkness or room illumination). Duration of nystagmus and quality rating of nystagmus based on amplitude, frequency, and regularity were treated by analysis of variance technique. Also, the effect of the two arousal states were compared by t-test for the various conditions. The implications for the clinical situation were discussed. (Tufts)

1,088

Collins, W. E. & R. H. Poe 1961 AMPHETAMINE, AROUSAL, AND HUMAN VESTIBULAR NYSTAGMUS. Report on Vestibular Function and Acceleration in Relation to Performance. (Army Medical Research Lab., Fort Knox, Kentucky) Proj. 6x95-25-001, Rept. No. 526, 22 December 1961.  
ASTIA Doc. No. AD-271 070.

ABSTRACT: A normal clinical dosage of amphetamine and a placebo were administered to groups of rotation-naive and rotation-experienced subjects by the double-blind method. The drug produced significant effects on pulse rate and systolic blood pressure. However, it did not significantly affect the slow-phase velocity of vestibular nystagmus during the first 30 seconds of response to a rotatory stimulus  $4.15 \text{ degrees}/\text{sq sec}$  applied for 13 seconds under conditions of mental activity and mental relaxation. In agreement with other

1,089

Collins, W.E. and R.H. Poe 1962 AMPHETAMINE, AROUSAL, AND HUMAN VESTIBULAR NYSTAGMUS. J. Pharmacol Exp Ther. 138(1):120-125, Oct. 1961.

ABSTRACT: A normal clinical dosage of amphetamine and a placebo were administered to groups of rotation-naive and 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.

1,090

Collins, W.E. 1962 EFFECTS OF MENTAL SET UPON VESTIBULAR NYSTAGMUS. J. Exper. Psychol. 63(2):191-197

ABSTRACT: During rotational stimulation subjects were instructed, in different test sessions, to: (a) do mental arithmetic, (b) make estimates of subjective velocity, (c) reproduce durations of sound stimuli, and (d) assume a state of reverie. The reverie state resulted in significantly less recorded nystagmus than the other three tasks, while mental arithmetic was the most efficacious means of obtaining a vigorous response. A factor of sustained alertness seems to be an important condition for the maintenance of nystagmus. (Author)

1,091

Collins, W. E., & F. E. Guedry, Jr. 1962 AROUSAL EFFECTS AND NYSTAGMUS DURING PROLONGED CONSTANT ANGULAR ACCELERATION. Acta Oto-Laryngologica (Stockholm) 54:349-362

ABSTRACT: Six subjects were given a series of 10 rotary trials in which accelerations of 1.0 degrees/sec<sup>2</sup> and 1.8 degrees/sec<sup>2</sup> were employed for durations of 84 and 50 seconds respectively. Subjective states of arousal were manipulated by instructions. Duration and slow-phase velocity of nystagmus were measured. Qualitative as well as quantitative differences were observed as a function of arousal level.

Results indicated: (1) during mentally active states, no decline of nystagmus was evident during stimulation nor was there an abrupt cessation of nystagmus accompanying stimulus termination; (2) during states of mental relaxation, the nystagmic response was reduced, declines during stimulation appeared, and the response occasionally ended prior to, or at the moment of, stimulus termination. Theoretical implications of the findings are discussed. (AUTHOR)

studies, the mentally active state resulted in greater output and longer durations of nystagmus than did the relaxed state. Amphetamine produced significantly longer reactions than the placebo, tending to affect nystagmus more when subjects were relaxed. There were indications that the drug and mental activity may facilitate secondary nystagmus, especially with naive subjects. (Author)

1,092

Collins, W. E. 1962 MANIPULATION OF AROUSAL AND ITS EFFECT ON HUMAN VESTIBULAR NYSTAGMUS INDUCED BY CALORIC IRRIGATION AND ANGULAR ACCELERATIONS. (Paper, 33rd Annual Meeting, Aerospace Medical Association, 9-12 April 1962, Atlantic City, N. J.) (Federal Aviation Agency, Aviation Medical Services, Civil Aeromedical Research Institute, Oklahoma City, Oklahoma) Rept. No. 62-17; Oct. 1962; Aerospace Med. 32(2):124-129. February.

ABSTRACT: Investigations concerned with the effects of subjective states on vestibular nystagmus were reviewed. Methods of controlling such states were discussed. Data indicate that the significant factor in subject-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 require less attention with repetition, or if subjects are not kept alert, a significant reduction in nystagmus output may occur. A sudden alerting stimulus may then occasion a burst of nystagmic activity in an apparently "adapted" individual. Knowledge of subjective states is a pre-requisite for proper evaluation of vestibular responses in theoretical formulations, in many clinical situations, and in ascertaining vestibular components associated with air- or space vehicle maneuvers. (AUTHOR)

1,093

Collins, W.E. 1963 OBSERVATIONS ON THE ELICITATION OF SECONDARY AND INVERTED PRIMARY NYSTAGMUS FROM THE CAT BY UNILATERAL CALORIC IRRIGATION. (Federal Aviation Agency, Civil Aeromedical Research Institute, Oklahoma City, Oklahoma) CARI Report 63-3, February 1963

ABSTRACT: Vestibular stimulation by repeated unilateral caloric irrigation of cats occasioned the appearance of secondary, tertiary, and inverted primary nystagmus in some animals. These inverse responses were recorded with stimulus temperatures of 5, 23.5, and 53.5 C, applied for durations ranging from 15-35 seconds. The inverse reaction most frequently obtained was the secondary nystagmus. Several possible explanations for the occurrence of the phenomena were examined. The findings appear related to "habituation" of the vestibular system, and thus have implications for vestibular adaptation in clinical situations and during air-vehicle maneuvers.

Collins, W. E., F. E. Guedry, & J. B. Posner 1962 CONTROL OF CALORIC NYSTAGMUS BY MANIPULATING AROUSAL AND VISUAL FIXATION DISTANCE. Ann. Oto-Rhino-Laryngologica 71:187-202

ABSTRACT: 1) Groups of "naive" and "experienced" subjects were given a series of aural irrigations under various conditions. Variables manipulated included instructions designed to alert or relax the subjects, fixation distance, and illumination vs. total darkness. 2) The alert condition produced nystagmus of greater amplitude and longer duration and yielded a smoother graphed function than the reveries condition. Near fixation (30.5 cm) yielded greater response than ceiling fixation, and two subjects showed no observable reaction to the latter condition. These findings are of importance in clinical situations and in theoretical formulations of vestibular functioning. 3) Instructions which influence arousal and visual fixation distance should not be matters of inadvertent variation in clinical examination procedures. (AUTHOR)

1,095

Comenzo, R. J. 1960  
DESIGN FOR MANNED RE-ENTRY GLIDE  
(1960 Proceedings of the Institute of Environmental Sciences. Paper not available at time of publication)

1,096

Comrey, A.L., A.A. Canfield, R.C. Wilson and W.S. Zimmerman 1951 THE EFFECT OF INCREASED POSITIVE RADIAL ACCELERATION UPON PERCEPTUAL SPEED ABILITY. J. Aviation Med., 22(1):60-64, Feb 1951

ABSTRACT: Limited exposure to the effects of increased positive radial acceleration, up to the level of 4 g, may distract subjects in the performance of perceptual-speed tasks, but adaptation to such distractions readily takes place. This is based on the assumption that the subjects vision is not limited due to greyout or blackout. The increased acceleration force apparently has little effect on ability to note minor differences in visual detail.

1,097

Conley, M. 1950 THE MEN WHO CAN MAKE SPACE FLIGHT POSSIBLE TODAY. J. Space Flight, 2:1-3

ABSTRACT: Suggests a crew of six and the things each will need to know.

1,098

Conley, M. 1952 A METHOD OF SUPPORTING THE HUMAN BODY STRUCTURE DURING SPACE FLIGHT. J. Space Flight 4(9):3-4, Nov. 1952.

ABSTRACT: Lightweight zippered supporters, made of webbed cotton fabric, are recommended for use in space ships to protect various parts of the body from effects of acceleration, deceleration, and zero-g conditions. They would be worn underneath the underclothing as a "second skin", to hold the body's shape and prevent rupturing of organs.

1,099

Conley, M. 1952 A METHOD OF SUPPORTING THE HUMAN BODY STRUCTURE DURING SPACE FLIGHT  
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1,100

Connors, J.F. & J.C. Lovell 1960 SOME OBSERVATIONS ON SUPERSONIC STABILIZATION AND DECELERATION DEVICES.  
( Institute of the Aeronautical Sciences) Paper No. 60-19, Jan. 1960.

1,101

Connors, R.J. & L.D. Sachs 1957 EVALUATION OF THE ESCAPE SYSTEMS FOR THE B-52 AND RB-52 AIRPLANES (American Machine and Foundry Co., Chicago, Ill.)  
Rept. No. R-1363, Contract Da 11-022-ORD-1604, Jan 1957, ASTIA AD-124 308

ABSTRACT: The escape systems for the B-52 and RB-52 airplanes comprise various subsystems providing for emergency escape of several crewmen. Numerous "get ready" operations, such as seat positioning, equipment stowage, hatch jettison, etc., are performed in each subsystem prior to ejection of the crewman. Each subsystem consists of several cartridge actuated devices, such as initiators, thrusters, and catapults. The devices are connected with lengths of hose or tube or by mechanical linkage to an aircraft component set in motion. The details of each subsystem and the estimated or measured pressure at the inlet of each cartridge actuated device are presented.

1,102

Consumer Reports 1960 AUTO SEAT BELTS  
(Consumer Reports, February, 1960, pp. 82-87)

ABSTRACT: Tests have proved that seat belts can substantially reduce the annual toll of people killed and injured in auto accidents. However, most people do not have seat belts because they are either indifferent to them through lack of any information or because seat belts are too expensive.

Details are given of the standards that the Federal Government specified for seat belts.

Recommendations are given for buying seat belts and what to specify when having them installed. A list of acceptable and unacceptable brands of seat belts is also included.

1,103

Convair DEVELOPMENT TEST OF PILOT EMERGENCY ESCAPE, UPPER TORSO HARNESS.  
(Convair, San Diego) Test Report 9999.

1,104

Convair 1956 F-102A PILOT'S EMERGENCY ESCAPE SYSTEM SLED TEST.  
(Convair, San Diego) Report No. 9163, September 1955-January 1956.

1,105

Convair 1956 REPORT OF DEVELOPMENT ENGINEERING INSPECTION.  
F-102B SUPERSONIC SEAT.  
(Convair, General Dynamics Corp.) 15 May 1956.

1,106

Convair Division of General Dynamics Corporation 1958 INDUSTRY (ICESC)  
SUPERSONIC UPWARD EJECTION PILOT'S ESCAPE SYSTEM. Part I. Development  
Phase Sled Tests. Rept. 57-100F-1, San Diego

1,107

Convair 1960 F-106 PILOT'S ADVANCED ESCAPE SYSTEM, HUMAN POSITIONING  
TESTS. (Convair, San Diego, Calif.) Rept. no. DL 60-132, October 1960  
AD 258 887

ABSTRACT: Research was undertaken to provide the test subjects with experience in the rapid positioning prelaunch sequence of the B-seat. A reserve chest-type parachute was incorporated in these positioning tests to determine its placement for compatibility with the pre-launch positioning of the seat. A

total of nine runs were conducted using a 95- percentile anthropomorphic dummy, A 50- percentile human, and a 65-percentile human, as test subjects. The dummy was tested in a MK IV full-pressure suit only, while the humans were tested in CSU-4/P full-bladder pressure suits, MK IV full-pressure suits, K-2B summer flying suits, and CWU-1/P winter flying suits. The present MK IV full-pressure suit was not compatible with the pre-launch positioning of the seat, even when unpressurized. These tests also indicated that a pressurized CSU-4/P of the foot pan motor unit, causing the motor to stall, and preventing complete seat positioning. (Author)

1,108

Conway, S. M. P., & B. J. Cremin 1956 SOME MEDICAL PROBLEMS OF PARACHUTING IN MALAYA. J. Royal Army Med. Corps (London) 102(1):70-72, Jan. 1956

ABSTRACT: A 4.6% casualty rate was found in 995 operational or training parachute jumps of troops and medical personnel over the Malayan jungles. The hazards of jumping in the jungle include parachute hook-up and catching in branches and trees, or giving-way of the parachute after initial hook-up. The most common injuries occurred in the back, usually crush fractures of the lumbar and thoracic vertebrae. Other injuries occurred in the ankle, ribs, pelvis, clavicles, or any other bones which come in contact with direct violence by branches or the ground. Lacerations and bruises were usually treated on the spot, but more serious injuries were evacuated by helicopter. Casualties were reduced by air reconnaissance of the terrain prior to jumps.

1,109

Conybeare, J.J. 1942 SOME PROBLEMS OF AVIATION MEDICINE.  
Guy's Hosp. Gaz. 56:2-6

1,110

Cook Electric Company 1954 PROGRAM FOR STUDY OF THE PHYSIOLOGICAL EFFECT OF EMERGENCY ESCAPES AT TRANSONIC SPEEDS.  
(Cook Research Laboratories, Cook Electric Company, Chicago, Ill.)

1,111

Cook Electric Company 1962 FEASIBILITY STUDY OF HYPERSONIC PARACHUTE FREE FLIGHT TEST CAPABILITY, PHASE I  
(Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio)  
Project No. 6065, Task No. 606506, ASD-TR-61-600, March 1962, Contract No. AF 33(616)-8469, ASTIA AD 275 578

ABSTRACT: A study has been conducted to determine the feasibility of establishing a free-flight test capability for aerodynamic decelerators at supersonic and hypersonic velocities. Methods for boosting test vehicle weights of

250, 500, 800, and 2000 pounds to various altitudes and Mach numbers utilizing presently available rocket motors and range facilities are evaluated. Test altitudes vary from 2000 to 250,000 feet for a Mach number range of 1.0 to 10. Instrumentation requirements for measuring decelerator performance characteristics and vehicle flight parameters are investigated. Methods for water and land recovery of the payload section of the vehicles are presented. The results of the study indicate that presently available vehicle design and instrumentation techniques, as well as existing range facilities, may be employed.

1,112

Cook, J.C. 1960 THE GRAVITATION PHENOMENON AND ITS ENERGY IMPLICATIONS.  
(Symposium on Medical and Biological Aspects of the Energies of Space,  
at The School of Aviation Medicine (USAF), Brooks AFB, Texas)

1,113

Cook, J.E., J.P. Stapp, F.M. Townsend & V.A. Stenbridge 1958 THE PATHOLOGIC  
FINDINGS IN EXPERIMENTAL ANIMALS SUBJECTED TO RAPID ACCELERATION AND ABRUPT  
DECELERATION.  
(Paper, 1958 Meeting of Aero Medical Association, Statler Hotel, Washington,  
March 24-26, 1958)

ABSTRACT: Animals are frequently utilized in experiments designed to gain data concerning individual tolerances and safety margins. While those animal tests are not intended to replace actual human participation in evaluating man's ability to withstand physical stress, the properly selected and utilized animals allows for both the examination of living tissues and varied environments without the initial use of human volunteers. This paper presents the pathologic lesions observed in experimental animals subjected to rapid acceleration, abrupt deceleration, supersonic thrust wind blast and prolonged high transverse G. The advantages and disadvantages of the various experimental animals (primates, bears, swine) is given together with pertinent anatomical comparison of the different species. (J. Aviation Med. 29(3):234)

1,114

Cook, J.E., J.D. Mosely & H.J. von Beckh 1959 PATHOLOGY OF VISCERAL  
DISPLACEMENT IN ANIMAL SUBJECTS EXPOSED TO ABRUPT DECELERATION  
(Paper, Meeting of Aero Medical Association, Statler Hilton Hotel,  
Los Angeles, April 27-29, 1959)

ABSTRACT: Eight Canadian black bears, approximately two years of age and averaging 160 pounds, were subjected to abrupt deceleration. The subjects were autopsied and analyses were made of the pathologic findings in relation to the G loads sustained. These findings were correlated with positioning and the restraint system used. Studies made on human volunteer subjects exposed to similar forces will be discussed. A description of a self-positioning rat G couch will be shown. The performance of this automatic

G-orienting device, during the bear sled-runs, will be discussed.  
(J. Aviation Med. 30(3):180, March 1959)

1,115

Cook, J. E., & J. D. Mosely 1960 VISCERAL DISPLACEMENT IN BLACK BEARS SUBJECT  
ED TO ABRUPT DECELERATION. Aerospace Medicine 31(1):1-8, Jan. 1960  
See also (Air Force Missile Development Ctr., Holloman AFB, N. Mex.)  
AFMDC TN 60-6, March 1960

ABSTRACT: Eight American black bears, utilized in abrupt deceleration studies, showed considerable promise as comparative abrupt deceleration subjects. They approximate man's confirmation and weight and stand alone easily on the rear limbs with the head at a normal inclination. Their tolerance to plateau, onset and duration g depends entirely upon positioning and restraint as does man. In the rearward facing position based upon necropsy findings and statements from human volunteer subjects, it appears that the bears' tolerance to abrupt deceleration of less than 0.2 seconds durations is close to that of man. In the forward facing position with a full harness they have sustained g levels with reversible lesions which would be unusually painful and not recommended for human volunteers.

1,116

Cook, James E., John P. Stapp; F. M. Townsend; and V. A. Stenbridge 1962  
PATHOLOGIC FINDINGS OF EXPERIMENTAL ANIMALS SUBJECTED TO RAPID ACCEL-  
ERATION AND ABRUPT DECELERATION. (Armed Forces Inst. of Pathology,  
Washington, DC, and Aero Medical Field Lab., Air Force Missile Develop-  
ment Center, Holloman AFB, New Mexico) January 1962

1,117

Cooper, K.H. & F.M.G. Holstrom 1961 INJURIES DURING EJECTION SEAT TRAINING.  
(Paper presented at 32nd annual meeting, Aerospace Medical Association,  
Chicago, Ill.)

ABSTRACT: The USAF ejection seat trainer used for emergency escape familiarization is an occasional cause of injury to trainees. Injuries that occur are usually minor and related to high headward acceleration of very short duration. Three new cases of coccygeal injury resulting from ejection seat training are reported. The character and magnitude of the accelerative forces, the role of body position, and the protective value of high energy absorbent seat cushions are discussed. Recommendations to minimize the recurrence of such injuries are included. (Aerospace Med., 32(3):227, March 1961)

1,118

Cooper, K.H. 1963 INJURIES DURING EJECTION SEAT TRAINING.  
Aerospace Medicine 32(2):139-141, Feb. 1963.

ABSTRACT: 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 unfavorable 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.

1,119

Cooper, W.N. and M.A. Beaupre 1961 INTERNALIZED ANIMAL TELEMETRY SYSTEM -  
ENGINEERING CONSIDERATIONS.  
(Paper, 1961 Meeting of Aerospace Medical Association, Chicago, April 24-27)

ABSTRACT: This paper describes the engineering development of an improved method of gathering biomedical data. A biological telemetry system was implanted within an animal and subsequently tested under simulated missile conditions. The biological and physical environments are discussed. Engineering aspects of the surgery performed to implant a transmitter and sensing electrodes into two simians is presented. A description is given of an animal support system which includes methods of restraint, couch configuration, protective qualities, and hardware integral with the couch. Formulation of test specifications, amount and type of test performed, and the equipment used, are discussed. Data recorded and the comparative results of these data are described.  
(Aerospace Medicine 32(3):227, March 1961)

1,120

Cope, F.W. & B.D. Polis 1957 CHANGE IN PLASMA TRANSAMINASE ACTIVITY OF  
RHESUS MONKEYS AFTER EXPOSURE TO VIBRATION, ACCELERATION, HEAT, OR HYPOXIA.  
(U.S. Naval Air Development Center, Johnsville, Pa.)  
NADC-MA-5718. ASTIA AD 209 173.

ABSTRACT: Significant increases in plasma glutamic-oxalacetic transaminase levels were observed in monkeys exposed to vibration, acceleration, heat, hypoxia, or noise and confinement stress. In all but 1 of 17 animals, no specific tissue damage was evident. The increase in plasma transaminase is interpreted as a non-specific stress effect. The data suggest that caution should be exercised in basing clinical judgments on serum transaminase levels.  
(Author)

1,121

Cope, F.W. 1958 ELASTIC CHARACTERISTICS OF ISOLATED SEGMENTS OF HUMAN AORTAS UNDER DYNAMIC CONDITIONS. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA 5809, 13 Aug. 1958. ASTIA AD 209 084.

See also J. Applied Physiol. 14(1):55-59, Jan. 1959.

**ABSTRACT:** When isolated segments of human descending thoracic aorta were caused to change their volume rapidly and continuously in sinusoidal fashion with pulse pressures and pulse rates maintained in the physiological range, the resulting pressure-volume curves showed slight but consistent increases in stiffness, compared to pressure-volume curves obtained on the same specimens when inflated stepwise. There was introduced into the pressure measuring system a time lag of sufficient magnitude to eliminate the hysteresis loop. The extent of hysteresis in the aorta was not determined because time lags in the aorta could not be distinguished from time lags in the measuring equipment. (Author).

1,122

Cope, F.W. 1958 EFFECTS OF AGEING, DRUGS, EXERCISE AND OTHER STRESSES ON THE ELASTIC CHARACTERISTICS OF THE INTACT LIVING HUMAN AORTA. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5815, 19 Nov. 1958.

**ABSTRACT:** A method was developed by which aortic distensibility characteristics can be computed in the intact living human, if systolic and diastolic arterial pressures, heart rate and cardiac output are known. In this way the aortic characteristics of a large series of normal men of different ages were computed. Comparing these results with measurements on excised aortas, a more pronounced trend toward increasing aortic stiffness with increasing age is evident in living than in dead aortas. Norepinephrine and exercise apparently cause the living aortas to constrict but to become more distensible. The same change occurs after 30 min. of high spinal anesthesia. The ganglionic blocking agents hemamethonium pentamethonium, and tetraethylammonium usually cause the living aorta to become stiffer, presumably due to dilation. The aortas of patients with pulmonary disease usually react in different fashion to exercise or tetraethylammonium. The increased aortic distensibility that occurs with the hypertension induced by norepinephrine or exercise acts as a compensatory mechanism by decreasing systolic pressure. (Author)

1,123

Cope, F.W. 1958 EFFECTS OF AGEING, DRUGS, EXERCISE AND OTHER STRESSES ON THE ELASTIC CHARACTERISTICS OF THE INTACT LIVING HUMAN AORTA. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5815, 19 Nov. 1958.

**ABSTRACT:** A method was developed by which aortic distensibility characteristics can be computed in the intact living human, if systolic and diastolic arterial

1,124

Cope, F.W. - 1959 PROBLEMS IN HUMAN VIBRATION ENGINEERING.  
(Naval Air Development Ctr., Johnsville, Pa.) NADC-MA 5902, 6 March 1959.  
ASTIA AD 216 507.

See also Ergonomics 3(1):35, Jan. 1960.

ABSTRACT: Vibration is considered to include the oscillatory motion of traveling vehicles. The predominant linear sinusoidal component of this motion is usually in the vertical direction and of 0-50 cps in frequency. A human or animal, subjected to vibration, may exhibit a variety of symptoms and anatomical damage. These effects may be diminished by shielding the operator from the vibration of the vehicle by means of an elastic device. A variety of suitable devices are available. However, excessive shielding is undesirable in that it will increase the relative motion of the operator with respect to the vehicle which may be expected to cause performance decrements. (Author)

1,125

Cope, F.W., and D. Polis. 1959 INCREASED PLASMA GLUTAMIC-OXALACETIC  
TRANSAMINASE ACTIVITY IN MONKEYS DUE TO NONSPECIFIC STRESS EFFECT.  
J. Aviation Med. 30(2):90-96.

ABSTRACT: Significant increases in plasma glutamic-oxalacetic transaminase levels in monkeys have been found after exposure to vibration, acceleration, heat, and noise and confinement stress. In all but one of fourteen animals, no specific tissue damage was evident. Repeated exposure of the same monkey to the same intensity of vibration stress produced progressively smaller mean increases in the plasma transaminase levels. The data suggest that an increase in plasma transaminase activity can occur as a nonspecific stress effect. It follows that caution should be exercised in basing clinical judgements on serum transaminase levels.

1,126

Cope, F.W. & B.D. Polis 1959 SOME EFFECTS OF PROLONGED LOW FREQUENCY VIBRATION  
ON THE MOLECULAR AND CELLULAR COMPOSITION OF BLOOD  
Journal of Aviation Medicine 30: 90-96, 1959  
See also: U.S. Naval Air Development Center Rept. No. NADC-MA-5715,  
Nov. 6, 1957

ABSTRACT: Thesus monkeys were exposed to vertical sinusoidal vibration of amplitude 0.1 inch and frequency 20 cps for 3 hours a day for 8-12 successive days. The monkeys were strapped in a sitting position on a vertically vibrating table top. Control monkeys were placed nearby. The vibrated monkeys showed no grossly visible abnormalities. On the first day of vibration, the neutrophile counts and plasma transaminase levels rose abruptly, and then gradually decreased as

the vibration was repeated on successive days. These changes were interpreted as nonspecific changes such as may be characteristic of the General-Adaptation-Syndrome and do not necessarily indicate any specific tissue damage such as myocardial infarction of the monkey. Similar changes of lesser magnitude were produced by merely handling the monkeys. Plasma glucose and ascorbic acid levels and eosinophile counts, which are known to change with stress, were maximally depressed by the mild stress of handling the animals. No additional effect on these determinations could be ascribed to vibration. The data obtained with monkeys suggest that a rise in transaminase activity merely reflects a general response to a stressful state.

1,127

Cope, F.W. 1960 PROBLEMS IN HUMAN VIBRATION ENGINEERING.  
Ergonomics 3(1):35. Jan. 1960.  
See also (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-5902,  
6 March 1959. ASTIA AD-216 507.

ABSTRACT: Vibration is considered to include the oscillatory motion of traveling vehicles. The predominant linear sinusoidal component of this motion is usually in the vertical direction and of 0-50 cps in frequency. A human or animal, subjected to vibration, may exhibit a variety of symptoms and anatomical damage. These effects may be diminished by shielding the operator from the vibration of the vehicle by means of an elastic device. A variety of suitable devices are available. However, excessive shielding is undesirable in that it will increase the relative motion of the operator with respect to the vehicle which may be expected to cause performance decrements. (Author)

1,128

Cope, F. W. 1961 AN AUTOMATED SYSTEM FOR THE STUDY OF MENTAL FUNCTION  
IN THE HUMAN SUBJECTED TO ACCELERATION STRESS.  
(Aviation Medical Acceleration Lab., Naval Air Development Center,  
Johnsville, Pa.)  
Rept. no. NADC-MA-6113 Sept. 8, 1961. ASTIA AD 263 609

ABSTRACT: A design is given for a system that provides a continuous, easily analyzable record of a subject's mental functioning as measured by response time during a period of acceleration or other stress. The subject is given the task of adding 2 random numbers which are given to him via his earphones every 3 seconds. The subject is told to press a right or left hand switch according to whether the answer is even or odd. A continuous readout is presented by small combination analog-digital computer system. The steepness of the slope of the output record indicates the speed and/or accuracy of the subject's mental functioning. Preliminary studies using the above method showed that mental functioning seems to be slowed during acceleration stress. For acceleration studies, the method has the advantage of giving an indication of mental function independent of changes in vision occurring during greyout. (Author)

1,129

Cope, F. W. 1961 A METHOD FOR THE COMPUTATION OF AORTIC DISTENSIBILITY  
IN THE LIVING HUMAN PATIENT.  
(US Naval Air Development Center, Johnsville, Pa.)  
April 3, 1961 NADC-MA-6109:1-6

1,130

Cope, F.W. and R.E. Jensen 1961 PRELIMINARY REPORT ON AN AUTOMATED SYSTEM  
FOR THE STUDY OF MENTAL FUNCTION IN THE HUMAN SUBJECTED TO ACCELERATION  
STRESS. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-6113,  
8 Sept. 1961. ASTIA AD 263 609.

ABSTRACT: A design is given for a system that provides a continuous, easily  
analyzable record of a subject's mental functioning as measured by response  
time during a period of acceleration or other stress. The subject is given  
the task of adding 2 random numbers which are given to him via his earphones  
every 3 seconds. The subject is told to press a right or left hand switch  
according to whether the answer is even or odd. A continuous readout is pre-  
sented by a small combination analog-digital computer system. The steepness  
of the slope of the output record indicates the speed and/or accuracy of the  
subject's mental functioning. Preliminary studies using the above method showed  
that mental functioning seems to be slowed during acceleration stress. For  
acceleration studies, the method has the advantage of giving an indication of  
mental function independent of changes in vision occurring during greyout.

1,131

Coplan, M. J. 1960 RE-ENTRY DRAG DEVICES STUDIED.  
Missiles and Rockets 7(22):48, 63, Nov. 28, 1960

ABSTRACT: Research is being conducted on the development of ideal materials for  
expandable drag devices.

1,132

Coppa, A.P. 1958 STRUCTURAL CONSIDERATION OF MANNED SPACE VEHICLES.  
(Paper presented at ARS 13th annual meeting, 17-21 Nov 1958, New York)  
ARS paper no. 732-58

ABSTRACT: This paper considers the structural requirements for a manned space  
vehicle. It gives approaches leading to an optimum vehicle, considering the  
requirements of thermodynamics and human factors, in addition to structure.  
Several space vehicle configurations are presented including a ballistic and  
a glide type in order to exemplify some of the structural problems encountered  
in each type during the phases of space flight, entry into an atmosphere, and  
landing. These include aerodynamic heating and loading, meteoroid impact,  
and other problems. Materials and constructions are discussed sufficiently  
to demonstrate available choices and indicate areas of required development.

1,133

Corazzi, U. 1961 POSSIAMO VIVERE NELLO SPACIO? (COULD WE LIVE IN SPACE?)  
Oltre il cielo (Rome), 5(90):271-274, Oct. 1961. (In Italian)

ABSTRACT: This is a review of the studies done by Colonel Professor Rodolfo Margaria, director of the Institute of Physiology of the University of Milano. The review includes his studies on high altitude physiology, aviation medicine, protection from accelerative forces, respiration and position sense, space flight physiology, mammalian resistance to acceleration, effects of zero gravity on the otolithic apparatus, and the effects of interplanetary voyages on the central nervous system and mental conditions. There is also a biographical sketch of the author included.

1,134

Corbin, K. B. & H. L. Williams 1960 DIZZINESS  
The Medical Clinics of North America 44(4):941-951.

ABSTRACT: Dizziness and vertigo may be defined as unreal sensations of movement. Dizziness is caused by a variety of conditions, and patients use the term to describe various sensations. True rotary vertigo usually indicates a disturbance in the vestibular mechanism, anywhere from the end-organ to the cerebral cortex; on the other hand, faintness or lightheadedness usually indicates a cerebral vascular disturbance due to a variety of causes. This paper is concerned with the differential diagnosis of diseases in which a principal complaint is dizziness or vertigo and in which the sensation of unreal movement is due to a dysfunction of some part of the vestibular system, anywhere from labyrinthine end-organ to cerebral cortex.

1,135

Cordy, R.N. 1961 SPRING MASS DAMPED SYSTEM EXPONENTIAL RESPONSE.  
(Atomics International, North American Aviation) NAA-SR-Memo-6171  
27 June 1961.

ABSTRACT: The second order equation describing spring-mass-damped systems is solved for exponential forcing functions. The results, presented as amplitude and time delay errors, are plotted for large ranges of natural frequency, damping and exponential period.

1,136

Corey, E.L. 1946 MEDICAL ASPECTS OF BLAST U.S. Nav. Med. Bull. 46:623-652

1,137

Corkindale, K.G. 1961 PSYCHOLOGICAL PROBLEMS OF SPACE FLIGHT.  
New Scientist (London), 10(236):457-459. May 23, 1961.

ABSTRACT: The effects of the following psychological stresses on performance and behavior of the astronaut are summarized: high g forces, weightlessness, isolation, restraint, and sensory deprivation.

1,138

Cörmann, R. 1940 UNTERSUCHUNGEN ÜBER DIE EINWIRKUNG VON SCHWINGUNGEN AUF DEN MENSCHLICHEN ORGANISMUS (Investigation of the Effects of Vibration Upon the Human Organism)  
Luftfahrtmedizin 4: 73-117.

1,139

Cornell University 1948 NEED OF MULTI-G ACCELERATION-DECELERATION RESEARCH  
(Cornell University Medical College, Cornell Committee for Air Safety Research  
October 22, 1948

ABSTRACT: During the past five years the Crash Injury Research project has studied the causes of serious and fatal injuries in more than 600 survivable aircraft accidents. Data for the study have come principally from accidents in small planes. Lack of multi-g research facilities for studying the mechanics of structures and the mechanics of the human body under heavy dynamic loads has left an important part of aviation's safety problem completely unexplored. The universal lack of knowledge of the forces present in crashes makes interpretation of accident-injury details difficult. The Crash Injury Research project and all groups concerned with the future safety of flying have a deep interest in multi-g acceleration-deceleration facilities, for such facilities will permit research on the basic factors governing chances of safety in severe crack-ups: (1) energy absorption by structure, (2) optimum relationships between the human body and surrounding aircraft structure under conditions of crash force.

1,140

Cornell University Medical College 1950 HUMAN TOLERANCE OF CRASH DECELERATION  
(Cornell Committee for Air Safety Research, Cornell University Medical  
College, New York) 31 Jan. 1950. ASTIA AD 208 667.

ABSTRACT: Human volunteers have been subjected to decelerations of 35 g without injury. Jolt loads of 57g have been recorded on safety belts and shoulder harness during 35g decelerations. Results of this research indicate

that the strength of aircraft structures and installations, rather than the strength of the human body, is the limiting factor in pilot protection. Experiments with the rocket sled developed by Northrop Aircraft concerning body positioning and shoulder harness during deceleration is making military flying much safer.

1,141

Cornell University Medical College 1951 INFORMATIVE ACCIDENT  
RELEASE NO. 12. DETAILS OF HASTINGS CRASH NEAR BENINA, LYBIA;  
AND DETAILS OF VALETTA CRASH NEAR STOCKHOLM, SWEDEN.  
(Crash Injury Research, Cornell University Medical College, New York)  
22 May 1951.

1,142

Cornell University Medical College 1952 CRASH INJURY STUDY OF THE NORTHEAST  
AIRLINES - CONVAIR 240 ACCIDENT AT LAGUARDIA AIRPORT ON JAN. 14, 1952.  
(Crash Injury Research, Cornell University, New York)  
August 1952. ASTIA TIP U-13763.

ABSTRACT: This report describes the basic accident-injury findings of the Convair Accident. Relationships between crash force, seats, safety belts, structures and injuries are discussed and summarized in order to record useful information for future considerations of crashworthy design.

1,143

Cornell University Medical College 1952 SHOULDER HARNESS: ITS USE AND  
EFFECTIVENESS. (Crash Injury Research, Cornell University, New York)  
Nov. 1952.

1,144

Cornell University 1956 GENERAL DESIGN REQUIREMENTS FOR CRASH WORTHINESS AND  
DE-LETHALIZATION OF PASSENGER TRANSPORT AIRCRAFT  
(Aviation Crash Injury Research of Cornell University) Naval Research Contract  
NONR 401/21, AV-CIR-0-45/67 August 1956

1,145

Cornell University Medical College 1956 AN EVALUATION OF SAFETY  
BELT EFFECTIVENESS IN AUTOMOBILE ACCIDENTS. (AS DEMONSTRATED BY A  
CLINICAL STUDY OF 236 OCCUPANTS OF 162 CARS IN RURAL ACCIDENTS)  
(Automotive Crash Injury Research, Cornell University Medical College,  
New York, New York)

1,146

Cornell Aeronautical Laboratory, Inc. 1958 CORNELL PROBES WEIGHTLESSNESS.  
Aviation Week 68(2):26-28. 13 Jan. 1958.

ABSTRACT: A review of work being done at Cornell Aeronautical Laboratory, Inc. for Air Research and Development Command. The work reviewed concerns investigation of the efficiency of man's intellectual functions as opposed to physiological reactions, during weightless space travel in rockets, satellites or other space vehicles.

1,147

Cornell Aeronautical Laboratory 1958 CORNELL INVESTIGATES WEIGHTLESS-  
NESS. Missiles and Rockets, 3(2):138 Feb. 1958

ABSTRACT: Cornell Aeronautical Laboratory has recommended to the USAF experiments in which both a monkey and a rat would be sent aloft in a capsule enclosed within the nose of a rocket to study animal behavior under conditions of weightlessness. Some data on the studies made by CAL which resulted in the recommendation for experiments.

1,148

Cornell University 1958 ANNUAL REPORT AVIATION CRASH INJURY RESEARCH OF  
CORNELL UNIVERSITY, AUGUST 15, 1957 THROUGH NOVEMBER 15, 1958  
(Aviation Crash Injury Research, Cornell University, Naval Research Contract  
No. Nonr-4-1(21) Feb. 16, 1959- ASTIA AD 210 703

ABSTRACT: A report on the objectives and tasks, general program, publications, and investigations of Av-CIR.

1,149

Cornell-Guggenheim Aviation Safety Center 1961 RELATIONSHIP BETWEEN IMPACT  
VARIABLES AND INJURIES SUSTAINED IN LIGHTPLANE ACCIDENTS. (Cornell-  
Guggenheim Aviation Safety Center, New York) Contract DA 44-177-tc-707;  
TREC TR 61-95; AvCIR 61-5; ASTIA AD-263 676L

ABSTRACT: Impact conditions are related to injuries sustained by 248 occupants involved in lightplane crashes. Seat tie-down and belt restraint were considered effective and structural collapse was generally not extensive, yet one of every four occupants was killed. Injury severity, fatality rate, and incidence of injury to all areas of the body - except the lower torso and thoracic-lumbar spine - were directly related to impact velocity and to angle of impact but inversely related to stopping distance. Lumbar and thoracic spine injuries occurred more frequently in low-angle, long deceleration crashes. It was concluded that crucial injuries largely stem from flailing of the body against injury-producing structures within the occupant's environment. Belt restraint is thus seen to play only a moderate role in reducing injury severity. The need for additional safety measures is emphasized. (AUTHOR)

1,150

Cortesi, Arnaldo 1959 LOSS OF FOUR RUSSIANS IN SPACE REPORTED...  
ITALIAN NEWS AGENCY SAYS DEAD IN TESTS SINCE '57 INCLUDED A WOMAN.  
The New York Times, 14 December, p. 9.

ABSTRACT: A report received from the Italian News Agency Continentale notes unsuccessful Russian attempts to put humans into space on four occasions. Source is attributed to "most reliable sources in Prague". All four attempts were made from the missile base of Kapustin Yar near Aralsk on Lake Aral. Alexei Ledovsky, the first to lose his life in 1957, was followed by instruments to less than 200 miles. His rocket transmissions were "abruptly terminated" and nothing further was heard of him. A second astronaut, Serenty Schiborin, was fired in a rocket in 1957 and lost in space. The two fatal launchings, according to Continentale, caused the Russians to pause for over a year before the next attempts, However Andreii Mitkov was killed in January, 1959, after the successful launching of the first Soviet moon rocket. His rocket exploded 20 minutes after launch. Continentale reported that the woman, Mirija Grozov, lost her life in a "space vehicle" rather than a rocket, similar to the U.S. X-15, but did not report under what conditions she was killed.

1,151

Cotner, J. S. 1962 ANALYSIS OF AIR RESISTANCE EFFECTS ON THE VELOCITY OF  
FALLING HUMAN BEINGS.  
(Civil Aeromedical Research Institute, Oklahoma City) Unpublished Paper.

ABSTRACT: Data is provided on the effect of air resistance on the velocity of falling bodies. A simple method employing a closed-form solution for velocity at impact was devised for fall cases where body position and clothing condition were observed to be constant. Tables and curves providing direct graphical solution were included. (CARI)

1,152

Cotner, J.R. and J. Weertman 1961 BIBLIOGRAPHY ON HIGH SPEED DEFORMATION  
OF MATERIALS 1950 - 1961. (Northwestern Technological Inst., Evanston,  
Ill.) ASTIA AD-261 376

ABSTRACT: Abstracts of the literature, from 1950 to 1961, dealing with high speed deformation of materials are given in this bibliography. References concerning stress wave propagation are included to aid in the understanding of the deformation. The arrangement of the abstracts is chronological with an alphabetic sequence within each year. An author index is included. The principal reference works used are : American Society of Metals Review of Metal Literature Applied Mechanics Reviews; Physics Reviews; Journal of Applied Physics; Journal of Applied Mechanics; American Society for Testing Materials, Proceedings; Proceedings of the Society for Experimental Stress Analysis; Transactions of the American Institute of Mining and Metallurgical Engineers, the Metallurgical Society; Proceedings of the Conference on the Properties of Materials of High Rates of Strain; Proceedings of Third Symposium on Hypervelocity Impact; Plasticity, Structural Mechanics; and Repsonse of Metals to High Velocity Deformation. (Author)

1,153

Cotten, F.S. 1945 AN AERODYNAMIC SUIT FOR THE PROTECTION OF PILOTS  
AGAINST BLACKOUT. Australian J. So. 7:161-166

1,154

Cotten, F.S. & J.H. Tyrer EXPERIMENTAL RESULTS ON THE AMOUNT OF PROTECTION  
AGAINST G AFFORDED BY RESTRICTING CAAC SUIT TO "LEGS" PLUS A BELT.  
(Flying Personnel Research Committee, Royal Australian Air Force)  
RAAF-FR 83(a)

ABSTRACT: With the convention that the unprotected blackout threshold equals 100, results obtained from grayout data on the centrifuge so far are as follows:

- (a) The average error of a single test of a series carried out during one centrifuge run is less than 3%.
- (b) The average error of the mean value of individual tests in one centrifuge run is less than 2%.
- (c) The capacity of any subject to withstand "g" often shows a progressive change during a series of tests, and if this is not taken into account, serious errors may be introduced.
- (d) The average "g" threshold using "legs" of suit alone is 121.
- (e) Average threshold using "legs" plus air belt is 128.
- (f) Average threshold using whole suit is 134.
- (g) Values (d) and (f) are probably reliable; value (e) is probably too low.
- (h) More protection is given by the suit to those with low initial "g"-thresholds than to those with high thresholds.

1,155

Cotzin, M., C. J. Hill, & G. R. Wendt 1955 STUDIES OF MOTION SICKNESS.  
XIV. Subjective reports of the apparent path of motion on a vertical  
Accelerator. J. Psychol. 39:417-421

1,156

Coughlin, W. J. 1955 FORCE OF 10 HURRICANES BUFFET EJECTED PILOT  
(GEORGE F. SMITH). Aviation Week, 14 November 1955 63(20):14-17

See Also: Anon. 1955 George Smith's Phenomenal Escape.

ABSTRACT: In this report, many of the technical and medical problems about supersonic ejected pilots are told for the first time by a survivor, test-pilot G.F. Smith, who makes a low-altitude supersonic bailout and survives.

1,157

Courtney, M.D. 1951 RECENT NAVY AERO-MEDICAL EQUIPMENT DEVELOPMENTS.  
Journal of Aviation Medicine, 22(6):540-543 Dec. 1951

ABSTRACT: New developments in protective equipment for pilots of high performance aircraft which include helmets and flying suits, improved bail-out devices and techniques and oxygen equipment.

1,158

Courtney, M. D., & J. L. Brown 1955 HUMAN LIMITATIONS IN AIRCRAFT CATAPULT AND ARRESTING. PHASE II. (Naval Air Development Ctr., Johnsville, Pa.)  
Project NM 001 100 318; TED ADC AE 1407; 31 Dec. 1955

ABSTRACT: An investigation has been made of the nature of acceleration patterns obtained with existing catapults, including the XC-7 steam catapult. The nature of control which must be exercised on aircraft immediately after launching has been obtained from the Aeronautical Instruments Laboratory. This information was compared with information obtained by interviewing a number of pilots as to the nature of the control which they must perform during carrier take-off and arrested landing. With this background information, a simulated control task was devised which would provide a basis for measuring performance decrement as a function of acceleration. Instrumentation for this control task has been assembled by the Aeronautical Instruments Laboratory.

1,159

Courville, C.B. 1942 STRUCTURAL CHANGES IN THE BRAIN CONSEQUENT TO TRAUMATIC DISTURBANCES OF INTRACRANIAL FLUID BALANCE Bulletin of the Los Angeles Neurological Society 7:55-76

1,160

Courville, C.B. 1945 COUP-CONTRECOUP MECHANISM OF CRANIOCEREBRAL INJURIES  
Archives of Surgery 45:19-43, June 1945

1,161

Covey, R.E. 1962 XII. AERODYNAMIC FACILITIES A. 21-INCH HYPERSONIC WIND TUNNEL  
In: Jet Propulsion Laboratory Research Summary No. 36-13 ASTIA AD 274 011

ABSTRACT: A preliminary investigation Test WT 21-C4C, was conducted to determine the minimum starting and running compression ratios for Mach Number 9.3 in the hypersonic wind tunnel. The purpose of this test was to establish the existing diffuser efficiency for the tunnel. In future tests, the minimum starting and

running compression ratios for Mach Numbers 6.0 and 8.0 will be obtained. Transient and steady-state heat transfer were studied in Test WT 21-C10E by JPL, using a 3-in. diameter hemisphere-cylinder model in the 21-in. hypersonic wind tunnel. Test WT 21-C22B was conducted by JPL as part of a program to develop a small stagnation temperature probe useful in the hypersonic region. Test WT 21-C22C was conducted by JPL as part of a program to develop a hypersonic stagnation temperature probe capable of measuring the stagnation temperature, without instrument error, over a large range of Mach Number, Reynolds Number, and temperature.

1,162

Covey, R.E. 1962 XII. AERODYNAMIC FACILITIES B. 20-INCH SUPERSONIC WIND TUNNEL

In: Jet Propulsion Laboratory Research Summary No. 36-13 ASTIA AD 274 011

ABSTRACT: Test WT 20-484 was conducted by JPL to investigate the feasibility of obtaining dynamic stability coefficients in a wind tunnel. Test results are currently being analyzed. Future effort will concentrate on this and the improvement of hardware and data acquisition and reduction methods. Test 20-C43A was conducted to determine the usefulness of a heated stagnation temperature probe in surveying the tunnel thermal boundary layer and the wake behind a cylinder in supersonic flow. The cylinders used were 0.5, 1.5, and 2.0 in. in diameter. Data were obtained at Mach Number 3.74. The results of the test are now being analyzed. Test WT 20-482 was a test of North American Aviation Company (Downey) 42-in. long, 10-deg included angle cone model. The purpose of the test was to investigate the effect of two-dimensional disturbance elements on boundary layer transition with zero heat transfer.

1,163

Coy, R. G. 1956 INVESTIGATION OF THE RELATIVE EFFICIENCY OF PILOT PARACHUTES. (Wright Air Development Ctr., Wright-Patterson AFB, Ohio) WADC TR 56-147; ASTIA AD-89 095; March 1956

ABSTRACT: The relative efficiency of pilot parachutes MA1, MA1A, MA1B, and MA1C was evaluated by measuring and determining the forces, impulses, and time to deployment when deploying a portion of the main canopy from a dummy mounted in a vertical wind tunnel. Pressure distribution tests were completed by measuring the total pressures during simulated free fall in a vertical wind tunnel. The results indicated that Pilot Chute Type MA1A deploys in a shorter time than the other three types tested for a dummy angle of zero degrees. Types MA1 and MA1B transmit less energy to the test rig and have smaller average and peak force values than Types MA1A and MA1C at dummy angles of 0, 45, and 90 degrees. (AUTHOR)

1,164

Craddick, R. A. 1963 PSYCHOLOGICAL CORRELATES OF BIODYNAMIC STRESS.  
(New Mexico State University, Las Cruces, New Mexico)

ABSTRACT: Current research studying psychological correlates of biodynamic stress at Holloman AFB suggests several methodological problems. An outline of the methodological approach being used and concurrent problems will be discussed. Comparisons of performance on various psychological tests prior to and immediately after experiencing different "S" stress on sled-run impact are being studied. Over-all performance changes following six months of biodynamic stress will be measured. Discussion of five subjects exposed to over 500 cumulative "G" stress will be discussed in terms of their test performances. (Aerospace Medicine 34(3): 251, March 1963)

1,165

Cragun, M.K., ed. 1962 THE FIFTH STAPP AUTOMOTIVE CRASH AND FIELD DEMONSTRATION CONFERENCE. SEPT. 14-16, 1961.  
(Minneapolis: University of Minnesota, 1962)

1,166

Craig, P. H., K. R. Coburn, R. F. Gray, & E. L. Beckman 1960 THE PATHOLOGICAL CHANGES PRODUCED IN LARGE PRIMATES EXPOSED TO HIGH POSITIVE G WHILE IMMERSSED IN A WATER CAPSULE. (Paper, 31st Annual Meeting of the Aerospace Medical Association, Americana Hotel, Bal Harbour, Miami Beach, Fla., May 9-11, 1960)

ABSTRACT: The biological changes which resulted when large primates were exposed to high positive G while immersed in a sealed, water-capsule have been evaluated by standard clinical methods and by the use of gross and microscopic pathology techniques. The findings from these studies will be presented.

1,167

Craig, R. B. & J. E. Colleary 1961 EVALUATION OF THE TE-15 and TM-19 RUNWAY ARRESTING GEARS WITH CARRIER-BASED AIRPLANES. (Naval Air Test Center, Patuxent River, Md.) Proj. TED No. PTR RSSH-31001, Serial No. FT2221-263, August 1961. ASTIA Doc. No. AD-264 588.

ABSTRACT: Seventy-four arrestments were performed into the TE-15, dual engine, rotary brake, nylon tape arresting gear located at Edwards AFB, California. Model A4D, F8U, and F3H airplanes are compatible for power-on landings at engaging speeds up to 170 kt. The model A3D airplane at

48,000 lb. is compatible for power-on landings at engaging speeds up to 160 kt. The model A3D airplane at 67,000 lb. is limited to an engaging speed of 140 kt. with power off. All aircraft can be arrested up to 50 ft. off-center with the exception of the model A4D. This airplane should be limited to 28 ft. off-center whenever possible. Two-blocking of the arresting gear can occur under certain conditions. The pendant supports tested were not of optimum design for an emergency gear. It is recommended that airplane compatibility tests be conducted to determine an optimum pendant support and that certain discrepancies in the arresting gear configuration be investigated which prevented testing of the arresting gear to maximum capacity (Author)

1,168

Cramer, R.L. 1961 SOME NEW NEUROPHYSIOLOGIC STUDIES ON MOTION SICKNESS AND ITS THERAPY. (Paper, 1961 Meeting of Aerospace Medical Association, Chicago, April 24-27)

ABSTRACT: This study is concerned with determining the locus of effect of various anti-motion sickness drugs. Although a number of currently available preparations have demonstrable prophylactic effects against motion sickness, little is known of the locus of their effect in the systems mediating autonomic responses to vestibular stimulation. If the vestibular nerve and nuclei are affected, then intravenous administration of these drugs should modify the responses of single cells in the vestibular nuclei to standard electrical stimulation of the Eight Nerve in decerebrate and decerebellate cat. Positive results will indicate that administration of these drugs to flying personnel must be considered carefully from the point of view of effects on other vestibular responses, including spatial disorientation. (Aerospace Medicine 32(3):277, March 1961)

1,169

Crampton, G.H. 1958 VESTIBULAR PHYSIOLOGY AND RELATED PARAMETERS IN ORBITAL FLIGHT. (Paper read at Symposium on "Possible Uses of Earth Satellites for Life Science Experiments", Washington, D.C., 14-17 May 1958)

1,170

Crampton, G.H. 1960 EFFECTS OF THE AROUSAL REACTION ON NYSTAGMUS HABITUATION IN CATS. (U.S. Army Medical Research Laboratory, Fort Knox, Ky.) AMRL Report No. 434, 24 Aug. 1960. ASTIA AD 242 786.

ABSTRACT: The purpose of this experiment is to examine the habituation or decrement of ocular nystagmus found with repeated angular acceleration of an animal in total darkness and to relate this decrement to the animal's state of alertness or arousal. It was found that habituation of nystagmus can be

attenuated by alerting the animal with sounds. However, neither occasional alerting by auditory stimuli nor a continuous alertness sustained by cutaneous electric shock prevent habituation from occurring. Furthermore, drowsiness of an animal, as indicated by electroencephalographic analysis, is not the only variable responsible for a decrement of nystagmus. Other factors, not yet identified, must be of importance.

1,171

Crampton, G.H. 1961 HABITUATION OF VESTIBULAR NYSTAGMUS IN THE CAT DURING SUSTAINED AROUSAL PRODUCED BY D-AMPHETAMINE.  
(U.S. Army Medical Research Lab., Ft. Knox, Ky.) Report No. 488.  
ASTIA AD 263 258.

ABSTRACT: These observations were designed to determine if habituation of ocular nystagmus in total darkness would occur when cats were maintained in a continuous state of arousal with d-amphetamine sulfate.

Amphetamine served to increase nystagmic output of the drug group by nearly 60 per cent over that of the control group, but the drug group showed a habituation that was equal in magnitude to that of the control group.

A loss of nystagmic output does occur in cats that cannot be attributed simply to a loss of generalized arousal. Other factors must be of importance to the habituation process. Two factors that have been proposed, (a) learning, and (b) fatigue of sensory and neural structures, are discussed.

1,172

Crampton, G. H., & W. J. Schwam 1961 TURTLE VESTIBULAR RESPONSES TO ANGULAR ACCELERATION WITH COMPARATIVE DATA FROM CAT AND MAN. (Army Medical Research Lab., Fort Knox, Ky.) Rept. No. 471; Project No. 6X95-25-001; ASTIA AD-255 879L

ABSTRACT: Under conditions in which visual cues were virtually eliminated, the box turtle (*Terrapene c. carolina*) responded to angular acceleration with a deviation of the head graded according to the intensity and duration of the stimulus. The head-turning continued throughout an acceleration and a subsequent deceleration served to return the head toward its normal central position. Habituation did not occur, nor could a vestibular ocular nystagmus be recorded. A similarity was found between the turtle head turning response and the slow phase of ocular nystagmus of cat and of man. (AUTHOR)

1,173

Crampton, G. H. & W. J. Schwam 1961 TURTLE VESTIBULAR RESPONSES TO ANGULAR ACCELERATION WITH COMPARATIVE DATA FROM CAT AND MAN (USA Medical Research Lab., Fort Knox, Ky.) USAMRL Proj. 6X95 25 001, Task 06, Rep. 471, April 1961.

ABSTRACT: To examine responses of the turtle (*Terrapene c. carolina*) to angular acceleration, four turtles were subjected to a series of calibrated angular accelerations in the horizontal plane designed to survey the relevant features of the head movement response to vestibular stimulation. In addition, an examination was made for ocular vestibular nystagmus. Finally, the head response was compared with representative records of ocular nystagmus from a cat and a man. Recommendations were made concerning the usefulness of the turtle for studying vestibular effects of accelerations existing during orbital space flight. (Tufts)

1,174

Crampton, G. H., & W. J. Schwam 1961 EFFECTS OF AROUSAL REACTION ON NYSTAGMUS HABITUATION IN THE CAT. American J. Physiology 200(1):29-33  
NOTE: Reel 7, Flash 7, Item 10

ABSTRACT: The effects of the arousal reaction on the reduction or habituation of nystagmus in unanesthetized cat repeatedly rotated in darkness were determined. A reduction in nystagmus was correlated with drowsiness as indicated by the electroencephalogram, but alerting an animal by sounds occasioned only a temporary and partial recovery of nystagmus. Further, a continuous arousal sustained by cutaneous electric shock stimuli did not prevent habituation. It is concluded that drowsiness or reduction of alertness is not wholly responsible for the nystagmic reduction and that other factors, not yet identified, play a powerful role. (AUTHOR)

1,175

Crampton, G. H. 1962 EFFECTS OF VISUAL EXPERIENCE ON VESTIBULAR NYSTAGMUS HABITUATION IN THE CAT. (US Army Medical Research Lab., Fort Knox, Ky.) Rept. No. 547, 13 Aug. 1962

ABSTRACT: Separate groups of ten cats each were exposed to three specific varieties of visual experience during a series of angular accelerations, and then compared on a test trial in darkness to three control groups of ten cats each that had received the same acceleration experience but without concomitant visual stimulation. Animals were maintained in a high state of arousal with d-amphetamine. Electro-oculographic recordings showed that the nystagmic response decrement was prominent for all six groups and that the visual experience neither hastened nor slowed the habituation process. (AUTHOR)

1,176

Crampton, G. H. 1962 EFFECTS OF VISUAL EXPERIENCE ON VESTIBULAR NYSTAGMUS  
HABITUATION IN THE CAT.  
Acta Otolaryng (Stockholm) 55:516-526, Nov.-Dec. 1962.

1,177

Crampton, G.H. and W.J. Schwam 1962 TURTLE VESTIBULAR RESPONSES TO ANGULAR  
ACCELERATION WITH COMPARATIVE DATA FROM CAT AND MAN  
Journal of Comparative & Physiological Psychology, 55:315-321

ABSTRACT: Under conditions in which visual cues were virtually eliminated, the box turtle (Terrapene c. carolina) responded to angular acceleration with a deviation of the head graded according to the intensity and duration of the stimulus. The head-turning continued throughout an acceleration and a subsequent deceleration served to return the head toward its normal central position. Habituation did not occur, nor could vestibular ocular nystagmus be recorded. A similarity was found between the turtle head-turning response and the slow phase of ocular nystagmus of cat and of man.

1,178

Crampton, G. H. 1962 DIRECTIONAL IMBALANCE OR VESTIBULAR NYSTAGMUS IN CAT  
FOLLOWING REPEATED UNIDIRECTIONAL ANGULAR ACCELERATION.  
(U. S. Army Medical Research Lab., Fort Knox, Ky.)  
Project No. 6X99-28-001, Report No. 529, Jan. 22, 1962. ASTIA AD 272 380  
Also see Acta. Otolaryng. (Stockholm) 55:41-48, July-August 1962.

ABSTRACT: Cats were subjected to schedules of angular accelerations to determine if a marked nystagmic habituation to accelerations of one direction would "transfer" and thus cause a reduced nystagmus to accelerations of the opposite direction. All testing was in total darkness and animals were maintained in a state of continuous arousal with d-amphetamine. It was found that habituation does not transfer, that nystagmus in the untested direction remains undiminished, and that a directional imbalance is the result.

1,179

Crampton, G.H. 1962 DIRECTIONAL IMBALANCE OF VESTIBULAR NYSTAGMUS IN CAT  
FOLLOWING REPEATED UNIDIRECTIONAL ANGULAR ACCELERATION  
Acta Otolaryngologica, 55:41-48 July-Aug., 1962

ABSTRACT: Cats were subjected to schedules of angular accelerations to determine if a marked nystagmic habituation to accelerations of one direction would "transfer" and thus cause a reduced nystagmus to accelerations of the opposite direction. All testing was in total darkness and animals were maintained in a state of continuous arousal with d-amphetamine. It was found that habituation does not transfer, that nystagmus in the untested direction remains undiminished, and that a directional imbalance is the result.

1,180

Cranmore, D. 1954 LETHAL LEVELS AND GROSS PATHOLOGY OF RATS EXPOSED TO POSITIVE AND NEGATIVE FORCES OF ACCELERATION. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-5410; ASTIA AD-39 424

ABSTRACT: In a study of the lethal levels of stress acceleration, 269 male albino rats were subjected to various combinations of magnitude and duration of positive or negative G stress. The weights of the rats ranged from 169 to 336 g. Centrifuges with arms 3 and 8 ft. in radius were used. Data on the mortality and gross pathology of the animals are presented. Strength-duration curves and mathematical formulae are included. The minimum survival time (100% survival) was attained at 35 positive G, and the infinite survival (the force at which the time factor ceases to be significant in the response) was at 12 positive G. The spread of these values was sharply decreased for negative G; the minimum survival time was reached at about 15 negative G while the stress tolerated for an infinite was about 3 negative G. Anoxic anoxia was postulated as the immediate cause of death due to acceleration stress. (ASTIA)

1,181

Cranmore, D. 1954 LETHAL LEVELS AND GROSS PATHOLOGY OF RATS EXPOSED TO POSITIVE AND NEGATIVE FORCES OF ACCELERATION. (U.S. Naval Air Development Center, Aviation Medical Acceleration Lab., Johnsville, Pa.) Report No. NADC-MA-5410, 30 July 1954. ASTIA AD 39424

ABSTRACT: Two hundred and sixty-nine male albino rats were subjected to various combinations of magnitude and duration of positive or negative G stress. Data on the mortality and gross pathology of the animals are presented.

Strength-duration curves and mathematical formulae are presented to express the probability of survival for male albino rats in terms of duration of exposure and magnitude of acceleration.

Significant values of G stress are defined on a basis of a constant "minimum survival time," and on a basis of "infinite survival," where time ceases to be a significant factor in mortality from G stress.

Anoxic anoxia is postulated as the immediate cause of death due to acceleration stress. This hypothesis is examined in relation to gross pathological findings and to time factors. NO. 5848 DE

1,182

Cranmore, D. 1955 A POST-MORTEM STUDY OF RHESUS MONKEYS (MACACA MULATTA) AT INTERVALS AFTER SINGLE OR REPEATED EXPOSURE TO NEGATIVE ACCELERATION. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-5504, 26 May 1955

1,183

Cranmore, D. 1955 PATHOLOGICAL CHANGES PRODUCED BY STRESS OF ACCELERATION.  
(Naval Air Development Ctr., Johnsville, Pa.) Project NM 001 100 306;  
31 December 1955; PHASE I

ABSTRACT: Twenty-two rhesus monkeys, with appropriate controls, were subjected to negative acceleration for one or more exposures at levels of 12, 32, or 40 G and killed 15 minutes to 90 days later. Lesions of the brain that might be attributed to acceleration were limited to occasional microscopic hemorrhages, moderate edema and scattered foci of cell loss. These were found in less than half of the animals and occasionally in controls also. Thus the changes in function of the central nervous system that follow exposure to negative G cannot be attributed to vascular accidents. Neither do current histological techniques reveal change in morphology that can be related to changes in function.

Animals subjected repeatedly to negative acceleration developed increased tolerance as indicated by lessening of peripheral hemorrhage and edema, and of the shock-like state induced by acceleration. These changes were accompanied by enlargement of the adrenal cortex and suggest that tolerance to acceleration may be increased by appropriate schedules of conditioning.

1,184

Cranmore, D., & H. L. Ratcliffe 1956 A STUDY OF ADAPTATION TO ACCELERATION WITH RATS AND GUINEA PIGS AS TEST ANIMALS. (Naval Air Development Ctr., Johnsville Pa.) NADC-MA-5602; ASTIA AD-90 233

ABSTRACT: Experiments were conducted to explore the possibility of increasing tolerance to acceleration stress by developing appropriate schedules of conditioning. Guinea pigs and rats were subjected repeatedly to negative acceleration at levels that produced temporary loss of balance and respiratory difficulty, facial edema and hemorrhages from the nose, eyes, and ears. These signs decreased in magnitude, and, in some instances, disappeared completely as the schedule continued. Other signs of increased tolerance, and evidence of slight to moderate adrenal cortical hypertrophy, led to the conclusion that the animals were undergoing adaptation to acceleration stress, and that increased activity of the adrenal cortex is a factor in this process. (AUTHOR)

1,185

Cranmore, D 1956 BEHAVIOR, MORTALITY, AND GROSS PATHOLOGY OF RATS UNDER ACCELERATIVE STRESS. J. Aviation Med. 27(2):131-140, April 1956

ABSTRACT: Two hundred and sixty-nine male albino rats were subjected to various combinations of magnitude and duration of positive or negative g stress. Data on the mortality and gross pathological findings of the animals are presented. Strength-duration curves and mathematical formulae are presented to express the probability of survival of male albino rats in terms of duration of exposure and magnitude of acceleration stress. Significant values of g stress are defined on a basis of a constant minimum survival time, and on a basis of "infinite" survival, where time ceases to be a significant factor in mortality from g stress. This hypothesis is examined in relation to the gross pathological findings and to time factors.

1,186

Crash Injury Research 1950 HUMAN TOLERANCE OF CRASH DECELERATION  
31 Jan. 1950 (Crash Injury Research, Cornell University Medical College)

ABSTRACT: The acceleration-deceleration research at Edwards AFB, in which volunteers withstood decelerations of 35 g without injury, is discussed with reference to cabin structure and body supports. A review of the campaign for the shoulder harness is included.

1,187

Craven, C. W. & E. L. Cole 1960 MANNED SPACE OPERATIONS  
In Vistas in Astronautics--1960, Volume III. Proceedings of Third AFOSR Astronautics Symposium, Los Angeles, Calif., October 12-14, 1960.  
(Society of Automotive Engineers, Inc., New York, N. Y.) Pp. 83-84.  
October 1960.

ABSTRACT: A brief review is given of some of the activities and problems of manned space operations. Acceleration, weightlessness, isolation, work cycles, radiation, restraint and support, and ecological systems are pointed out as areas in which intensified research is needed. (Tufts)

1,188

Creer, Brent Y., Harald A. Smedal & Rodney C. Wingrove 1960  
CENTRIFUGE STUDY OF PILOT TOLERANCE TO ACCELERATION AND THE EFFECTS OF  
ACCELERATION ON PILOT PERFORMANCE  
(National Aeronautics and Space Administration, Wash., D. C.)  
NASA TN D-337 November  
ASTIA AD: 245 411; NASA N62-70911

ABSTRACT: The centrifuge study showed there could be marked decreases in pilot tracking performance with increases in the magnitude of the impressed accelerations. Pilot comments indicated that in order to have the same level of control over the vehicle, and increase in the vehicle dynamic stability is required with increases in the magnitude of the acceleration impressed on the pilot. It appears that a great deal of additional research work is warranted in investigating the effects of sustained accelerations on the pilot performance.

The study indicated quite clearly the improvement in tolerance to acceleration times which can be realized through relatively minor improvements in the pilot's restraint system. It would appear that with a suitable restraint, the pilot's tolerance to eyeballs-out accelerations can be made equal to his tolerance to eye-balls-in accelerations. It is suggested in

this study that more meaningful tolerance to acceleration times may be obtained by using highly trained and highly motivated test subjects, as exemplified by the test pilot.

Finally, pilot comments indicated a unanimous preference for the two-axis class of side controller over the three-axis class. The pedal controls used in this study resulted in effective yaw control for most acceleration fields of this investigation.

The experimental setup consisted of a flight simulator with a centrifuge in the control loop. The pilot performed his control tasks while being subjected to acceleration fields such as might be encountered by a forward-facing pilot flying an atmosphere entry vehicle. Information was obtained on the combined effects of complexity of control task and magnitude and direction of acceleration forces on pilot performance. Boundaries of human tolerance to acceleration were established. A comparative evaluation was made of the three-axis type of side-arm controller and the two-axis type in combination with toe pedals for yaw control.

1,189

Creer, B.Y. 1962 INFLUENCE OF SUSTAINED ACCELERATION ON CERTAIN PILOT-PERFORMANCE CAPABILITIES. (Paper presented at 33rd annual meeting of the Aerospace Medical Association, 9-12 April 1962, Atlantic City)

ABSTRACT: The NASA has a continuing study of the effects of large acceleration forces on the pilot of a manned orbital or space vehicle. The objectives of these studies have been to investigate the effects of acceleration on the pilot's ability to perform the required tasks and on the effects of acceleration on the physiological processes of the pilot. These projects have been carried out using the Aviation Medical Acceleration Laboratory Centrifuge, U.S. Naval Air Development Center, Johnsville, Pa. The experimental setup consisted of a flight simulator with the centrifuge in the control loop. In previous Ames Research Center experiments, the influence of acceleration force fields up to 7 g on the pilot's ability to perform were investigated. In experiments which have recently been completed, the subject pilots have performed control tasks while being subjected to acceleration forces up to 14 g for the "eyeballs out" directions, and 9 g for the "eyeballs down" g field direction. The following specific results obtained to date from these research investigations will be presented and discussed:

1. Time tolerance to acceleration boundaries which are believed to apply to the test pilot population will be presented. These boundaries were derived by measuring the longest periods of time a test pilot can manually control a given simulated vehicle, with no marked deterioration in his performance while immersed in a specified, nearly constant elevated g field.
- (2) In these centrifuge investigations, an index of pilot performance was obtained by having the pilot track a randomly driven target while flying the simulated vehicle. The effect of acceleration on the pilot's ability to track the target, as a function of the length of time, the magnitude and the direction of the applied g field will be presented. Information will also be given on the maximum g beyond which the pilot could not be expected to manually control the simulated space vehicle.
- (3) Data have been obtained on the influence of rate-of-onset-acceleration on pilot performance, and on the pilot's time-tolerance-to-acceleration. These data will be presented and discussed in terms of the maximum rate-of-onset-of-acceleration which will be encountered by a vehicle entering the earth's atmosphere at parabolic velocities.

Creswell, A.W., J. Ernsting et al. 1959 DURATION OF PROTECTION AFFORDED BY THE PRESSURE BREATHING MASK, PRESSURE JERKIN AND ANTI-G SUIT COMBINATION. (RAF Institute of Aviation Medicine, Farnborough) FPRC Memo. 117

ABSTRACT: The protection against anoxia at 56,000 feet afforded by pressure breathing at 60 mm Hg with the pressure mask, jerkin, and anti-g suit system was investigated using the Mk 21 demand oxygen regulator. Experiments demonstrated that two additional stresses are applied to the subject during pressure breathing with this system. One is associated with the discomfort and stimulation of the carotid artery baroreceptors due to the use of an oronasal mask to deliver the pressure to the respiratory tract. The other stress is that of anoxia due to the use of an intrapulmonary pressure of 126 mm Hg absolute (alveolar oxygen tension of approximately 50 mm Hg). This pressure breathing system cannot be relied upon to provide adequate protection against anoxia if the period of exposure exceeds 30 seconds at 56,000 feet followed by a descent to 40,000 feet at 10,000 feet per minute. It is recommended that the pressure breathing mask, pressure jerkin, anti-g suit and the Mk 21 oxygen regulator combination should only be used in aircraft which exceed an altitude of 50,000 feet by a small margin only and which can descend from maximum altitude to below 40,000 feet rapidly. (Author)

1,191

Crisman, R. B., & C. L. Forrest 1957 HUMAN FACTORS IN THE DESIGN OF HIGH PERFORMANCE AIRCRAFT. (Paper, SAE National Aeronautical Meeting, April 1957)

1,192

Critz, G. T., F. M. Highly, Jr., & E. Hendler 1963 DETERMINATION OF HUMAN TOLERANCE TO NEGATIVE IMPACT ACCELERATION. PHASE II. (Paper, 34th Annual Meeting of the Aerospace Medical Association, Statler-Hilton Hotel, Los Angeles, Calif., April 29-May 2, 1963)

SUMMARY AND CONCLUSIONS: Under the design conditions of this study; i.e., closed seat angle, rate of acceleration prolonged by inhibiting devices, a helmet with restraining devices, and a restraint system as modified for this project, healthy adult subjects could tolerate without injury 14.5 plateau, 18.5 peak impact tailward G with duration of 60 milliseconds. Rate of onset of subject G of 1540 maximal and peak subject G of 31.8 were tolerable.

Symptoms, chiefly of the central nervous system, were virtually abolished. Other symptoms and signs were fewer and less dramatic. No cardiac arrhythmias were noted, and the ride was "smoother".

Evidence is offered that neck stretching, either by over movement of the head or under movement of the shoulders, may have produced symptoms.

The mechanism for the production of rebound positive G was undetermined from the present study. (AUTHOR)

1,193

Crocco, G. A. 1951 LA SOPPORTAZIONE FISILOGICA NEI MISSILI A REAZIONE  
(Physiological Endurance and Rocket Flight)  
L'Aerotecnica (Rome) 55-59, 15 Feb. 1951

1,194

Crook, J.M. 1963 RESEARCH LEADING TO THE ESTABLISHMENT OF PARAMETERS  
FOR OMNI-DIRECTIONAL RESTRAINT AND/OR CONTAINMENT FOR PILOTS IN AIRCRAFT.  
(National Textile Research, Inc., Raleigh, N.C.) ASTIA AD-400 920

ABSTRACT: Investigations were directed toward the establishment of methods, utilizing broad woven fabrics, to accept, dissipate, and distribute impact shock forces such as would be developed during sudden and abrupt changes in acceleration caused by crash, high-speed maneuvers, and operational malfunction of various types of airframes. These investigations included the following: (1) to determine the feasibility of employing broad woven fabrics to effectively restrain, contain, and omni-position the body during abrupt changes in acceleration; (2) to determine the design parameters necessary to provide lineal and/or area load acceptance of restraint garments; (3) to determine the fabrics and weave constructions best suited to this application; (4) to determine the fundamental requirements of body restraint with omni-directional capabilities; and (5) to study the force distributions of the fabric as it relates to imparting loads to the body. (Author)

1,195

Crosbie, R., & C. Clark 1955 CAM DESIGNING FOR THE HUMAN CENTRIFUGE.  
(Naval Air Development Center, Johnsville, Pa.) NADC-MA-5512  
18 Nov. 1955. ASTIA AD 86293.

ABSTRACT: A mathematical analysis is presented for designing cams which control the motion of the inner and outer gimbals in coordination with the speed of the human centrifuge so that the subject can be aligned with the resultant acceleration vector. The gimbal system consists of an outer gimbal which rotates about a horizontal axis perpendicular to the centrifuge arm and of an inner gimbal and perpendicular to the axis of the outer gimbal. The analysis consists of the formulation of curves which represent cam contours for desired resultant acceleration programs. Various G programs are listed with their respective formulas. A method is described for accurately reproducing the calculated results as cam contours. An illuminated cam layout box is described for accurately plotting the cam contours.

1,196

Crosbie, R., C. Clark, R. W. Lawton, J. W. Taylor, & M. Chianta 1955 ELASTIC PROPERTIES OF MAMMALIAN TISSUE. PHASE V. X-RAY CINEFLUOROGRAPHY (Naval Air Development Ctr., Johnsville, Pa.) Project NM 001 100 315; 31 Dec. 1955

ABSTRACT: Densitometric calibration procedures are in progress to allow the interpretation of density changes in terms of organ thickness as well as organ position. Inoperative Westinghouse Fluorex Image Amplifier and Philips X-Ray Image Intensifier tubes have been tested for electrode displacement and glass failure under acceleration, the former to 12.4 G transverse with but slight reversible electrode displacement and the latter to 9.6 G transverse with no detectible electrode displacement. Neither tube broke. Operative tubes are not yet available here, but are of interest in order to reduce the x-ray dose to human subjects by a factor of ten to forty. Measurement correlation has been achieved between the x-ray film frames and the simultaneously recorded physiological data. Work is in progress to extend such measurements, particularly to relate the x-ray visualizations to other measurements of respiration and circulation. Preliminary measurements and computations have been made of the elasticity of the heart supports of a chimpanzee under acceleration.

1,197

Crosbie, R., & C. Clark 1955 DEVELOPMENT OF BIOLOGICAL AND RESEARCH APPARATUS FOR USE IN ACCELERATION AND DECELERATION STUDIES. (Naval Air Development Ctr., Johnsville, Pa.) Project NM 001 100 303; 31 Dec. 1955; PHASE II

ABSTRACT: The mathematics involved in the calculation of cam contours for acceleration program control of the human centrifuge were completed at a much earlier date (1951). However, due to repeated overhauls on the outer gimbal and the main centrifuge control units, the completion of the report has been delayed. The report is now completed and, if one neglects distortion effects on the response curves (these are negligible for low performance runs), methods are now available which enable one to calculate and accurately lay out cams which control the motion of the inner and outer gimbal in coordination with the speed of the human centrifuge at AMAL in order to control the resultant acceleration vector with respect to the subject.

1,198

Crosbie, R.J. 1956 DIRECTIONAL CONTROL OF ACCELERATIVE FORCES IN CENTRIFUGE BY SYSTEM OF GIMBALS.

(Naval Air Development Center, Johnsville, Pa.) NADC-MA-5608.

See also J. Aviation Med. 27(6):505-511, Dec. 1956.

ABSTRACT: A two gimbal system of the human centrifuge is described and illustrated. In human centrifuge studies, by suspending the subject in a controllable double gimbal system, as compared to placing him on a freely swinging platform, the following beneficial results are derived: (1) It is possible to vector out the tangential acceleration due to the angular acceleration of the

centrifuge arm by proper movement of the inner gimbal, so that it is not felt as a transverse G component of the resultant G. The oculogyral illusions of the gondola tumbling are less unpleasant and less disorienting than the oculogravic illusions caused by the rotating resultant G vector on a nongimbaled centrifuged ride. (2) The overshooting and oscillating of the freely swinging platform are practically eliminated by the tight control placed on the outer gimbal during its movement. (3) The ability of the gimbals to operate singly or in combination allows for a great variety of jostling G patterns, typical of uncontrolled aircraft. These may be duplicated as often as necessary to gain a statistical evaluation of the tolerance of the average pilot under such conditions. (4) Catapult G patterns may be partially reproduced by proper positioning of the gimbals. Valuable information for a preliminary study on the catapult can therefore be obtained prior to actual catapulting, under more precise control conditions and at a much reduced cost per run. (5) The gimbal system may offer the means whereby a pilot, with the aid of suitable instrumentation, may actually control his own ride under various conditions. (SAM, Brooks AFB, Texas)

1,199

Crosbie, R.J. 1956 UTILIZATION OF A SYSTEM OF GIMBALS ON THE HUMAN CENTRIFUGE FOR THE CONTROL OF DIRECTION OF ACCELERATION WITH RESPECT TO THE SUBJECT. J. Aviation Med. 27:505-511. See also (NADC, AMAL, Johnsville, Pa.) Rept. No. MA-5608, Aug. 1956. ASTIA AD 107 772.

ABSTRACT: Advantages of a centrifuge which utilizes a system of controllable gimbals over a freely swinging platform type of centrifuge are discussed. Particular emphasis is placed upon the ability of such a system to eliminate transverse and lateral components of the resultant acceleration on a subject during an entire G run. Although this elimination could be realized at the center of the gimbal system, the secondary accelerations produced by the gimbal motion itself, which exist at all parts of the subject's body remote from the center of rotation, could not be ignored. However, it was found that the oculogyral illusions which resulted from these accelerations were less disturbing to the subject than the oculogravic illusions which occurred on the freely swinging platform. Other advantages of this device which are discussed include the elimination of the characteristic oscillations of the freely swinging platform and the addition of a greater variety of G programs to centrifuges in general.

1,200

Crosbie, R. J. 1956 FORCES DEVELOPED ON A CAR TRAVELING RADIALLY ALONG A MOVING CENTRIFUGE ARM. (Naval Air Development Ctr., Johnsville, Pa.) NADC-MA-5610; ASTIA AD-108 391

ABSTRACT: Equations are derived which enable one to determine the forces acting on a car traveling radially along a moving centrifuge arm. These forces are of interest in determining the feasibility of attaching a track to a centrifuge arm which will provide a device for producing either a step or an impulse forcing func-

tion. The author concludes that the Coriolis force developed on a radially moving car is of such magnitude as to make this method of producing a step forcing function extremely difficult, if not actually unfeasible. Under certain limiting conditions, the Coriolis force developed on this radially moving car may be canceled by proper control of the angular deceleration of the centrifuge. This deceleration must generally be of such magnitude that the centrifuge is slowed considerably, and hence the production of a step forcing function without the disadvantages of the Coriolis force is practically impossible. However, a definite impulse forcing function may be produced if the car is brought to rest at the end of the track on the centrifuge arm by compressing a spring of known force constant. This impulse is much less, however, than that obtainable by a typical linear accelerator or ejection seat device. (AUTHOR)

1,201

Crosbie, R.J. and F. Gollub 1959 A STRESS ANALYSIS ON THE INNER GIMBAL DRIVE SHAFT OF THE HUMAN CENTRIFUGE FOR VARIOUS GONDOLA LOADING CONDITIONS. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5901; ASTIA AD 217 637.

ABSTRACT: Equations are derived which enable one to predict the effect of load distribution in the gondola of the human centrifuge on the torsion stress of the inner gimbal drive shaft under various dynamic conditions. Experimental verification of these equations are obtained over a frequency range of the inner gimbal from 0 to 1.1 cps at  $\pm 20^\circ$ . Simultaneously the centrifuge acceleration was increased to a 12 G level. Analysis of these results indicate that additional loads in the gondola should be distributed to minimize unbalanced moments about the center. The extent of permissible moment unbalance may be obtained from the equations derived herein. In some cases this requirement may necessitate adding extra weights to counter-balance payload loads. (Author)

1,202

Crosbie, R.J. 1959 THE REQUIREMENTS FOR MODIFICATION OF THE HUMAN CENTRIFUGE FOR HIGH PERFORMANCE AIRCRAFT AND SPACE VEHICLE SIMULATION RESEARCH. (U.S. Naval Air Development Center, Johnsville, Pa.) NADC-MA-5907. ASTIA AD 225 000.

ABSTRACT: A proposed modification program for the human centrifuge at the Aviation Medical Acceleration Laboratory is outlined. Specifications are given concerning centrifuge improvements as a dynamic simulator for space vehicle studies such as the X-15 and Mercury Project and for g-tolerance and performance investigations. A proposed 100 g capability for the centrifuge is discussed and an interchangeable capsule concept is explained. Also presented are the detailed requirements for the complete program along with criteria for a feasibility study of the proposed modifications. (Author)

1,203

Crosbie, R.J. 1960 EXPLICIT EXPRESSIONS FOR THE ANGULAR ACCELERATIONS AND LINEAR ACCELERATIONS DEVELOPED AT A POINT OFF CENTER IN A GONDOLA MOUNTED WITHIN A THREE GIMBAL SYSTEM ON THE END OF A MOVING CENTRIFUGE ARM. ( U.S. Naval Air Development Center, Johnsville, Penn.) NADC-MA-6034, ASTIA AD-248 216

ABSTRACT: That a gondola mounted within a controllable three gimbal system on the end of a moving centrifuge arm has the capability of providing a more realistic flight simulation than is possible with a two gimbal system has generally been conceded. The Human Centrifuge at the Aviation Medical Acceleration Laboratory is being modified to provide a third gimbal (yaw) to its present roll and pitch gimbal system also envisions a gondola mounted within a three gimbal system.

This paper, although it does not offer any direct solution to the control problem, does provide equations which will enable one to calculate both the angular accelerations and linear accelerations developed at a point off center of the gondola as a consequence of various combinations of gimbal motions superimposed upon the centrifuge motion. Grosswald (2) has developed the equations for a two gimbal system and much of his notation is used in this paper.

1,204

Crosbie, R.J. 1961 MODIFICATION OF THE HUMAN CENTRIFUGE AT THE AVIATION MEDICAL ACCELERATION LABORATORY: PROGRESS REPORT CONCERNING. (Naval Air Development Center, Johnsville, Pa.) NADC-MA-L6101; ASTIA AD 251 947.

ABSTRACT: This report includes:

McKiernan-Terry Corp., Dover, N.J., "Johnsville Naval Air Development Center Human Centrifuge Modification Program, (Job No. 19042)." Technical Progress Reports No. 1-6, Contract N62269-825, 31 Aug. 1960 - 21 Feb. 1961.

A proposed modification program for the human centrifuge at the Aviation Medical Acceleration Laboratory is outlined. Specifications are given concerning centrifuge improvements as a dynamic simulator for space vehicle studies such as the X-15 and Mercury Project and for G-tolerance and performance investigations. A proposed 100 G capability for the centrifuge is discussed and an interchangeable capsule concept is explained. Also presented are the detailed requirements. (Author)

1,205

Gross, A.G. & J. Ball 1943 SUBCONJUNCTIVAL HAEMORRHAGE CAUSED BY ACROBATIC FLYING  
Lancet, 2:766

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Cross, C. A. 1959 A SPACE FLIGHT SIMULATOR.  
Aeronautics 28-30, Feb. 1959

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Crossfield, A.S. 1957 A TEST PILOT'S VIEWPOINT.  
In Campbell, P.A., et al. SPACE TRAVEL: A SYMPOSIUM.  
J. Aviation Med. 28:492-495

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Crossfield, S. 1961 FUTURE MANNED AIRCRAFT Lectures in Aerospace Medicine,  
16-20 January 1961.  
(School of Aviation Medicine, Brooks AFB, Texas)

1,209

Crout, P.D. 1960 A METHOD FOR DETERMINING VELOCITY BY COMBINING POSITION AND  
ACCELERATION DATA TAKEN ON THE SNORT TRACK (Naval Ordnance Test Station, China  
Lake, Calif.) 28 Mar 1960; NOTS TP 2474, NAVWEPS rept. no. 7069; ASTIA AD-239  
676

ABSTRACT: A method of combining accelerometer and track-coil data to obtain  
velocity data using Lagrange polynomials is described. An error analysis shows  
that under most conditions an RMS of less than 0.1 fps over a velocity range of  
200 to 2,000 fps is possible. (Author)

1,210

Cruchet, R. & R. Moulinier 1911 LE MAL DES AVIATEURS. (Aviator's Sickness)  
C.R. Acad. Sci.(Paris), 152:1114-1115  
See also C.R. Soc. Biol. 82:677-679

1,211

Cruchet, R. 1911 LE VOL EN HAUTEUR ET LE MAL DES AVIATEURS (High-Altitude  
Flight and Aviator's Sickness)  
Revue scientifique (Paris) 49(2): 740-744

1,212

Cruchet R. and R. Mouliner 1919 LE MAL DES AVIATEURS. (Aviator's sickness)  
Compt. rend. Soc. de biol., (Paris) 82:677-679

ABSTRACT: Aviator's sickness includes the following phenomena: more marked vasomotor reactions, congestion of the face, humming in the ears, auricular pain, headache, tachycardia, sleepiness, and occasional syncope. Aviators participating in high altitude flying must have good sight and perfect hearing.

1,213

Cruchet R. 1959 THE ROLE OF SPEED IN AIRCRAFT.  
Rev Prat (Par) 9:2709-13, 1 October 1959

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Cumberland, C. H. & G. S. Bowey 1948 PASSENGER SEATS IN CIVIL AIRCRAFT:  
DESIGN CONSIDERATIONS. (Ministry of Supply, London) Air Transport  
Technical Memorandum No. 11, April 1948.

1,215

Cushman, R. Nov. 1956 ROCKET-TUBE EJECTOR ADDS TO ESCAPE MARGIN FOR  
JET PILOTS. Aviation Week 65(20):71-77

ABSTRACT: Rocket-tube pilot emergency escape catapult is being readied for the Convair F.106 by the Talco Engineering Corp., Hamden, Conn. The new ejector uses a canted rocket inside a tube to give added ejection height at low altitudes and to counteract the air-blast deceleration at high speed.

ACCELERATION

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Daguet, J. 1946 PHYSIOPATHOLOGIC EFFECTS OF ACCELERATION ON THE AVIATOR.  
Biol. Med. 35(11):197-219.

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Dahms, J. G. and S. T. Ferguson 1958 FORCES IMPOSED ON PILOTS DURING IN-  
FLIGHT EMERGENCIES. (USN, Air Dev. Ctr, Johnsville, Pa.) Rept. No.  
NADC-ED-5813, 2 July 1958.

1,218

Daigle, D.L. and J.C. Lonborg 1961 EVALUATION OF CERTAIN CRUSHABLE MATERIALS.  
(Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena)  
Technical report no. 32-120, ASTIA AD-266 550

ABSTRACT: A series of static and dynamic tests of crushable materials, using drop towers and other devices, is described. A crushable material may be used to protect a relatively delicate object at impact by limiting the acceleration applied to the object while absorbing the impact kinetic energy. Materials tested included balsa wood, aluminum honeycomb, and various foam plastics. The tests were not, except in the case of the balsa, extensive, nor was any specific engineering problem under study. The materials were not rated. The intent was rather to develop a guide for the selection of materials for various applications and a method of testing the materials. (Author)

1,219

Daily, Madison M. Aug. 1960 A STUDY OF THE MOTION OF A MANNED-SATELLITE  
RE-ENTERING THE EARTH'S ATMOSPHERE (Air Force Inst. of Tech.,  
Wright-Patterson AFB, Ohio) Rept. No. GAO-58-2. ASTIA AD 201 592

ABSTRACT: A study is presented of the motion of a manned satellite re-entering the earth's atmosphere at a desired maximum deceleration of 10 g. The motion of 3 non-lifting configurations were investigated from an initial altitude of 400,000 ft to the surface of the earth. The configurations consisted of a sphere alone, a sphere and one parachute, and a sphere with 4 parachutes that