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DEPARTMENT OF GENERAL HYGIENE
AND PHYSICAL CULTURE

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METHODS OF RESEARCH OF PHYSICAL FACTORS OF THE AIR ENVIRONMENT AND THEIR HYGIENIC ASSESSMENT

Methodological recommendations for students

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Methods of research of physical factors of the air environment and their hygienic assessment: methodological recommendations for medical students

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This methodological guide contains material that reflects modern hygienic ideas about the most important factor in the human environment - atmospheric air. Data on the structure of the atmosphere, its chemical composition, basic physical properties - temperature, humidity, atmospheric pressure, speed and direction of movement of air masses, their normative values, methods of measuring the effect of these indicators on human health are presented. Information on the main types of weather, climate and microclimate.

The manual contains a list of questions for self-control, test tasks, a list of basic and recommended additional literature.

The manual contains a list of used and recommended literature. Educational and methodological manual "Methods of research of physical factors of the air environment and their hygienic assessment", prepared in the discipline "Hygiene" in accordance with the Federal State Educational Standard of Higher Professional Education for students studying in the specialty of Medicine (31.05.01).

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Subject: *Research methods physical factors of the air environment and their hygienic assessment.*

Occupation purpose: to study influence of physical factors of the air environment on an organism; to acquaint students with methods barometriya, thermometry, psikhrometriya, anemometriya, katatermometriya; to sort methods of complex assessment of meteorological factors on a human body.

Venue of occupation: department.

Duration: 4 hours.

Equipment of occupation: tables, devices (thermometers minimum and maximum, thermograph, psychrometer Assmana, hygrometer, hygrometer of psikhrometricheskiya, gigrograf, barometer, barograph, anemometer vane, anemometer cup, katatermometr spherical, katatermometr cylindrical, actinometer).

Technique of holding occupation. Practical occupation provides assimilation by students of techniques of assessment of physical factors of the air environment. The teacher by poll determines the level of house training of students then students study a methodical grant and start measurement of indicators of a microclimate of the educational room. The received results are entered in "The protocol of measurements of weather conditions". For assessment of a microclimate of the educational room students compare indicators of temperature, relative humidity, speed of the movement and the cooling ability of air to indicators of comfort and write the conclusion about character of the studied microclimate.

20,9% of oxygen are a part of atmospheric air; 78,0% azothat; 0,03% carbonic gas; water vapors, ozone, hydrogen, helium, argon, neon, krypton, xenon, radon, etc. inert gases (in with to Ummah 1%). Air belongs to the environment factors rendering constant impact on a human body. Air is necessary for life activity of an organism, breath, participates in thermal exchange. State the air environment influences health of the person, it mood, working capacity and health. Medicine widely uses air environment as preventive and medical factrum (hardening, climatotherapy). Influence of air on an organism can to be not only positive, but also negative. Change structure and physical properties of air can bring to to various

diseases as as a result of direct hook N mediated influences through clothes, the soil, the dwelling.

At hygienic assessment of air it is necessary learnto tyvat it physical properties (temperature, humidity, speed of the movement barometric pressure, tension of solar radiation radioactivity, electric state), and also chemical structure, mechanical impurity (dust, smokes), microorganisms. Physical propertiesand atmospheric inzdukha are connected about climateandchesky features region. In residential and public buildings physical properties of air are stabler since in them it is supported microclimate due to ventilation and heating. At the industrial enterprises on properties of air Wednesdays technological influences process. In certain cases physical properties of air gain independent value of the harmful professional factor connected with heat sources.

Hygienic value of air temperature

The person is affected by fluctuations of air temperature in various climatic areas, at change of weather conditions, at disturbance of temperature condition in rooms. Influence of adverse air temperature on an organism takes place on production, during the work in the open air.

Air temperature exerts impact on thermal exchange of an organism. Thermoregulatory mechanisms function under control of the central nervous system that allows the person to adapt to various temperature conditions. Heat exchange of an organism is supported by an equilibration of processes of chemical and physical thermal control. Chemical thermal control - heat generation - occurs owing to oxidizing processes. Physical thermal control - heat exchange, return it is warm. Distinguish the next ways of return of heat to surrounding space:

1. *Radiation* it is warm a body of the person (in relation to surrounding surfaces with lower temperature) - radiation thermolysis.
2. *Convection* - return is warm from a body surface of the person (to less heated layers of air inflowing to it.
3. *Carrying out* - return is warm to the objects which are directly adjoining to a body surface.

4. Evaporation waters from the surface of skin and mucous membranes.

At rest and thermal comfort heatlosses convection make 15,3%; radiation — 55,6%; evaporation — 29,1%.

If air temperature and people around surfaces shock temperatures of a surface of skin, the organism gives heat radiation and convection. When air temperature and surrounding surfaces same, as well as temperature of skin or above it, a thermolysis is carried out by evaporation. Increase in air humidity at the same time limits heatlosses evaporation. Low temperature in combination with the increased humidity promote increase heatlosses organism thermal radiation.

Limits of thermal control are not boundless. Long stay in strongly heated atmosphere causes fervescence, acceleration of pulse, disturbance activity cardiovascular systems, decrease functional activity of digestive tract. High tempershura air negatively influences functional state central nervous system. It is shown easing attention, disturbance of accuracy and coordination movements, delay of reactions. Are observed bystry fatigue, decrease in physical and intellectual working capacity.

Long influence of high temperature, especially and combination from raised humidity, conducts to considerable to accumulation of heat in an organism and development *overripening.* Considerably accelerate overheating of an organism physical activity, vapor-tight clothes and other factors. When overheating body temperature rises to 38-39°C. Clinic: a headache, dizziness, the general weakness, distortion of color perception of objects, morbidity of muscles, dryness in a mouth, nausea, vomiting, hyperemia of the person, plentiful sweating, increase of pulse and breath. The organism loses a significant amount of water in the form of urine and sweat. Loss more than 10% of water leads to the symptoms (a desert disease) menacing for life. Under especially unfavorable conditions (a combination of high temperature to high humidity and motionless air) can arise *heatstroke.* The heatstroke is characterized with the body temperature of 40-41°C and serious general condition of an organism. At the same time are noted pallor, cyanosis, expansion of pupils, frequent shallow breathing, spasms, tachycardia, falling of

arterial pressure (thermal collapse), loss of consciousness. In hard cases psychological frustration are observed. The heatstroke can arise in hot workshops, and also during the work in the open air in a hot humid climate.

Low air temperature increases a thermolysis, creating danger *overcoolings* organism, especially in combination with the increased humidity. Overcooling occurs at strong wind, especially quicker if the person is in the light, close or got wet clothes. Resistance of an organism to cooling decreases at physical exhaustion, starvation, alcoholic intoxication, injuries and diseases. At action of cold there can be perfigeration, an adynamia, drowsiness, weakening of muscle performance, sharp decrease in reaction to pain stimulations (narcotic action of cold). Cold is an origin of diseases of a respiratory organs, rheumatism, miozit, neuritis, radiculitis. Chronic cooling reduces body resistance to infectious diseases.

In conditions of production has place *radiation cooling*, followed by considerable fall of temperature of skin and mucous covers of respiratory tracts. The changes in an organism happening at the same time more resistant, than at convection, recovery period longer. Can be result of contact overcooling *freezing injury.* Long local influence of low temperature in combination with the increased humidity causes development of a vegetative polyneuritis, cold neurovasculitis. Functional neurovascular frustration are noted (a syndrome Reynaud).

The person are especially unhealthy bystry in sharp fluctuations of air temperature, since organism is not in time to adapt with it. Fluctuations of temperature are dangerous for persons with heart diseases, sclerosis vessels, diseases of kidneys. In purposes *prevention* are necessary: strengthening those regulating device by an organism hardening, balanced diet, optimization modes pile and rest, choice corresponding clothes.

Action on body radiant heat.

In processes of heat exchange of an organism with external environment great value has radiant (radiation) heat exchange Radiant heat and warmly air masses (convection heat) cause the same caumesthesia, but mechanisms of their impact on an organism are various. Convection heat influences a body surface of the person,

radiant - deeply getting. Changes in an organism under the influence of infrared radiation depend on its intensity, spectral structure, the area the irradiated surface and other factors.

Short infrared beams (to 1,4 microns) possess more expressed systemic effect at the expense of bigger penetration depth in fabric (to several centimeters), are capable to get through bones of a skull and to influence a meninx, brain fabric. *Heliosis* results from intensive direct radiation of the head the infrared radiation of short-wave range (1-1,4 microns). At the same time there can be severe defeats up to the expressed meningitis and encephalitis. Clinic: general weakness, headache, dizziness, sonitus, concern, visual disturbance, nausea, vomiting. In hard cases - stupefaction, sharp excitement, spasms, hallucinations, nonsense, a loss of consciousness. Body temperature, unlike heatstroke, normal or is slightly increased. *Long* infrared beams (1,4-10 microns) cause local reaction, are absorbed by an upper layer of skin (2 mm). Beams with the wavelength of 6-10 microns are especially strongly absorbed, causing "the heating effect".

At action of infrared radiation morbid conditions at individuals in connection with professional activity can develop: heliosis, injuries of skin (erythema, burn, pigmentation), injuries of eyes (cataract, conjunctivitis).

Hygienic value of air humidity

Air humidity is of great importance since influences heat exchange of an organism with the environment. Distinguish 6 types humidity.

1. *Absolute humidity* - elasticity nodyaiy Maron, airborne at present (mm. rt. st the Art.), or amount of water vapor in grams in 1 m^3 air (g/m^3).
2. *The maximum humidity* - elasticity of water vapor in mm.rt.st. at full saturation of air moisture at this temperature, or amount of water vapor in grams, necessary for full saturation of 1 m^3 air at the same temperature.
3. *Relative humidity* - relation of an absolute humidity to maximum, expressed as a percentage, or air saturation percent by water vapor at the time of observation.
4. *Deficit of saturation* - difference between the maximum and absolute

humidity. The more deficit of saturation, the more moisture can absorb air.

5. *Physiological deficit of humidity* arithmetic difference between the maximum air humidity at 37° (body temperature) and an absolute humidity of air at the time of observation. This size specifies how many grams of water each cubic meter of expired air can take from an organism.
6. *Dew point* - temperature at which the airborne water vapor sates space (the size of an absolute humidity is equal maximum).

Relative humidity and deficit of saturation have the greatest hygienic value. The less relative humidity, the more deficit of humidity, the quicker will be a thermolysis by evaporation. High temperature is transferred easier if air dry. Crude air (both cold, and warm) is harmful to an organism. At a combination of high temperature of air and high relative humidity (more than 90%) evaporation of sweat does not happen, there occurs overheating of an organism. At high temperature of air low and moderate relative humidity (to 70%) promotes evaporation, overheating does not arise. At a low temperature low relative humidity promotes reduction of return of heat an organism. Adverse influence of low relative humidity is shown only at saturation rate less than 20%. Excessively dry air dries up mucous membranes, on them cracks which are easily infected are formed. At the same time high mobility of air causes overheating, worsens health, reduces working capacity. The combination of high humidity to low air temperature causes bystry overcooling of an organism since wet air is a good conductor of heat. Long influence of wet air and crude clothes - in combination to low temperature promotes strong cooling and development of freezing injuries even at the above-zero temperature of air.

Fight against high humidity indoors consists in respect for hygienic norms of a cubic capacity of air on one person, use of rational ventilation, isolation of walls from ground waters.

Hygienic value of speed of the movement of air

Speed of the movement of air exerts a great influence on thermal exchange of an organism, on breath processes, power expenditure, the psychological sphere. The movement of air changes influence of temperature and humidity on a heat balance of

an organism. Wind reflex strengthens processes of a metabolism. The movement of air increases heatlosses due to convection and evaporation, however at high temperature and high humidity does not give the cooling effect. In hot time wind favorably influences an organism, especially when performing physical activity. In the winter wind causes overcooling and increases danger of freezing injuries. Moroz is had to a calm weather easier, than at strong wind. Wind more than 20 m /with breaks the respiratory rhythm, interferes with performance of physical activity and movement. Strong long wind sharply oppresses the person. Irritant action of wind is shown at a speed more than 6-7 m/s. Optimum speed of the movement of air in summertime of-1 - 5 m /with.

Resistance of an organism to cold air flows can be increased by a hardening, wearing light clothes.

Hygienic value of barometric pressure

Depending on changes of atmospheric pressure! force in direction of wind, frequency and quantity of an atmospheric precipitation, fluctuations of temperature. Through weather and climate barometric pressure influences health.

On the Earth's surface of fluctuation of atmospheric pressure are connected with weather conditions, do not exceed 4-10 mm.rt.st. The persons suffering considerably react to fluctuations of atmospheric pressure especially rhematoid arthritis, with the increased nervous irritability (sensation of fear, deterioration in a dream, mood can be observed). Connect emergence of attacks of stenocardia with decrease in atmospheric pressure.

Lowered atmospheric pressure leads to development *hypobaropathy.* The hypobaropathy arises at bystry rise on height (pilots, climbers) as a result of decrease in partial pressure of oxygen in the inhaled air. The first symptoms of oxygen insufficiency are shown at rise on height of 3000 m. In the mountainous areas located at the height of 2500-3000 above sea level above, considerable reduction of barometric pressure is observed that is an origin *mountain disease.* It is expressed in emergence of an asthma, heartbeat, dizziness, nausea, nasal bleedings, pallor of integuments. Changes of higher nervous activity and sense bodys can be observed.

Raised atmospheric pressure meets in caissons, during the work in mines, construction of underwater tunnels, the subway. At non-compliance with necessary preventive actions there are sharp physiological shifts in an organism. At decrease in surrounding pressure (during raising of the diver from depth on a surface, at the worker's exit from a caisson) the gas dynamic equilibrium is broken, fabrics and liquids of an organism become the satiated gases, and first of all nitrogen. There is a process desaturations. At a slow decompression process of removal of excess nitrogen of fabrics proceeds without formation of gas bubbles. At a bystry decompression the content of gases in fabrics reaches critical levels, there is a danger of a gas embolism. The gas embolism leads to serious occupational disease - *caisson disease.* The central and peripheral nervous system, hypodermic fatty tissue, marrow, joints are surprised. Manifestations of a caisson disease: acute joint pains, in muscles of extremities, stomach, monoppegiya, paraplegia, hemorrhage. Hit embolus in coronary vessels of heart can be a cause of death. For prevention of a caisson disease use technical, sanitary and hygienic and medical actions.

The increased atmospheric pressure can make impact on health workers in pressures chamber operating rooms when using hyperbaric oxygenation. Now hygienic requirements to the mode and working conditions in such operating rooms, rules of a decompression are developed, there is a list of contraindications for medical staff to work in pressures chamber - operating rooms.

Complex action of the air environment on an organism

Physical factors of the air environment influence a human body in a complex that is considered at hygienic assessment of their influence on health.

Microclimate - the complex of physical factors of the environment in limited space exerting impact on thermal exchange of an organism. The microclimate is defined by the key physical parameters: temperature, speed of the movement and air humidity, temperature of surrounding surfaces and radiant energy. Atmospheric pressure has essential value only in special conditions of activity of the person (aircraft, lacunar works, works in mountains).

Hygienic value of indicators of a microclimate consists in their influence on

thermal balance of an organism. Thermal radiation of the person under the influence of a microclimate is physiological reaction. The thermal condition of the person changes over a wide range depending on food, clothes, the performed work.

Complex influence of physical properties of the air environment is most expressed in a microclimate of the enclosed space. The microclimate of rooms is artificial, the person can actively influence his parameters. *Microclimate of residential, public buildings* is defined by their purpose, a design, properties of construction materials, a glazing of rooms, the heating device, ventilation, climatic conditions of this area. *Production microclimate* (appendix 1) is defined by technological process", number working, nature of ventilation, heating type. In hot and cold workshops the special microclimate which makes harmful effects on heat exchange forms, worsens health of working. *Microclimate of the open areas* — natural is also defined by climate of the area. At small deviations of physical factors of the air environment from a comfort zone the health of healthy people does not change, patients often have meteotropny reactions. People, suffering are especially sensitive to change of meteorological factors cardiovascular, nervouslymental and catarrhal diseases.

Sanitary standards of a microclimate divide on *optimum* (zone of thermal comfort) and *admissible.* The optimum rules are respected in hospitals, child care facilities. There is a number of industries in which not only on hygienic, but also on optimum are necessary for production requirements conditions microclimate (instrument making, radio engineering, electronic equipment). Admissible norms of a microclimate provide efficiency of the person at some tension of system of thermal control. Sanitary standards of a microclimate for objects of different function are developed for the cold and warm periods of year, on climatic zones.

Great value has managed (adjustable) microclimate. Such microclimate is carried out at help of special sanitary and thosenichesky installations (air conditioning, various cooling systems and heating). Perhaps creation *dynamic* microclimate for removal of exhaustion at monotonous work or for humiliation of temperature in night time in sleeping rooms.

For creation *comfortable conditions* are recommended following parameters of a microclimate of rooms:

Average air temperature 18-20° (for children 20-22°), in chambers for premature children - 25°, in dressing rooms and rooms for medical procedures - 22°, operating rooms - 21°, patrimonial - 25°. Temperature drops of air in the horizontal direction from outside to an internal wall should not exceed, down - 2,5° on 1 m During the day fluctuations of air temperature indoors at central heating should not exceed 3°.

The size of relative humidity of air at the specified temperatures: 40-60% (winter of 30-50%).

Speed of the movement of air in rooms has to be 0,2 - 0,4 m/s, at the exit from stitched openings of ventilating channels of hospital chambers - no more than 1 m/s, in bathing, shower, physiotherapeutic offices - 0,7 m /with.

Determination of atmospheric pressure The size of atmospheric pressure is determined by mercury and metal barometers. *Aneroid barometer* represents a corrugated metal box from which air is extorted. At increase in atmospheric pressure of a wall aneroid boxes cave in inside, at reduction become straight. G these fluctuations are transferred by the help of a spring and system of rychazhok to the arrow moving on the dial. The scale of a barometer is graduated in millimeters of mercury or pascals.

Barograf use for continuous observation of fluctuations of atmospheric pressure. The device consists of a row connected with each other aneroid boxes. At change of pressure of a cover of these boxes move that is transferred on system of rychazhok to an arrow with a feather. The arrow notes corresponding pressure (in mm. rt.st.) on the chart tape tense and fixed on the rotating drum of the clockwork. The drum is rotated with a speed of one complete revolution a week. On a tape it turns out record in the form of a curve with the indication of days and hours.

The size of pressure is expressed in mm.rt.st. or in hectopascals - gpa. Usual fluctuations of atmospheric pressure make 760±20 mm.rt.st. or 1013±26,5 gp (1 gp = 0,7501 mm.rt.st.).

Determination of air temperature

Average air temperature is taken indoors in the following points: down at the level of 0,2; 1,0; 1,5 m from a floor; across - in the center of the room and at distance of 0,2 m from an outside and internal wall, in three points on diagonal. After calculation of average air temperature, a difference of temperatures on a vertical and a horizontal of the room corresponding is given assessment.

Average daily temperature air is defined from series of observations (3-4 times a day at regular intervals).

Air temperature is taken indoors *mercury* and *spirit* thermometers. Are most widespread mercury since have the bigger accuracy and width of range: from - 35° to +370°C. Alcohol has a low boiling point (78,3°). By means of spirit thermometers it is possible to take very low temperatures (to -130°). Thermometers are graduated in degrees Celsius, Reaumur, Fahrenheit.

1°C=4/5°P or 9/5°F

1°P=5/4°C or 9/4°F

1°F =5/9°C or 4/9°P.

The Reaumur scale practically went out of use now.

Maximum thermometer - mercury. Keeps the indication of the most high temperature taking place for a certain period of observation.

The minimum thermometer - spirtovy.

Electrothermometers apply to measurement of temperature walls.

Thermograph - the self-recording device for establishment of limits of fluctuations of temperature in the currentand working day, days, week, months.

Air humidity definition

Air humidity is defined by psychrometers and hygrometers. According to indications of psychrometers calculate absolute and relative humidity. Hygrometers show directly relative humidity. Principle psikhrometriya it is concluded in definition of indications of two thermometers, the ball of one of which is moistened.

Calculation of an absolute humidity is made on a formula:

$$K=f- 0,5(t_1 – t_2) * B/755,$$

where *To* - required absolute humidity, g/m^3;

f - maximum tension of water vapor at a temperature of the wet thermometer, mm.rt.st. (is determined by the table);

0,5 - constant psikhrometrichesky coefficient;

t_1 - temperature of the dry thermometer, °C;

t_2 - temperature of the wet thermometer, °C;

In - barometric pressure at the time of definition, mm.rt.st.;

755 - average barometric pressure, mm.rt.st.

Transfer of an absolute humidity in relative it is made on a formula:

R=K/F 100,*

where *R* — required relative humidity, %;

K - absolute humidity, g/m^3;

F - maximum humidity at a temperature dry the thermometer (is determined by the table).

Relative humidity can be determined by the special table in which evidences of dry and wet thermometers are given (appendix 2).

Hygrometer hair it is intended for direct definitions of relative humidity.

Gigrograf it is intended for registration of continuous changes of relative humidity. Use daily, week gigrograf.

Determination of speed of the movement of air

For determination of big speeds of the movement of air (to 50 m/s) use *devices anemometers,* for measurement of small speeds the movements of air in rooms (from 0,1 to 2 m/s) apply *katatermometra.*

Cup anemometer it is used for determination of speed of the movement of air from 1 to 50 m/s, *vane*- 0,5-15 m /with.

Electroanemometer allows to determine the speed of the movement of air from 0,03 to 5 m/s and its temperature ranging from 10 to 60°C.

Complex assessment of a microclimate

1. Katatermometriya. Katatermometr directly determines the speed of cooling of the device depending on temperature, humidity, the speed of the movement of air. Therefore it allows to consider total influence of these important meteorological factors in their various combinations between . At it change of any one factor can change the size of return of heat. Increase in air humidity at a low temperature will promote cooling of the device, at high temperature - to complicate a thermolysis. Increase in speed of the movement of air increases return of heat. Toatatermometriya as the method of complex assessment of weather conditions is applied seldom.

2. Determination of effective temperatures also allows to establish indirectly total impact on an organism of temperature, humidity and the movement of air. Assessment of weather conditions is made on the basis of comparison of certain combinations of temperatures, humidity and the movement of air to subjective thermal feelings of the person. *Equivalent and effective temperature* (EET) - the conditional temperature showing effect heatfeelings, depending on simultaneous impact on an organism of temperature, humidity and the movement of air in their certain combinations. *Effective temperature* (ET) — the characteristic of the weather conditions having the same thermal effect, as motionless air at 100% of humidity and a certain temperature.

Norms effective temperatures. All effective temperatures, at which 50% of the studied persons feel well, belong to *to comfort zone.* In its limits it is established *line lumpfort,* at which 100% the studied persons feel comfort. For usually dressed the people who are in rest or carrying out easy work, the zone of comfort lies within 17,2-21,7 ° effective temperatures; the line of comfort - 18,1-18,9 °.

Definition of ET it is made by means of special tables (on to sizes of temperature, humidity and speed of the movement air in observation moment). There is a simplified method definitions of ET according to special nomograms (with accounting of temperature dry and wet thermometers and speed of the movement of air).

Voltage measurement of a radiant energy

The actinometry is carried out by means of the devicein - actinohmmeters, which show radiation tension in small calories, received within a minute on 1 cm^2 surfaces, racesput perpendicularly to a source of beams.

Independent work of students:

1. To measure indicators microclimate in educational audience.
2. To issue the received results in the form of the protocol.
3. To draw the conclusion about character of the studied microclimate and at unsatisfactory assessment to offer the corresponding recommendations about its improvement.
4. To solve situational problems of this subject (a sample of a situational task cm. in the appendix 3).

Protocol of measurements of weather conditions

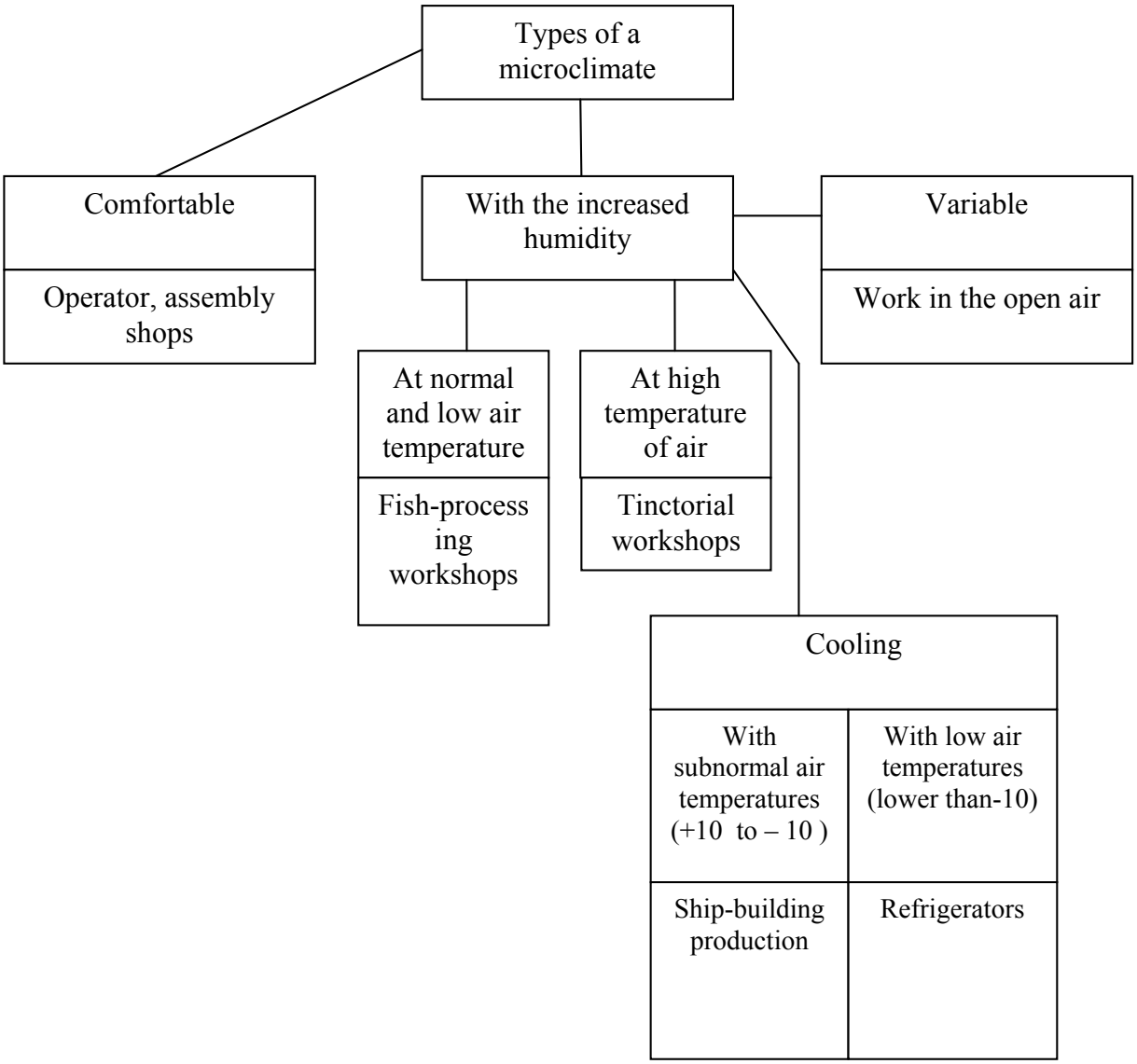
1. Date...; the place of measurements - educational audience.
2. Barometric pressure.
3. Air temperature on the dry and wet thermometer. .
4. Absolute humidity.
5. Maximum humidity.
6. Relative humidity.
7. Deficit of humidity; physiological deficit of saturation.
8. Dew point.
9. Cooling-off period of a dry katatermometr in seconds.
10. Factor of a katatermometr.
11. Cooling size on a katatermometra.
12. Speed of the movement of air on a katatermometr.
13. Conclusion (recommendations).

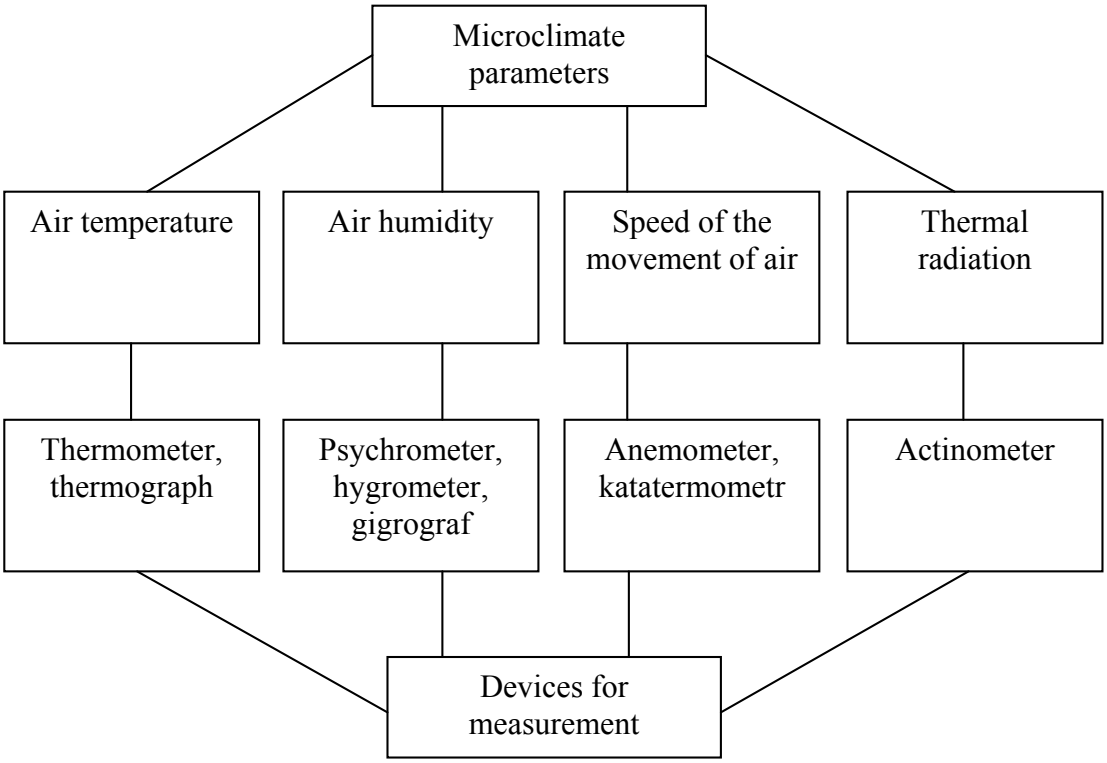
CONTROL QUESTIONS

1. What hygienic value of separate layers of the atmosphere?
2. Chemical composition of atmospheric air, its hygienic value.
3. What is a microclimate? To give the characteristic to different types of a microclimate.
4. Heat exchange of an organism with external environment, thermoregulation mechanisms.
5. What physiological value fluctuations of temperature have air and what measures can be taken for increase in body resistance to these phenomena?
6. What hygienic value of air humidity consists in? What measures are taken for fight against high humidity in rooms?
7. List types of air humidity and characterize ways of their measurement.
8. What impact is exerted on an organism of fluctuation of barometric pressure?
9. What devices measure barometric pressure and in what units?
10. What hygienic value has the movement of air?
11. What is a wind rose as it is built and what its practical value?
12. By what devices determine the speed of the movement air in the open atmosphere and in rooms?
13. Radiant heat, its hygienic value, ways of measurement.
14. What differences of a heliosis from thermal?
15. What the essence of total impact on a human body of various meteorological factors consists in?
16. Why there are meteotropny reactions?
17. What to you andzvestna methods of complex assessment of a microclimate?

Appendix 1

Production microclimate




Microclimate parameters
Air temperature
Air humidity
Speed of the movement of air
Thermal radiation
Thermometer, thermograph
Psychrometer, hygrometer, gigrograf
Anemometer, katatermometr
Actinometer
Devices for measurement