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AVIATION AND SPACE MEDICINE

V. V. Parin, Editor in Chief

*Akademiya Meditsinskikh Nauk, SSSR,
Moscow, 1963*

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AVIATION AND SPACE MEDICINE

V. V. Parin, Editor in Chief

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surface of aviation instruments, in the working places of the first and second pilots, and at different spots in the crew compartment (with use made of a luminous substance of intermittent action, 65 hours a month sanitary rate of deposit, and 10-month work year) were one-half to one-third the maximum permissible level.

The results of an investigation of higher nervous activity, various functions of the visual analyzer, perception and evaluation of readings of aviation instruments, degree of fatigue of flight personnel, etc., revealed that insignificant physiological changes (within the limits of ordinary functional changes) appeared in bodily functions after 4-hour flights with the experimental system of instrument-panel illumination. Similar results were obtained in an investigation of flight personnel when a luminous substance of constant action was used.

It appears that the green color is best, as demonstrated in the processes of eye adaptation and readaptation, electric sensitivity of the eye, shortening of the afterimage and lengthening of the latent period. The degree of change in these indices was 15-25 percent. The use of green paint also improves the conditions for reading the dials of instruments and makes it easier to distinguish between warning signs.

The conclusions of our investigations are as follows:

- (a) Instrument panels painted with a luminous substance of constant action should be changed owing to the relatively high radio-activity.
- (b) Lighting instrument panels with luminous substances of intermittent action irradiated by UFO armatures is effective.
- (c) Of the two types of instrument panel lighting, the more useful is the FKP-03K green-colored zinc sulfide.

THE EFFECT OF LOW CONCENTRATIONS OF CARBON MONOXIDE ON MAN IN PRESSURIZED CABINS OF PASSENGER PLANES

V. A. Gilinskiy, A. V. Chapek, A. G. Kozlova,
N. M. Kulikova and A. Ya. Loshak

The human organism in general and during flight in particular requires careful observance of certain environmental conditions, i.e., the so-called comfort conditions that make it possible for a flier to live and remain fit with minimal fatigue during flight.

Many authors (A. A. Letavet, E. E. Grigor'yev, L. S. Gorsheleva, I. I. Datsenko, and others) have concluded that prolonged exposure to low concentrations of carbon monoxide may adversely affect health by causing chronic carbon monoxide poisoning.

We found no references in the available Soviet or foreign literature to carbon monoxide effect on human beings in pressurized cabins exposed for 3 hours to maximum permissible concentrations and to low concentrations under ground conditions (pressure-chamber experiment) and at altitudes of 8000-10,000 meters.

There is as yet no consensus either in international practice or in the Soviet Union on the maximum permissible concentration of carbon monoxide in pressurized airplane cabins. The specialized literature contains no data that confirm the soundness of applying the maximum permissible CO concentration (0.02 mg/liter) established for ground conditions to the conditions of low partial pressure of oxygen in inhaled air.

We performed pressure-chamber experiments on 82 persons to study the effect of low concentrations of carbon monoxide. We also made 30 flights on IL-18, AN-10, and TU-104 planes during which we examined 185 members of the crew and passengers and studied 347 air samples obtained in the cabins.

The results of the investigations showed that 3 hours' exposure to carbon monoxide (starting with 0.01 mg/liter or more), both under experimental conditions (ground and pressure-chamber at 2400 m) and during actual flight had adverse effects on the functioning of several organs and systems, namely:

- (a) Higher nervous activity (manifested in a breakdown of differentiations; deterioration of memory, capacity and concentration of attention; increase in amount of time required for a proof-reading test, etc.).
- (b) Functions of the visual and vestibular analyzers (increase in latent period and decrease in duration of the after-image, shortening of the time of illusion of counter-rotation, etc.).
- (c) Metabolic processes (change in bodily temperature).
- (d) Cardiovascular system (change in arterial pressure, oscillatory index, change in myocardial function, etc.).
- (e) Muscular strength (decrease in indices of manual dynamometry).

(f) Tissue respiration (formation of carboxyhemoglobin in the blood).

(g) Leukopoiesis (change in composition and formed elements of the blood).

On the basis of the physiological-sanitary data obtained and the results of laboratory tests, it is suggested that the maximum permissible concentration of carbon monoxide in pressurized passenger airplane cabins be 0.01 mg/liter.

MORPHOLOGICAL CHANGES IN THE NERVOUS SYSTEM OF ANIMALS SUBJECTED TO LATERAL ACCELERATIONS

B. S. Glushkov

Although much material on the subject has been gathered in the past 20 years, continued study of morphological changes arising in the nervous system after exposure to accelerations is of value in clarifying the reasons for impairment of various functions caused by acceleration. Unfortunately, morphological data are meager.

This report presents preliminary findings on morphological changes in various divisions of the nervous system of animals subjected to single lateral accelerations of varying intensity and duration. Experiments were performed on 7 rabbits, with accelerations ranging from 4.9 to 5.9 g produced in a centrifuge with lateral (back-chest) orientation of the animals in the direction of the centrifugal force. The action lasted from 60 to 180 seconds. The animals were kept under observation from 1 to 7 days after the experiment.

The following were used for histological investigation: the entire brain, two fragments from each section of the spinal cord with the intervertebral ganglia, both nodose ganglia of the vagus nerves, both superior cervical sympathetic ganglia, semilunar ganglia, thoracic sympathetic chain, celiac ganglia, and some viscera (heart, lungs, esophagus, stomach, major blood vessels). All material was treated by the methods of Nissl, Van Gieson, Marchi, Mallory, Bielschowsky-Gros, Cajal in Ranson's and Favorskiy's modifications, and with hematoxylin-eosin.

Hemorrhages of varying severity were found in the brains of 4 rabbits - from small extravasates to a large subcortical focus in rabbit No. 2 (5.2 g.- 180 seconds). All animals showed spinal cord

hemorrhages concentrated, for the most part, in the gray substance, chiefly in the thoracic and lumbar segments, in the nature of small perivascular foci.

Perivascular edema was noted in all cases. When stained by Nissl's method, the most distinct but generally reversible changes in nerve cells were found in the cerebral cortex (chiefly in layers 2 and 3) and hippocampus. These changes represented various phases of chromatolysis of Nissl substance, frequent vacuolation of nerve cells and, at times, "severe disease" of the latter.

Changes in the nerve cells of the intervertebral and other sensory and autonomic ganglia were insignificant, consisting mainly in a redistribution of Nissl substance in the cell body - in a coarsening or dispersion of the substance.

The nature of the morphological changes caused by lateral acceleration which seem to be reversible, suggests they are the result of marked disorders of blood circulation in the CNS.

SOME FUNCTIONAL CHANGES IN MAN AFTER PROLONGED ISOLATION

F. D. Gorbov, V. I. Myasnikov, and V. I. Razdovskiy

The increasing pace of automation of industrial processes is making essential the early and discriminating determination of stress and fatigue. The problem assumes greater urgency in cases where the factor of continuous work is combined with spatial shifting of man with the object, e.g., in various types of transport, aviation, and, above all, in spacecraft (V. I. Yazdovskiy, 1962).

In 18 experiments, the subjects spent 10-15 consecutive days in a small, enclosed space in a specially equipped chamber. The main condition of the experiment - isolation - was ensured by solitude, lack of two-way oral communication, and practically complete isolation from outside light, sound, or other stimuli. One-way communication from subject to experimenter was limited by the program and transmission time.

The subjects' functional state was evaluated in various ways: observation of behavior and emotional reactions; the dynamics of bioelectric activity in the cerebral cortex; determination of the speed of motor reactions; and psychological exercises (tests for "noise