This Month in Aerospace Medicine History-- October 2005

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One Hundred Years Ago

Up until 1905 all airplane flights lasted less than 30 minutes. However, on October 4 of that year, Orville Wright kept his aircraft in the air for 33 minutes and 17 seconds, becoming the first pilot to stay aloft for over half an hour (7).

Fifty Years Ago

Simulating rocket flight in a human centrifuge (Division of Applied Physics, National Research Council, Ottawa, Canada, and the Aero Medical Laboratory, Wright-Patterson AFB, OH): "In the course of its flight, the occupants of a passenger-carrying rocket are subjected to accelerations differing substantially from that normally experienced. The use of a human centrifuge capable of high peak acceleration and rate of change of acceleration allows us to duplicate sufficiently closely the acceleration curves of a rocket and to determine their effect on human beings in advance of actual flight. If rocket performance and the limitations of human tolerance are closely matched, it would probably be advisable to make individual tests for each rocket design. Alternatively, if it can be shown that normal tolerance is in excess of that required by any foreseeable rocket design, the design problems themselves and those of passenger selection are greatly simplified. In addition, the possibilities of emergency corrective action being undertaken during flight can be investigated…

"Hyperbolic acceleration curves are derived for three or four stage rockets which could attain the 10 to 11 km./sec velocity necessary for establishment in a practical orbit round the earth.

"A preliminary study has evaluated the capacity of nine subjects to perform a dual pursuit task while undergoing a typical series of curves.

"Evidence is presented to indicate that select crewmen can be expected to assist in the control of such a vehicle during the critical acceleration phases of the flight" (6).

Human factor-based instrument design (Aeronautical Medical Equipment Laboratory, Naval Air Experimental Station, Philadelphia, PA, and the Bureau of Aeronautics, Washington, DC): "The necessity for providing for the human factor in aircraft operation to a greater or lesser degree inevitably influences decisions on the design of equipment to be used by the crew members. In determining the presentation details for an informational display in an aircraft cockpit, no designer would fail to include visibility, legibility, and interpretability among his considerations. As a consequence, the manner in which today's pilot is informed of the state of his aircraft and the environment is, to a point, quite effective…

"Considerable progress has been made in the Navy's program to improve the pilot's working environment. In the interim phase of the program for the human engineering of data presentation, significant developments have occurred in miniaturizing instruments, integrating displays, improving instrument legibility and interpretability, laying out cockpits for easier pilot functioning and accommodating the cockpit to the visual requirements of high speeds and high altitudes. New forms of instrument lighting are being tried in order to improve this aspect of display. This report presents the more notable developments in this program, discussing the planning, development, and testing which provide the basis for progress" (2).

Human interpretation of radar presentation (Department of Ophthalmology, U.S. Air Force School of Aviation Medicine, Randolph AFB, TX): "The research activities described in this report represent an investigation of some of the physical and physiological variables which constitute the appearance of pictures on the radar plan position indicator (PPI). The intensity modulated radar scope, which is commonly used in modern aircraft, utilizes differences in the intensity of radar echoes from the ground for producing a visible picture on the scope or screen of the radar set. By rotating the electron beam or 'sweep' around the center of the scope, a two-dimensional (circular) picture is obtained on the surface of the phosphor-coated picture tube. In a similar way, the picture can be obtained by rotating the sweep over a certain area of the scope only. This type of sweep has been designated as 'sector scanning.' In any event, the image presented to the radar observer consists of apparent brightness differences due to differences in reflectance between the target and its background or of objects within a target area…

"An exhaustive study of brightness contrasts at the various target identification thresholds and appearance levels was completed just recently, which covers the practical range of sweep brightness during radar PPI interpretation. The data have not been evaluated statistically, but they may prove to be a gold mine for the statistician as well as for the engineer. Brightness and contrast differences seem to exist between the two types of sweep rotation, two degrees of basic sweep brightness, five target identification thresholds or video gain settings. This conclusion is made after an inspection of the graphically plotted raw data. These differences, and the effect of the many variables controlled in this experiment, can be expressed quantitatively after a thorough statistical analysis of the results. The major variables in radar scope interpretation, namely, brightness contrast and the uniformity of the viewing conditions, were discussed. Some of the functions relating the visual to the physical variables of the radar display will be better understood, and more improvements in equipment and working conditions furnished when we learn more about the action and interaction of the perceptual factors involved in the interpretation of radar PPI presentation" (4).

Twenty-five Years Ago

Gender-based differences in muscle strength (U.S. Army Research Institute of Environmental Medicine, Natick, MA): "The influence of U.S. Army Basic Initial Entry Training on the maximum voluntary isometric strength (MVIS) and anthropometric parameters of men and women was investigated. Significant increases in weight and lean body mass (LBM) and decreases in percent body fat were found for both sexes during training. Significant increases in the MVIS of the upper torso (UT), leg extensors (LE), and trunk extensor (TE) were also found for both sexes. Females and males improved about the same amount on the LE (12.4% and 9.7%, respectively) but females improved significantly more than males on the UT (9.3% and 4.2%, respectively) and TE (15.9% and 8.1%, respectively). The greater gains in the females were presumably due to their lower initial strength levels and the consequently greater relative training stimulus. When strength was expressed relative to LBM, both sexes were able to exert similar amounts of strength on the LE and TE, suggesting that differences in strength between the sexes may primarily be a function of muscle mass" (5).

Diet patterns of fighter pilots (Headquarter Strike Command, Royal Air Force, High Wycombe, Buckinghamshire, United Kingdom): "The dietary patterns of 266 fast-jet aircrew serving at nine operational bases in the RAF Strike Command were studied by questionnaires and statistical analysis, including interrogation of a computer package. There were 113 aircrew (42.5%) who admitted to specific symptoms which, in 59 cases (22%), could have been due to inadequate feeding, apart from or in addition to other stresses associated with the high workload and nature of the operational task. Surprisingly, missing breakfast or eating a light breakfast did not appear to be significant, but diet-related symptoms were associated with missing a meal, during the flying programme, which the individual would normally expect to eat. Because of the pressures and tempo of the flying task, many aircrew said they could often not spare the time to leave the squadron for a meal. Provision of decentralised catering facilities at these units was recommended" (3).

Haddon's Matrix applied to aviation mishaps (USAF School of Aerospace Medicine, AFB, TX): "An accident/injury matrix developed for use in automobile accidents [Haddon's Auto Crash Matrix] was modified for use in aviation. The matrix subdivides an accident into three temporal phases: preaccident, accident, and postaccident. Each temporal phase is then further divided into specific factors: human, environmental, aircraft, and life support equipment. This form of analysis will assist in determining the chain of events in an accident and serve as a logical tool for developing future preventive strategies… At the end of the accident investigation, a completed matrix will bring together all available information as to precisely what happened. It permits the causes of the accident to be deduced, as well as why these elements came together at one time to produce the mishap. Most important, the matrix serves as a ready tool in determining what strategies are needed to prevent similar accidents or injuries" (1).

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