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VIIth International Symposium on Marine
23 through 30 September 1976,
Aboard the M/V BELLORUSSIYA

CAPT. J. Vorosmarti, MC, USN*

14 February 1977

*Naval Medical Research Institute, Bethe

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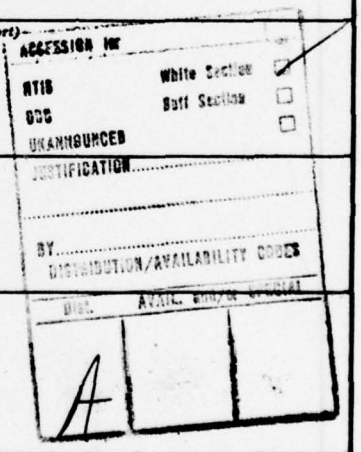

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The VIIth International Symposium on Marine Medicine, sponsored by the USSR Ministry of Health, Research Institute of Water Transport, was held on the Black Sea on 23-30 September 1976. Presentations covered hygiene and epidemiology, chemical and physical factors on ships, clinical aspects of marine medicine, environmental hygiene and underwater medicine.

This report reviews the diving medicine sessions specifically and the plenary sessions generally. Selected abstracts are included in the Appendix.

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VIIth INTERNATIONAL SYMPOSIUM ON MARINE MEDICINE, 23 through 30 September 1976, ABOARD THE M/V BELLORUSSIYA

General Aspects

This meeting was the latest in a series of irregularly held symposia to consider all aspects of marine medicine from rat control on ships to physiologic problems of deep diving. The meeting was attended by about 225 persons, with all but a few coming from Russia and the Eastern European satellite countries. Cuba was also represented by several participants. The Western nations represented, in addition to the United States, were Germany, France, Sweden, Finland and Norway. There was no obvious participation by any military personnel of any of the Eastern Bloc nations.

The meeting was held aboard the Finnish-built cruise ship, M/V BELLORUSSIYA, operating out of the Black Sea port of Odessa. This was a very pleasant milieu in which to have a meeting, particularly since tours were provided at the ports of Yalta, Sukhumi, Sochi and Batumi. An excellent simultaneous translation service from Russian to English and German was provided. Two disadvantages were the lack of a program listing papers by day and time; and the length of the sessions--9:00 A.M. to 2:00 P.M. The first meant that one never knew which papers were to be presented nor where; and he had to sit through all presentations to hear those in which he was interested. An amusing aside in connection with this is that almost midway through the first plenary session, the session chairman admonished the audience that they were there to work and that all the comings and goings from the meeting were not appreciated! The second disadvantage was the long time between breakfast and lunch. There was generally a 10-minute break during the 5-hour sessions: no coffee, etc., was available either during the session or the break. This made for some very fidgety, hungry audiences. It also cut down on the discussions following the formal presentations since no one was anxious to spend any more time in the session than he had to.

Scientific Program

The main scientific program began on the 24th with a general plenary session. The next three days the conference was broken into several working sessions including hygiene and epidemiology, clinical aspects of marine medicine, underwater medicine, chemical and physical factors on ships, environmental hygiene, and epidemiology and nutritional hygiene. On the 28th, a plenary session again was held with topics of general interest in the marine medicine area. The meeting officially closed on the 29th, although most of the Russian organizing committee and heads of the various subsections were due to stay aboard to complete their final reports on their various areas of expertise on the 30th.

Opening Plenary Session

This session was dedicated to general papers, discussing what the Russians consider to be major problems in the area of marine medicine. The first hour was given to what essentially were propaganda statements by representatives of various countries which included Finland, the German Democratic Republic and Cuba.

The first paper entitled, "Problems of Hygiene and Physiology of Labor and Rest on Water Transport", by S.S. Markaryan and D.I. Lazarenko, listed the following as problems requiring investigation: electromagnetic radiation, ultrasonics, radiative heating, vibration, noise and toxicology. The authors also included some personal general observations and suggested that perhaps to overcome some of the problems, voyages should be limited to four months. Unfortunately, they did not specify what the problems were, nor did they specifically state why the four-month limitation should be put into effect.

Evidently, as in the rest of the world, one of the very important current issues in the USSR is environmental protection, and L.I. Elpiner in his paper, "Problems of Environmental Hygiene and Shipping", discussed control of environmental contaminants, including petroleum products, sewage and garbage. He mentioned some work in the production of fresh water using the reverse osmosis process through membranes, but no specifics were given concerning this program.

"Clinical Aspects of Marine Medicine", by L.I. Aleinikova, was a general discussion of the diseases encountered in the medical care of merchant mariners, barge workers, dockyard workers, etc. The chief problems appeared to be the usual ones of cardiovascular disease, with hypertension leading that list, and gastrointestinal and respiratory tract problems. Aleinikova emphasized "hypokinesis", but unfortunately, never defined it. I have the impression, however, that it has a great deal to do with psychological problems encountered on long voyages, because another area which seemed very important to the Russians aboard was the general adaptation to shipboard life. They are spending a fair amount of time and effort on studying circadian rhythms and their effect on watch-standing and general shipboard life. Aleinikova also stated that every Russian merchant ship is required to carry one physician and that most major ships carry two to three and have a small clinic or hospital aboard. They also have a system for treating merchant seamen on shore, and all their ports have special hospitals or clinics for this purpose. The Russian health-spa system is used to a great extent in treating problems of merchant mariners.

"Problems of Underwater Medicine", given by G.I. Kurenkov, was a general discussion of problems encountered in underwater work. He discussed two approaches that are being used for investigating physiological

problems under water. The first is the investigation of depth limits to which man could be exposed, and the second is man's adaptation to long-term exposures to the underwater environment. Specific problems raised were those of respiration and the high pressure nervous syndrome. He stated that some work has been carried out to depths of 1400 m with small animals and that large animals have been studied to depths of 1000 m. This research apparently shows that hypoxia is the major factor causing problems at these great depths, and Kurenkov specifically referred to it as the "Chouteau Effect". Other problems described were slow versus fast compression rates, changes in Va/Q and cellular membrane permeability. He stated that a large percentage of divers seemed to be affected with forms of cardiorespiratory diseases (unspecified) and with diseases of the ear. Kurenkov gave two figures, which I was unable to confirm later. One is that the mortality of divers is one in one thousand. (I wondered whether this was a translation error and should have been morbidity rather than mortality.) The other was that 20-40% of the divers have aseptic necrosis of the bone.

A paper was then delivered by I.D. Ladniy and I.S. Maletkov which dealt with the general observation that infectious disease can be spread rapidly by the merchant marine over a great distance.

"The Organization of Disinfection Measures on Water Transport" was then presented by L.A. Manevitch. This was a general discussion of an inspection and sanitation system for ships. This covered all general public health services required for the control of disease including insect problems, deratization, removal of infected patients from ships, care of people who have been in contact with infections, provisions of adequate drinking water, training of crews in personal hygiene, and disinfection aboard ship.

In his general summary, the session Chairman made a strong plea for more research in the environmental protection area and called for all countries engaged in merchant shipping to join together in a common approach to all the problems which had been discussed during the session.

On the 25th and 26th, I attended the two sessions concerned with diving medicine. There were 57 abstracts published for these sessions, but only 32 were presented. One of those not presented was a discussion ofthe mechanism of hyperbaric narcosis which was to have been presented by G.L. Zaltsman and A.G. Gurgenidze, neither of whom attended the meeting.

The first paper on the 25th, given by Dr. Brauer of the Institute of Marine Biomedical Research at Wilmington, N.C., was a review of the history and the recent research of the high pressure nervous syndrome. Ornhagen, of the University of Lund, Sweden, then presented a paper on sex difference and tolerance to hydrostatic pressure. Hypothermic mice of both sexes were subjected to high pressure while breathing oxygenated

fluorocarbon. Maximally tolerated pressure (MTP) was defined as the pressure where respiratory or cardiac failure occurred. In males MTP equaled 134.5 ± 34.4 ATA; females 237 ± 20.8. Castration of both males and females at 30 days of age did not change the sex difference in MTP, whereas castration at 15 days of age abolished the difference between sexes.

"Using the H-Reflex Method for Quantitative Evaluation of Pain in Humans" in determining the pain sensitivity in hyperbaric conditions, was presented by A.V. Syrovegin and V.A. Garibdzhanov. Since this paper was read too fast, the translators gave up completely, so I have included the abstract in the Appendix to this report.

G.V. Troshinin, V.N. Batigna and Z.A. Donina discussed changes in respiration in rabbits at pressures up to 40 kg/cm^2 in nitrogen-oxygen, and in helium-oxygen. At pressures producing equal gas densities, that is, helium-oxygen at 40 kg/cm^2 and nitrogen-oxygen at 6 kg/cm^2, there was a decrease in respiratory frequency, tidal volume and lung ventilation. Lung ventilation decreased 22-38% in helium-oxygen and 39-54% in nitrogen-oxygen as compared to surface controls. The brain surface PO_2 was unchanged, but the blood oxygen content dropped from 94% to 84% at the end of one hour exposure. The electrical activity of inspiratory muscles increased sharply under both conditions. Increasing pressure in nitrogen-oxygen from 6 kg/cm^2 to 40 kg/cm^2 resulted in abrupt decreases in ventilation, arterial oxygen saturation and brain surface oxygen. Animals died within 15-30 minutes with manifestations of asphyxia.

The abstract of the next paper by B.O. Yahontov is given in the Appendix. This was one of the better papers of the meeting. In addition to the information given in the abstract, he also stated that they make arterial blood measurements in the chamber under pressure with calibrations being done by tonometry. In gas densities up to five times those of air at 1 atm, the PaO_2 did not change. Between 5 and 10 times the normal density, there was no correlation between the density and the PaO_2, but no absolute values were given.

A paper by an unknown author which had no published abstract concerned some experiments done to investigate the effects of external resistance to breathing. This appeared to be basically a review of work which has already been done by investigators in the West in the past. The author did, however, show a graph which was purported to predict the PO_2 required in the breathing media depending on the work load and the heart rate. This may indicate that some consideration is being given to changing the oxygen content of diver's breathing gas instead of using a constant volume percent of O_2 in the breathing media, or that a type of breathing apparatus may exist in which the PO_2 can be varied.

The next presentation was also one which was not scheduled and had no published abstract. It was a garbled presentation which was an impassioned plea for the use of nitrogen and breathing mixtures because of the importance of this gas to body metabolism. In other words, the speaker was saying that nitrogen is not an inert gas. For support, he reviewed the problems of US astronauts when a pure oxygen atmosphere was used and reviewed some experiments that he had done in raising partridges in helium-oxygen atmospheres versus air. Those raised in the helium-oxygen atmosphere, he said, had an increased teratogenesis of the embryos and also had a decrease in bound nitrogen. Bound nitrogen was not defined. He also discussed the role of ionized nitrogen which supposedly increases nitrogen binding by 16% in these partridge embryos. At the end of this paper there was a spirited and very antagonistic discussion which was eventually stopped by the chairman.

A paper "On the Respiration of Scuba-Swimmers at Rest and Exercise at Underwater Conditions" is given in the Appendix. The only comment I will make here is that the authors admitted that the apparatus used was of an extremely poor design.

L.I. Ardashnikova then discussed circulatory changes which appear in divers under water. This study was done by measuring blood flow in the shin and also in the pulmonary vasculature. The method of measuring in pulmonary vasculature was not discussed. Basically, they reported that (1) in the water, there is no evidence of the hydrostatic differences in the blood column which is found on land when a man is standing up. They also determined that the pulse is slower when the man was in the water at 12 m. Using what they called the rheographic index of pulmonary vasculature, they reported that there was increased resistance of the pulmonary vessels and increased work in the right side of the heart. Also using this rheographic index and shin blood flow, they found that the divers doing work on an ergometer had less increase in pulmonary and shin blood flow than did non-divers. They also reported that the increase in lung circulation in nitrogen-oxygen at 5 atms was not found when repeating the experiments in helium-oxygen up to 10 atms.

Cardiac activity in hyperbaric conditions was presented by G.N. Estropova. This abstract is included in the Appendix. In addition to the information in the abstract, she also discussed some specific changes in the electrocardiograms of divers. Specifically, these are as follows: the amplitude of the P wave increased at 40-50 m during work, and under the same conditions the heart rate was lower than it was at 20 m. In 19% of the divers studied, the T wave amplitude was decreased by one-third, and 32% of divers had T wave depressions. She also reported myocardial electrical activity depression at 5 atm of nitrogen-oxygen and helium-oxygen mixtures, and extrasystoles and decreases in heart rate to depths of 10 atm. During a 3-week stay at 5 atm in the helium-oxygen-nitrogen environment, all divers developed premature ventricular contractions and

depressed ST segments. A good deal of these problems were based on the increased pulmonary resistance which was suggested by the P wave amplitude increase and also by the work Ardashnikova previously presented.

V.D. Pushkarev then discussed the influence of the hyperbaric medium on blood coagulation. This was essentially a review of work already published in the West, plus some research he had carried out on 12 male subjects who were exposed to 3-5 atm between 6 and 8 o'clock in the morning followed by decompression. The experimental protocol was not described any further than this, so there was no way of knowing how long the exposures were or what the decompression schedule was. He reported that the data showed a decrease in the thromboenzymes and blood platelets, an increase in thrombin activity and a low blood clot elasticity.

G.V. Dziak and L.A. Kziak discussed divers' cardiohemodynamics and microcirculation features. No further information was given other than that in the abstract which is included in the Appendix.

D.V. Vandyshev presented his study of the peroxidation of lipids using a chemoluminescence method in hyperbaric oxygenation. He came to the conclusion that this study proved that hyperbaric oxygenation peroxidizes lipids in the blood plasma. This was a very confused presentation; the method of measuring luminescence was not discussed and the lipids supposedly oxidized were not identified.

I.F. Sokolyansky reported on studies done on muscle PO_2 in hyperbaric conditions. These were carried out by using (100-μm-diam) platinum electrodes. The results showed only that when the environmental oxygen level was increased or decreased, a concomitant change occurred in the muscle oxygen levels.

Dr. Murin from Sweden discussed some of the experimental decompression schedules with which he has been working in dives to 120 m and 150 m with 60-minute bottom times. These have previously been published in the literature and will not be discussed here.

R.L. Boush and V.X. Farfel reviewed the ergonomic aspects of working underwater. This was essentially a review of the problems which a diver runs into including weightlessness, lack of support, low temperatures, the effect of diving equipment on movements of men, changes in visual acuity, etc.

M.R. Gurevitch then discussed the energy expenditure required by divers during various jobs underwater. Although no specific data were given, nor any discussion of methods of measuring cardiac output and respiration were discussed, they have evidently made some actual measurements of these parameters on divers working underwater. They concluded that a considerable increase of respiration, pulse rate and energy

expenditure was occuring during such work. This reached its highest extent when ship cleaning was done, using what Gurevitch described as a vibrating brush. He said that this work was equivalent to hard physical work on the surface. The co-authors were S.A. Bershtein, A.G. Kartzeva, M.M. Seredenko, A.I. Polyarush and V. Koltchenko.

N.M. Turubiner presented some data on the effect of a multiple-day exposure under increased pressure on the function of the adrenal gland. His abstract is included in the Appendix and no other data were mentioned in his presentation. The depth at which the dive was conducted also was not stated.

Two papers were delivered by R.L. Boush during this session. One related to physiological reactions to underwater work and the other to parameters of muscular work during hyperbaric conditions. These were both straightforward papers, and the essential data from both are included in the Appendix and will not be repeated here.

A very interesting paper concerning mechanisms of gas bubble formation in blood during decompression was given by A.A. Shurubura. This was an important paper not because of the fact that they found gas bubbles forming in blood during decompression, but because of the method they used. The electrical impedence was measured by electrodes which were placed on the inner surfaces of the arms and essentially measured the impedence across the chest. The electrodes were approximately 20 mm in diameter and 4-5 mm thick and appeared to be made of sintered brass. In fact, it looked very much like a sintered metal filter. Using this method, which he had confirmed by previous measurements in animals, Shurubura found in 154 humans that gas bubble formation begins from the start of decompression and grows in parallel with Boyle's law. He also stated that large gas bubbles appear in the right heart at the beginning of diastole; however, he did not say how this was determined as opposed to the rest of the thorax. These bubbles are then pumped from the heart to pulmonary circulation where they are partially eliminated from the lungs. He also reported that heparinization of the animals resulted in fewer bubbles, but no quantitative data were given in this area.

L. Laba from Poland reviewed the reasons for divers withdrawing from their profession. He stated that by and large the chief reason was health limitations and that these usually occur between the ages of 40 to 45 years. However, they've had a few who remained in diving until they were 60. This presentation also did not include any quantitative statistics.

P. Budrin presented some statistics over a 15-year period concerning accidents while using aqualungs. The direct cause of death in 80% was barotrauma caused by rapid decompression or uncontrolled surfacing: in the remaining 20% of the cases the cause was drowning. Drowning was

stated as being a result of faults in equipment or by the wrong use of equipment. He specifically mentioned the erroneous switching of valves or the exhaustion of the oxygen supplies.

B.A. Shaparenko, along with V.D. Pushkarev, P. Tofimenko and A.N. Zhurba, presented some data on ear, nose and throat problems under hyperbaric conditions. This paper contained no new information.

T.Doboshynsky, B. Kerznikovich and L. Laba presented a paper in which they attempted to estimate individual sensitivity to hyperbaric oxygen. Forty 21-year old males were examined using an oxygen tolerance test which was unspecified, time of apnea, step and hypoxic tests. These also were not defined, but in any case, none gave any correlation to predicting the susceptibility to acute oxygen poisoning.

E.G. Kostylev, V.P. Lapshyn and Y.A. Malofeev reported on the use of helium-oxygen along with normal anesthetic gases for producing anesthesia in patients with obstructive lung disease, etc. They have used helium-oxygen halothane mixtures in more than 100 patients and noticed no problems other than those which could normally be subscribed to using anesthesia.

A paper on the effect of diving on females was given by someone named Farber who was not further identified and no abstract was available. Essentially, in 50 female athletes they determined that diving did not affect the length of menstrual cycle and that the 50 divers studied had 50% less dysmenorrhea than in 50 other athletes in a control group.

The sessions on the 27th and 28th were general sessions once again and included papers on problems of noise, vibration, chemical toxic agents, etc., in the merchant marine. I have included several of the abstracts of these papers in the Appendix. These papers covered, as I said before, almost all subjects of public health, toxicology, etc. In one area, electromagnetic radiation, which has received a lot of publicity lately only one paper was listed but it was not given.

Impressions:

My major impression was that the presentation and scientific content of the majority of the papers at this meeting were rather undistinguished. There is a great deal of effort apparently being expended or at least a lot of lip service being given in Eastern bloc nations to areas of public health which in other parts of the world are no longer problems, but subjects of standard controls and procedures.

This also holds true for the diving research area and appears to to the lack of access to recent Western literature. This was vividly evident in private discussions that I had with several active investigators. They are extremely anxious to get hold of any reprints, journals,

etc. The areas in which they are most eager for information are decompression from 10 ATA or deeper, oxygen toxicity, HPNS, respiratory heat loss, and almost anything to do with saturation diving. From the papers presented, it appears that the investigators at this meeting did not have access to facilities with a depth capability of more than 10 ATA. I did learn of two larger facilities now in the design stages. One is a 150 ATA man-rated facility at the Academy of Sciences in Leningrad and the other is a 100 ATA man-rated facility planned in Gelendchik on the Black Sea. It is obvious that with this commitment a great deal more research will be done. This, I think, accounts for a good deal of the anxiety of the people with whom I spoke. They wish to make contacts outside of Russia so that they can be brought up-to-date and stay current with Western work in the field.

From the numbers of abstracts and attendees at the Symposium, the two main centers of diving research appear to be (a) Institute of Hygiene of Water Transport, Ministry of Health USSR, Moscow, Laboratory Head, G.I. Kurinov; and (b) Bogomoletz Institute of Physiology of the Ukranian SSR, Kiev, Professor A. Kolchinskaya, Head.

Finally, outside of brief references to operational diving in some of the presentations there were no discussions concerning specific operational tasks and problems or diving equipment.

APPENDIX

(The following abstracts have not been edited, but are published exactly as they appeared at the Symposium.)

A.V. Syrovegin
V.A. Garibdzhanov

USING THE H-REFLEX METHOD FOR A QUANTITATIVE EVALUATION OF PAIN IN HUMANS AND DETERMINING THE PAIN SENSITIVITY IN HYPERBARIC CONDITIONS

The application of an electric stimulus at the skin projection of the radial bone in the elbow joint in man caused a feeling of pain and many phase changes in the reflectory excitability of the motoneurons of the m. soleus, tested by the H-reflex method. It was noted that the amplitude of the H-responses registered from the m. soleus decreased if the H-reflex was induced 10 m/sec after application of the pain stimulus, and with a further increase in the time interval, it began to increase and maximum surpassed the control value 170-190 m/sec after application of the pain electroskin irritant. Such changes in the N-responses occurred when using an electric stimulus causing maximum bearable pain.

At the pain threshold level, a tangible increase of the H-reflex was observed only 170 m/sec after application of the pain stimulus. Intravenous administration of fentanil greatly reduced the reaction of the spinal motoneurons to pain electroskin irritation, whereas seduksen did not significantly change the pain sensitivity.

This method was used for evaluating the pain effect in conditions of the narcotic action of increased air pressure at 5 atm. It was noted that the amplitude of the H-reflex induced with a time interval of 10 m/sec after application on the pain stimulus (less in conventional conditions) also remains lower under pressure, whereas an increase in the amplitude of the H-reflex induced 170 m/sec after electroskin irritation under pressure was less pronounced than in conventional conditons.

B.O. Yahontov (USSR)

GAS EXCHANGE IN LUNG DURING INHALATION OF GASEOUS MIXTURES OF DIFFERENT DENSITY

The density of the respiratory medium, in the opinion of many investigators, is one of the factors limiting the supply of oxygen to the blood, since the increase in density, according to Graham's Law, should lead to a worsening of diffusion of O_2 and CO_2 in the lungs. However, the investigation carried out in a pressure chamber at different pressures does not confirm these theoretical assumptions. It has been established that a five-fold increase in the density of the breathing mixture does not influence the delivery of oxygen to the blood. Moreover, it has been established that the oxygen tension in the arterial blood by 6-9% is greater when breathing an oxygen mixture with a heavier inert gas (nitrogen, argon), than with lighter ones (helium), the result of which raises doubts as to the exclusive significance of density and the diffusion factor for intra-lung oxygen supply to the terminal respiratory tracts, where one of the chief factors of ventilation is diffusion, the degree and localization of the strata heterogenicity prove to be different when different inert gases are used. The sharp differences in molecular weights, dimensions and speed of the molecules of gas components in the breathing mixtures, at different densities, in all likelihood, are of greater significance for delivering oxygen in the gaseous phase than difference in density.

Analyzing the results of the investigation, they discuss possible mechanisms of compensation, which quite regularly reduce when there is an increase in the density of the speed of diffusion in the lungs, which could provide an explanation for the obtained facts.

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J.V. Stepanov
S.A. Gulyar
J.N. Korolyov
V.A. Grinevich
V.A. Zaboluyev
A.Z. Kolchinskaya (USSR)

ON THE RESPIRATION OF THE SCUBA-SWIMMERS AT REST AND EXERCISE AT UNDERWATER CONDITIONS

Respiration and gas exchange in ten scuba-swimmers and aquanauts at rest and exercise at sea-level and underwater conditions (at depths 5, 10 and 15 m t° of the water 14-23°C) were investigated. At the depths of 5 and 10 m the subjects inspired compressed air, at 15 m-nitrogen with 12% of oxygen.

After submersion at relative rest, though utilization of oxygen in the lungs fell due to increase of lung ventilation, gas exchange became more intensive. Oxygen consumption was 40% higher while subjects wore "Calypsoes"--100-200% higher than seashore.

Underwater exercise leads to lesser increase of lung ventilation and oxygen utilization than on the sea-shore, but oxygen depth and general oxygen demand and oxygen cost of the work at underwater conditions are higher.

G.N. Evstropova (USSR)

CARDIAC ACTIVITY IN HYPERBARIC CONDITIONS

Changes in the cardiac activity of divers were studied electrocardiographically and polycardiographically during work at depths of up to 50 m, as well as at rest and during work of different capacity during short-term and many-day expositions in dry barochambers under 4 ati pressure (in compressed air media and N_2-O_2) 5 and 10 ati (He-N_2-O_2). Changes of electrocardiographic indices which were observed in divers during work at depths of up to 50 m, characterized the work of divers as hard and exceptionally hard. During short-term and many-day expositions under increased pressure in dry barochambers we observed in the divers electrocardiographic indices and indices of phasial analysis in cardiac activity showing that there is an increase of resistance in the small blood circulation cycle and an increased load on the right ventricle of the heart. This is also confirmed by rheographic investigation of L.I. Ardashnikova in the same conditions. In some cases at rest and during work in hyperbaric media we observed in the divers a disruption of automatism and conductivity of the myocardium, a worsening of the metabolic processes in it. Work in hyperbaric conditions also induced changes of cardiac activity, which in conditions of normal pressure are observed during harder work. We established a dependence of the degree of expressed changes of indices of cardiac activity in divers on the size of pressure, length of exposition, repeated compression and seniority of work under increased pressure.

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G.V. Dziak
L.A. Dziak (USSR)

THE DIVERS CARDIOHAEMODYNAMICS AND MICROCIRCULATION STATE FEATURES

The paper deals with the results of the examination of 65 divers, having at least 5 years service. The research comprises: electrocardiography, study of heart systole phase structure using poly- and rheography, arterial oscollography and microphotography of eye bulbar conjuctivis. The electrocardiography analysis was carried out by scalar and vector methods with the estimation of ventricular gradient and the use of some pharmacological samples (potassium and inderal). The microcirculation state was estimated qualitatively and quantitatively. The research was carried out in dynamics with application of physical stress. The estimation of the obtained indices was carried out using successive Vald analysis, Beiss theorems and control method of statistical hypothesis.

The obtained results testify some features of bioelectrical heart activity. The vector analysis in comparison with pharmacological samples has proved to be a better method of differential diagnostics of "ischemic" ECG design. There is a tendency to the rise of arterial pressure, mainly due to the peripheral vessel resistance. The microcirculation state estimation revealed a range of interior, exterior and vascular symptoms. The indices of microcirculation correlated with the peripheral haemodynamics data.

The obtained results allow to detect the early pathology symptoms of cardiovascular system and correctly resolve the treatment and expertise problems.

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N.M. Turubiner (USSR)

THE EFFECT OF A MANY-DAY EXPOSITION UNDER INCREASED PRESSURE ON THE FUNCTION OF THE ADRENAL GLAND

Phase changes occur in the excretion of catecholamines of the adrenalin and noradrenalin, as well as of the corticosteroids with the urine during a 15-day stay under pressure of the nitrogenicoxygen media.

Before submerging the function of the sympathicoadrenal system, especially its hormonal link were increased--the excretion of adrenalin was increased by an average of 83% in six of the test people. The excretion of corticosteroids grows, especially of 17 KS, by an average of 69%. After 3-5 days of submersion in hyperbaric conditions the function of the sympathico-adrenal system, especially its mediatory link, increases significantly: the excretion of noradrenalin frequently goes beyond the boundaries of physiological values, making up 35-48 and even 80 mkg per 24 hours. The function of the adrenal cortex, especially the androgenic during this period drops 1.5-2 times as compared to the background level. Together with this we observe an expressed disruption of the daily rhythm of excretion of both catecholamines as well as the corticosteroids, despite the preservation of the usual cycle of sleep and waking. The above named changes were preserved to the end of the exposition, during the period of decompression and in the course of the day after returning to normal atmospheric pressure.

The experiments make it possible for us to draw the conclusion that the adaptation of the organism to hyperbaric conditions in the above named media, apparently is limited and incomplete.

R.L. Bousch (USSR)

PHYSIOLOGICAL REACTIONS TO UNDERWATER WORK

During the diver's submergence, by remote control, we measured the frequency of heart contractions and electric activity of working muscles. Prior to and after submergence, a study was made of a maximum muscular force, accuracy of controlling muscular tension, physical working capacity.

The investigations were conducted at a temperature of air on the surface 28-34° and water temperature at the bed 6-8°C. The divers were lowered in ventilated equipment to a depth of 50-60 metres.

Before submerging, the pulse frequency was on the average 96 beats per minute, which was connected with considerable muscular effort in donning the suit and possible overheating of the body. During work on the bed (joining pipes) the pulse frequency was at the level of 140 per minute (120-200 per minute). During decompression, the pulse returned to the initial values (82 per minute).

While performing working operations, the summary electric activity of the muscles in the upper extremities remained at the level of about 50% maximum, and at certain moments reached 80-90 and even 100%.

After surfacing, there was a noticeable decrease in muscular force by 6-15%, a two-fold increase in errors in controlling muscular tension. The studied divers have different levels of physical working capacity from 850 to 1500 kgs.m/min. After working on the bed, all the divers were found to have a significant drop in physical working capacity--on an average of 60 kgs.m/min, and in certain cases, after performing very arduous jobs--by 130 kgs.m/min. Residual phenomena were observed even 2 days later.

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PARAMETERS OF MUSCULAR WORK DURING HYPERBARIC CONDITIONS

The task of the work was to find signs of fatigue during muscular load. In conditions of normal and increased pressure the divers carried out a portion of work--capacity 600-900 kgs.m/min on a special foot ergograph. Measures were made of the change in efforts of amplitude and length of each movement, capacity of work, as well as EMG of the working muscles and frequency of heart contractions.

The work of given capacity in the course of 20 minutes under normal pressure was not accompanied by any expressed signs of fatigue. The same work under increased air pressure of 4 ata led to the appearance of signs of fatigue in the course of the last 5 minutes of work. Under a pressure of 7 ata signs of fatigue set in after 10 minutes of work.

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ON THE SUBJECT OF REGULATING INTENSITY OF ELECTRO-MAGNETIC FIELD EMITTED BY SHIP'S RADIO TRANSMITTERS

Tests of intensity of electro-magnetic fields during transmission by the radio station "BRIG" and "MOUSSON" on series of three types vessels have shown, that intensity of electromagnetic fields amounts in the vicinity of emitting aerial (1.8 meters above deck) from 20-90 V/m--near magnetic compass and searchlight on the top bridge up to 1000-1500 V/m (0.5 m from acting aerial).

The tests confirm the necessity of strict control of the influence by electro-magnetic fields not only on radio operators who work in radio cabins but on all crew members present on deck in the vicinity of an emitting antennae during transmission.

The said questions undoubtedly calls for its reflection in the sanitary norms currently in force for the purpose of carrying out necessary prophylactic work on vessels.

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ALL-ROUND PHYSICAL AND CHEMICAL EFFECT ON THE ORGANISM IN TOXIC CARGO TRANSPORTATION

Continuous (21 days) twenty-four-hour effect on the organism of low frequency (16 Hz) vibration (80 dB) and noise (66 dB) at permissible levels and all-round effect of the mentioned physical factors together with benzol being shipped in great quantities was experimentally studied on white rats. In different series of six-months-experiments benzol was injected hypodermically and acted inhalationally in threshold doses (0.5 g/kg) and concentrations (15 mg/cbm) as well as at the limit-permissible-concentration level (5 mg/cmb). During the last 21 days of the experiment benzol effect combined with vibration and noise.

The results of our studies proved that under combined effect of benzol, vibration and noise at threshold levels there was a sharp reduction of some vegetative functions (mass, frequency of breathing and systole, blood oxygen tension and etc.) and the nervous system that indicated synergism in developing harmful effect of a complex of examined factors on the organism and especially on the nervous system.

Continuous and chronic benzol effect on animals at the limit-permissible-concentration level against a background of accompanying physical factors of vibration and noise caused less marked unfavorable changes of some physiological functions.

On the basis of the received data it is recommended to change rationing, in side decrease of benzol, vibration and noise in their combined effect.

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COMPARATIVE ANALYSIS OF THE LABORATORY, BENCH AND FIELD METHODS OF POLYMER EVALUATION IN SHIPBUILDING

The investigations of sanitary-chemical properties of synthetic materials used in shipbuilding are carried out by means of laboratory, bench and field tests. But notwithstanding the identity of basic experimental parameters in the investigations (i.e., temperature, ventilation saturation) laboratory and bench tests cannot practically imitate all the factors influencing the synthetic materials composition and gas liberation rate in service conditions. Hence, according to the publications available, the difference of the results obtained in the investigations of identical synthetic materials, depend on the testing conditions. This fact acquires a special importance in specific conditions of the synthetic materials operation in ship structures.

The synthetic materials and their combinations most widely used in the Soviet shipbuilding were subjected to comparative examinations revealing the dependence of the sanitary-chemical investigations results upon the test method employed. Laboratory and bench tests were carried out at temperature 40°C and single air exchange; and field tests in marine environment in middle and tropical latitudes or at temperatures of 19-25°C and 30-35°C respectively and single or six-fold air exchange in ordinary and air-conditioned (in tropics) ship accommodations as well as at temperatures of 20-25°C. Comparison of the results received in different tests was based on the concentration values for three main toxic agents (phenol, formaldehyde, styrene or ammonia) found in air-gas mixtures within the laboratory test vessels, bench-test premises and ship accommodations.

Comparative analysis of the test data revealed, that the highest concentrations of the above toxic agents liberated from the synthetic materials are found in the laboratory tests and the lowest concentrations in bench tests. Electronic data processing provides the following quantitative relations between these data and the test conditions.

If field test toxic agents concentration in the tropics in air-conditioned accommodations is assumed to be - "1", then similar figures for bench test average concentrations will be 3-6 and for laboratory tests--10-30.

The established relationship provides to hygienists and shipbuilding synthetic materials experts more reliable criteria for evaluation of sanitary-chemical properties of these materials and their potential danger

to people's health, according to the results, of any of these test methods. Besides there appears a possibility to predict the true level of gas liberation from synthetic materials on the basis of laboratory and bench tests data as the most available type of tests in hygienists' practice.

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HYPOXIA AS THE GENERAL REACTION MECHANISM OF THE BODY TO ENVIRONMENTAL FACTORS ON BOARD SHIPS DURING VOYAGES

The influence of complex and separate given physical and chemical factors of environment on the body was studied in natural and model experiments on board ships during voyages. Parallel to specific effects for the action of each agent, regular, general reactions of the body were revealed which do not correspond to the symptomo-complex of general adaptation syndrome.

The typical changes in the cardio-respiratory system, peripheral blood and tissue metabolism testify to the development of hypoxia as a general pathogenetic mechanism influenced by high and low temperatures, noise and vibration, wide spectrum of chemical factors, as well as by neuro-emotional stress.

Respiratory, chemical and tissue hypoxia simultaneously has a universal type of compensatory-adaptive mechanism, inclusion and degree of development of which depends on neuro-endocrine regulation.

The paper deals with hypoxia at systemic, organic, cellular, subcellular levels and discloses its significance in the general biologic, hygienic and clinical sense for adaptation of seamen's bodies to various sailing conditions.

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FOOD RATION FOR AQUANAUTS

The dietary of the people working underwater is a new problem yet imperfectly understood.

The studies conducted in our country and abroad evidence that even a short-term stay of a man in an underwater structure influences food perception.

The studies were conducted to determine the most digestible food articles for the dietary of the people working underwater during short-term stays (8-10 hours and 1-5 days). The studies revealed that under such conditions the following food articles are well digested: some types of canned meat, condensed milk, cottage cheese, dry fruits, juices, hot drinks, bread items in small quantities.

It's undesirable to use food with large content of tomato paste, vegetable oil, canned meat with flat taste. The studies carried out in cooperation with physicians revealed that under conditions of underwater structures intended for 8-10 hour operation cycle the ration energy must be 1500 kcal with albumen-fat-carbohydrate ratio to be equal to 1:1:3-4. On the basis of the studies we worked out a food ration with 1540 kcal energy and with content of albumen-57 g, fat-5 g, carbohydrate-186 g.

The rations were repeatedly subjected to tests by aquanaut teams and gained recognition.