

This Month in Aerospace Medicine History-- March 2006

By Walter Dalitsch III, M.D., M.P.H.

Seventy-five Years Ago

Revolutionary treatments of tuberculosis (Authorized Medical Examiner, Aeronautics Branch, U.S. Department of Commerce; Consultant Physician, Detroit Tuberculosis and Health Society): "During the last few years of the 19th century, partial results were claimed in artificial immunity against tuberculosis. Such findings were reported...using living attenuated organisms. The attenuation of the bacilli was produced by prolonged cultivation on artificial media or by other well known means..."

"Prevention of tuberculosis is possible in two chief ways. The first, that of eliminating the possibility of infection, is ideal but impractical in our present civilization, though marked progress is now being made in that direction. Early diagnosis and early treatment, with lessening of contacts, are making rapid strides. Childhood tuberculosis is being progressively taken care of in preventoria, open air schools, camps and year-round country boarding schools. The second method, that of increasing resistance, principally remains as the hope for the future..."

"For practical purposes, tuberculosis today is best divided into two groups - childhood type and adult type. Childhood type includes what was previously known as infantile, juvenile and hilum tuberculosis. It specifically includes tuberculous lesions of the tracheo-bronchial glands. It is usually found in children. Though rarely occurring in white adults, it is not uncommon in Negroes or Indians. In children the prognosis of this type of tuberculosis is good.

"Adult pulmonary tuberculosis is the result of a reinfection from an exogenous or endogenous source. It generally begins in the apex or in the subclavicular region from where it tends to spread. The tracheobronchial lymph nodes remain uninvolved. This type usually occurs in adults but may be found in children, the prognosis being poor in the latter..."

"In the past twenty years the treatment of pulmonary tuberculosis has made rapid strides, in fact it is almost revolutionary in type. Previously the recognized treatment was purely medical and consisted chiefly of bed rest, fresh air and sunlight and proper food. Now however, an increasingly large proportion of patients, about 50 per cent, are being treated surgically. It is a general principle in medicine that rest is the first and most important treatment in any disease, that is, physiological rest, giving nature an opportunity to heal the diseased are involved. Previously general body rest was the nearest approach to physiological rest of the lungs.

"Surgical treatment in tuberculosis adds to the therapeutic rest of the diseased area in various degrees by lung collapse which may be temporary or permanent. The surgical procedures are artificial pneumothorax, phrenicectomy and thoracoplasty or combinations of these. It is apparent that best results ensue where but one lung is involved. If a diseased area does not show signs of healing by recognized medical treatment in three months, collapse therapy is advisable. When a lung shows destruction of tissue or beginning cavity formation however, collapse therapy should be instigated at once..."

"Artificial pneumothorax, when the collapse is complete, is the most effective form of

compression. The complications as the treatment is now practiced are inconsequential..."

"Pneumothorax is advisable in uncontrollable pulmonary hemorrhage" (1).

Fifty Years Ago

Tolerance of monkeys and mice to rocket flights: "One of the problems in protecting man from the stresses of flight is the problem of escape from modern and future high speed, high altitudes [sic] aircraft. Biological specimens, including monkeys and white mice, have been test flown along with physical test equipment in the nose of upper atmosphere V-2 rockets and of Aerobee sounding rockets. The animals have been successfully received after flights to altitudes approximating 35 miles. Biological data from the animals in flight have been telemetered back to the base. These data fulfilled experimental expectations and confirmed experimental results from studies in aircraft and on the centrifuge. The capsules provided adequate environmental protection against pressure, gaseous and temperature changes.

"Electrocardiograms, breathing patterns, and blood pressures of the monkeys were undisturbed by the accelerations and subgravity states met in the 2000 miles per hour, 200,000 to 400,000 foot flights. The parachute systems landed the animals without injury. Mice, unrestrained during their rides, showed panic during the gravity-free periods without support but were undisturbed if they had some object to which to hold and orient themselves. The stresses met during these flight were well within the range of tolerance of vertebrate animals" (3).

Speculation on exposure to long-term zero gravity: "Once the space ship has attained escape velocity and the rocket engines are shut off the crew will of course be in a gravity free state. No animal or man has yet been in this condition for more than a few seconds at a time and it is therefore impossible to predict all of the objective and subjective effects of such a condition. However, such evidence as we do have indicates that no serious consequences will result from exposure to the gravity free state. The worst that could happen would be an inability to orient one's self in space and the occurrence of perhaps a mild form of motion sickness. This latter might result from the absence of stimulation to the vestibular receptors in the middle ear. Presumably, however, it would be possible to substitute centrifugal force for ordinary gravity and, thus, largely mitigate any adverse effects of the absence of gravity" (4).

Twenty-five Years Ago

Head motion, nystagmus and space sickness (Brandeis University, Waltham, Massachusetts; Naval Aerospace Medical Research Laboratory, Pensacola Naval Air Station, FL): "Recordings of horizontal nystagmus were obtained on 16 male subjects exposed to repeated patterns of horizontal angular acceleration, constant velocity rotation, and sudden-stop deceleration in the laboratory and in the free-fall and high-force periods of parabolic flight. Nystagmus intensity was a clear function of gravito-inertial force level: slow phase was a clear function of gravito-inertial force level: slow phase velocity and beat frequency increased during exposure to high force levels and decreased in free-fall compared to values obtained at 1 G. These findings indicate that the gain of the vestibulo-ocular reflex decreases in free-fall. This fact likely accounts for the disorientation and dizziness sometimes experienced by astronauts when moving their heads in the early phases or orbital flight and again after splashdown" (5).

Dangers of hydrazine (USAF Engineering and Services Center, Tyndall Air Force Base, FL): "The recent use of 70% hydrazine-water fuel in the F-16 emergency power unit (EPU) presents problems for organizations responsible for protection of personnel and the environment because of the worldwide deployment of this aircraft and the requirement for fuel handling in a flightline environment. Hydrazine has a low vapor pressure (14 mm Hg @ 25°C) but still evaporation rates (16-100 mg/cm² h) from liquid pools are sufficient to generate hazardous atmospheric concentrations greater than the permissible exposure level (3 ppm) up to 2 km downwind under worst-case meteorological conditions (F Stability). In contrast to the general feeling that hydrazine degrades in the presence of atmospheric oxygen, studies show hydrazine is relatively stable in both air (t_{1/2} ~6 h) and oxygenated aqueous solutions (t_{1/2} ~5 d). The toxicity and stable character of hydrazine in the environment requires quick and thorough management of any accidental spills to preclude hazards to personnel and serious environmental degradation. The Air Force has established comprehensive containment and treatment procedures which will be used in the event of inadvertent releases of hydrazine from the EPU or during handling or transport of the bulk fuel" (6).

Heat stress and mental performance (University of Illinois at Urbana-Champaign, Champaign, IL): "A time-related, heat stress tolerance curve for unimpaired mental performance was constructed by Wing from a summary of 15 studies. The tolerance limits, more properly described as the lower limits for heat impaired mental performance, were subsequently adopted by the National Institute for Occupational Safety and Health as the recommended standard of tolerance times for sedentary work in heat stress. Although Ramsey and Morrissey have reported a series of isoderection curves which indicate that mental performance impairment in heat may not be a simple function, a reappraisal of the upper limit for unimpaired has not yet been advanced. The present review reevaluates results of early studies, apparently supportive of Wing's position, and proposes an alternate interpretation. Further, analysis of more recent data suggests a mental performance impairment/heat stress relationship closely related to human thermophysiological tolerance limits" (2).

References

1. Brachman DS. Recent advances in tuberculosis: (a) prevention, (b) diagnosis, (c) treatment. *J Aviat Med* 1931; 2(1):2-22.
2. Hancock PA. Heat stress impairment of mental performance: A revision of tolerance limits. *Aviat Space Environ Med* 1981; 52(3) 177-80.
3. Henry JP. Physiological laboratories in rockets. *Bull for Med Research* 1956; 10:2.
4. Hitchcock FA. Learning to live with weightlessness. *Astronautica Acta* 1956 (March).
5. Lackner JR, Graybiel A. Variations in gravito-inertial force level affect the gain of the vestibulo-ocular reflex: Implications for the etiology of space motion sickness. *Aviat Space Environ Med* 1981; 52(3) 154-8.
6. MacNaughton MG, Stauffer TB, Stone DA. Environmental chemistry and management of hydrazine. *Aviat Space Environ Med* 1981; 52(3) 149-53.