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MEDICINE

FREQUENCY OF SPREAD OF BRONCHIAL ASTHMA AMONG MIDDLE-AGED PEOPLE AND EFFECTIVENESS OF TREATMENT. Almaty, City Clinical Hospital No. 1

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bronchial asthma, risk factors, triggers, tartrazine, treatment.

ABSTRACT

Bronchial asthma (BA) is a global problem. The incidence of bronchial asthma is growing all over the world. It is among the top ten non-communicable chronic diseases, which are the main cause of death among people, reducing life expectancy by 6.6 years for men and 13.5 years for women.

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Purpose of presentation of clinical observation. The aim of the study is to identify the effectiveness of treatment of bronchial asthma among middle-aged people by taking into account the etiological features, risk factors, frequency of its spread and severity.

Actuality. Among the diseases of the respiratory system, bronchial asthma occupies a leading place. Worldwide, 339 million people suffer from bronchial asthma. This figure may increase by 400 million by 2025. According to WHO, 15 million people lose their ability to work with asthma every year. The worldwide damage caused by this disease is 1%. According to experts, 250 thousand people die from asthma every year in the world. More than 2 million people with bronchial asthma need treatment in the intensive care unit; over the past 5 years, the number of patients with bronchial asthma in Kazakhstan has increased by 18.6%. In 2018, 105,365 cases of bronchial asthma were registered in Kazakhstan. Of these, 80% were middle-aged patients.

Methods and research materials. A study was conducted among patients with bronchial asthma. The study involved 20 patients from the pulmonology and Allergology departments of the City Clinical Hospital No. 1.

Results. according to the study method, the oldest of the patients was 74 years old, the youngest was 20 years old, and the average age was 55 years. According to the average age of patients, 55% of the results were obtained by the Department of Allergology and 45% by the Department of Pulmonology. By nationality, 5% of patients were of Russian nationality, and 95% were of Kazakh nationality. According to the address, the incidence of bronchial disease was 70% in Almaty, 25% in Almaty region, and 5% in other regions. According to the percentage report, it was found that patients living in Almaty have a higher incidence of bronchial asthma. It can be noted that patients suffering from bronchial asthma living in Almaty are more likely to be found in men (57%) than in women (43%) in terms of gender characteristics.

In the specialty mastered by patients, it is possible to determine that among builders there was a high frequency of occurrence of bronchial asthma. They were 15%, the second place was occupied by agronomists, medical workers and students (10%), the smallest percentage were patients in the following specialties: welder, blacksmith, poultry farmer, electrician, educator, correspondent, accountant, driver, cook, economist, security guard (5%). In terms of the duration of the disease, the maximum was 38 years, and the minimum was 3 years. According to the types of bronchial asthma, 50% of patients develop allergic type, 15% non-allergic type and 35% of mixed types of bronchial asthma.

Etiological factors: drug allergy was 36%, seasonal allergy was 36%, food allergy was 7%, mixed (drug, seasonal, food) was 21%. According to the degree of control: controlled - 55%, average controlled-35%, uncontrolled-10%. According to the severity of the disease, intermediate BA was found with a frequency of 20%, mild persistent 30%, moderate persistent 40%, severe persistent 10%. As a result of a study of 20 patients, the drugs used in the treatment of the disease were as follows: the most commonly prescribed "Berodual" 70%, "Salbutamol" 35%, "Seretide" 30%, "Pulmicort" 25%, "Symbicort" 25%, GCS 15%, "Bentalin" 10%.

Hence the conclusion: the type of allergic asthma is higher in frequency among bronchial asthma. This type of allergic asthma can be caused by a variety of etiologies. The main research area of the work is the role of additives in the composition of medicines in the bronchial mucosa.

Results. we conducted a prospective study of 20 patients with bronchial asthma in the Departments of Allergology and pulmonology of CCH No. 1 from 15.02 to 26.02.2019.

Research progress:

- average age of the studied patients: - 55 years
- gender: 60% male, 40% female.
- 70% of patients are residents of Almaty, 25% are residents of Almaty region, and 5% are residents of other regions.
- among the population of Almaty, 57% are men and 43% are women.
- 55% of patients with bronchial asthma are treated in the Allergology Department.
- the average duration of morbidity of patients is 11 years, Max - 38 years, min - 3 years.
- 50% of patients with bronchial asthma also have an allergic form of bronchial asthma. Of these, 36% are medicinal(drug), 36% are seasonal, 21% are mixed (medicines, food, seasonal dust), and 7% are food allergies.
- by degree of control: controlled - 55%, average controlled - 35%, uncontrolled - 10%
- by severity of BA: intermediate - 20%, light persistency - 30%. average persistency - 40%, heavy persistently- 10%.
- medications taken: Salbutamol - 35%, Pulmicort-25%, Seretide - 30%, Symbicort25%, Ventalin - 10%, GCS - 15%, Berodual - 70%.

Conclusions. 1) as a research paper, nonsteroidal anti-inflammatory drugs and tartrazine, which is used as a synthetic coloring agent in the composition of many drugs, were taken into account as one of the leading factors in the development of allergic asthma.

Tartrazine is a yellow lemon colored synthetic dye, food additive E102. It has the property of inhibiting TSOG-1, but only in small quantities. Aspirin is detected only in patients with a high degree of sensitivity to the development of bronchial asthma. However, this property of tartrazine is that it is recommended to limit foods containing yellow products and salicylates from the diet of all patients.

2) While prescribing hypoallergenic dietary therapy, you should pay attention to the following foods. Very high content of salicylates in the composition: apricots, pineapples, oranges, tangerines, grapes, plums, dried fruits, berries; canned olives, peppers, canned tomato paste and mushrooms; nuts, food spices, Cacos and olive oils, fruit juices, aromatic teas, wines, beer.

Foods that contain high amounts of salicylates: watermelon, melon, grapefruit, kiwi, peach, apple; zucchini, broccoli, cucumbers, blueberries, spinach, nuts, spices (vanilla, cinnamon, bay leaf), coffee.

Foods that contain moderate amounts of salicylates include: pomegranate, pear, lemon, dates, mushrooms, potatoes, beans, carrots, beets, pumpkins; walnuts, Cacos, pumpkin seeds; Cucurbita oil.

Foods that contain low and very low amounts of salicylates: bananas, limes, yellow apples, ripe pears, beans, green beans, onions, cauliflower, celery, kale varieties of potatoes; sunflower seeds, hazelnuts; sugar, salt, garlic, sunflower oil, butter, water, cocoa, milk, decaffeinated coffee, pear juice. Taking into account the above foods, patients are prescribed a diet.

Prescribing medications: care should be taken with drugs containing tartrazine (yellow dye), such as No-shpa, Tavegil.

3) In an allergic form of bronchial asthma, Berodual is considered an inhaler whose effectiveness is higher than that of other drugs.

4) In case of, when aspirin and nonsteroidal anti-inflammatory drugs should not be abandoned, then method of desensitization is carried out. Desensitization is a reducing sensitivity to a drug that is important for the patient to take. The method is based on the pathogenetic mechanism of the disease, i.e. repeated administration of nonsteroidal anti-inflammatory substances 24-72 hours after an attack that occurs after primary administration of nonsteroidal anti-inflammatory substances. Stevenson shows that this method improves the control of the symptoms of rhinosinusitis and bronchial asthma. The therapy scheme is selected individually. It starts with 5-10 mg of aspirin, reaches a dose of 650 mg or more, and then for a long time aspirin is administered in a supportive dose. It is 325-650 mg per day. BA is performed at the suppression stage.

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BIOLOGY

COMPARATIVE ANALYSIS OF PERENNIAL WOOD OF SOME SPECIES OF PLANTS

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perennial wood, vessels, tracheids, libriform fibers, radial and traction parenchyma, xerophytic, mesophytic plants.

ABSTRACT

The article presents data from the study of perennial wood of woody-shrub plants in the mountainous regions of the southwestern Tien Shan of Central Asia. It was found that, despite the common opinion about the aridity of the region's climate, among the studied species, there are a variety of adaptive characteristics of the studied organ.

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Introduction. One of the topical issues in the study of the flora of any region is the establishment of signs of adaptation of species to habitat conditions. To address these issues, the study of the structural features of various plant organs plays an important role, since these organs, especially perennial stems, retain the structural features formed during the evolution of the species [13; 20]. Lots of work have been devoted to these problems and, different authors studied the question from different positions. So, for example, A.A. Yatsenko-Khmelevsky, M.S. Gzyryan [20] identified 10 structural types of mature wood and according to it, the evolutionary position of the studied taxa was assessed. M.I. Kolosova [6], using the indicated types in the structure of wood, writes that evolutionarily advanced 1X-X types are characteristic of woody plants of Central Asia, which raises certain doubts. In her opinion, in the arid places of Central Asia, primitive V-VII types are found only in tugai. Z.A. Novruzova [9, 10], who studied the influence of environmental conditions on the structure of wood, believed that homogeneous rays are characteristic of such xerophytic plants as Amygdalus L., Lycium L. At that time, according to her, xerophytoid species (representatives of the genera Cotoneaster Medik., Pyrus L., Hippophae L., Malus Mill., Mespilus L., Rhamnus L., etc.) are characterized mainly by square-homogeneous ones, while mesophytes (Acer L., Lonicera L., Juglans L., Euonymus L., etc.) - heterogeneous rays. The wood of species of the genus Lonicera is characterized by many signs of primitiveness: scattered vessels, fibrous tracheids, narrow segments of vessels with oblique transverse walls [11].

Another large group of work is devoted to individual plant organs, which aims at elucidating the adaptation of individual taxonomic groups of plants to various environmental factors, issues of species evolution [13, 14; 19; 22; 23]. However, special work devoted to the study of the wood of plants of Central Asia, with the exception of A. Tazhibaev [12], has not been carried out.

Materials and methods. The objects of study were perennial wood of the following species. Family - Caprifoliaceae Juss. Genus Abelia R. 1. A. corymbosa Rgl. et Schmalh. - large shrub, endemic to Central Asia. Genus: Lonicera L. 2. L. microphylla Willd. ex Roem. et Schult. - shrub,

3. L. simulatrix A. Pojark. (synonym L. microphylla auct. fl. pro parte. non Willd.) - shrub, 4. L. karelinii Bge. ex P. Kir (syn. L. heterophylla Decne.). large shrub, 5. L. hispida Pall. ex Roem. et Schult. - small shrub, 6. L. bracteolaris Boiss. et Buhse –shrub, 7. L. stenantha A. Pojark. (syn. L. coerulea auct. fl. As Med.) - shrub, 8. L. corolkovii Stapf –large shrub, 9. L. paradoxa A. Pojark. - shrub, endemic to Central Asia, listed in the "Red Book of the Kyrgyz Republic", 10. L. nummulariifolia Jaub. et Spach. (syn. L. arborea auct. fl.As. Med) is a large shrub.

II. Family Rosaceae Juss. 1. Subfamily. Spiraeoideae Agardh.: Genus: Exochorda Lindl. 11. E.tianschanica Gontsch. - shrub, endemic to Central Asia. Genus: Spiraea L. 12. *S. hypericifolia* L., 13. *S. lasiocarpa* Kar. et Kir. - small shrub, 14. S.pilosa Franch.-small shrub, endemic to Central Asia. 2. Subfamily. Pomoideae Focke.: Genus: Sorbus L. 15. S.tianschanica Rupr. (syn. Pyrus tianschanica Franchet.) - large multilateral shrub, 16. S. persica Hedl. is a large small-stemmed tree-like shrub, listed in the “Red Book of the Kyrgyz Republic”. 17. S. turkestanica (Franch.) Hedl. (syn. Pyrus turkestanica Franchet.) - a large, small-stemmed tree-like shrub, listed in the "Red Book of the Kyrgyz Republic". Genus: Crataegus L. 18. C.pontica C. Koch. (syn. C.azarolus Fedtsch.) - a small tree, 19. C.turkestanica Pojark. (syn. C. monogyna Fedtsch.) - tree, 20. C. altaica Lge. - tree, or tree-like shrub, 21. C. songorica C. Koch. (syn. C. fisheri C.K.Schneid.) - tree, 22. C.tianschanica A. Pojark.- tree. Genus: Cotoneaster Medik. 23. C.oligantha A. Pojark. - shrub, 24. C. melanocarpa Lodd. (syn. C.vulgaris Ldb., C.integerrima var. melanocarpa Kryl.) - shrub, 25. C. multiflora Bge. - shrub, 26. C.insignis Pojark. - shrub. Genus: Malus Mill. 27. M. kirghisorum Al. et An. Theod. - tree, 28. M.niedzwetzkyana Dieck.- tree, listed in the Red Book of the Kyrgyz Republic. Genus: Pyrus L. 29. P. korshinskyi Litw. - tree, 30. P. regelii Rehd. (Syn. P. heterophylla Rgl. Et Schmalh.) - a small tree. 3. Subfamily. Prunoideae Focke.: Genus: Amygdalus L. 31. A.communis L. - large shrub or small tree, 32. A. petunnicovii Litw. (syn. Prunus petunnicovii Rehder.) - a small shrub, listed in the «Red Book of the Kyrgyz Republic». Genus: Armeniaca Mill. 33. A. vulgaris Lam. - tree. Genus: Prunus Mill. 34. P.sogdiana Vass. - a large shrub, or small tree. 35. P. ferganica Lincz. (syn. P. silvestris M. Pop.). Genus: Cerasus Juss. 36. C.alaica A. Pojark. (syn. Prunus prostrate auct.fl. As. Med.p.p) - cushion shrub, 37. C.erythrocarpa Nevski (syn. Prunus prostrate auct.fl. As. Med. p.p) - small shrub, 38. C verrucosa (Franch.) Nevski (syn. Prunus verrucosa Franch., Prunus verrucosa auct.fl. As. Med. p.p) - cushion shrub. 39. C.mahaleb (L.) Mill. (syn. Prunus mahaleb L., Padus mahaleb L. Mill.) - small tree, 40. C.tianschanica A. Pojark. (syn. Prunus prostrate auct.fl. As. Med.p.p) - shrub, Genus: Padus Mill. 41. P. racemosa (Lam.) Gilib. (Syn. Padus avium Mill.) - tree, or tree-like shrub. Genus: Aflatunia Vass. 42. A.ulmifolia (Franch.) Vass. (syn. Amygdalus ulmifolia (Franch.) M. Pop., Prunus ulmifolia Franch.) - shrub.

III. Family Elaeagnaceae Juss. Genus: Elaeagnus L.43. E. angustifolia L. - tree, 44. E. orientalis L. - tree, cultivated. Genus: Hippophae L. 45. H. rhamnoides L. - shrub.

IV. Family - Berberidaceae Juss. Genus: Berberis L. 46. B. oblonga (Rg.) Schneid. (Syn. B. integgerima Bunge) - shrub.

V. Family - Grossulaceae Juss. Genus: Ribes L. 47. R. meyeri Maxim. - shrub. 48. R.heterotrichum C.A.M. - shrub.

VI. Family - Anacardiaceae Lindl. Genus: Pistacia L. 49. P. vera L.-small-stemmed shrub.

VII. Family - Tamaricaceae Lindl. Genus: Tamarix L. 50. T. leptostachys Bge. (syn. T.ramosissima Bong.et Mey., T.gallica var.micrantha Ldb.) - shrub, 51. T. hispida Willd.-shrub. Genus: Myricaria Desv. 52. M.elegans Royle - shrub. 53. M. alopecuroides Schrenk. (syn. M. germanica C.A.M.) - shrub.

VIII. Family - Ulmaceae Mirbel. Genus: Celtis L. 54. C. caucasica Willd. - a small tree.

IX. Family Celastraceae Lindl. Genus: Euonymus L. 55. E. semenovii Rgl. et Herd. is a shrub.

X. Family Aceraceae Juss. Genus Acer L. 56. A. semenovii Rgl. et Herd. (syn. A. tataricum var.semenovii Rgl.) - tree, or large shrub, 57. A. turkestanicum Pax. - tree.

X1. Family - Juglandaceae A. Rich. ex Kunth. Genus: Juglans L. 58. J.regia L. – large tree.

XII. Family Solanaceae Juss. Genus: Lycium L. 59. L. dasystemum A. Pojark. - shrub.

The taxonomic affiliation of the studied species was determined according to the sources "Flora of the Kirghiz SSR" (vols. 1-X1), "Flora of the USSR" (vols. 1-XXX).

The subject of the research was the fixed materials of the wood of the specified species of trees and shrubs.

The wood has been studied according to the methods of A.F. Hammerman et al. [1940], A.A. Yatsenko-Khmelevsky [1954] and A.A. Fedorov [1962]. It was studied on preparations carried out in three projections - transverse, longitudinal-tangential and longitudinal-radial, and to measure the

elements of the organ, part of the material was macerated in nitric acid according to the generally accepted method [2; 21]. When describing the studied organs, we were guided by "Atlases" [16] and others. The results obtained were processed statistically with the calculation of the arithmetic mean value (M), the mean error (± m).

Results and discussion. The general plan of the structure of wood in the studied species is similar and it consists of vessels, tracheids, libriform fibers, and radial and traction parenchyma. The structure of perennial wood of the studied species differ in the nature of the location and the ratio of certain elements and their quantitative indicators (table 1). Analysis of the structure of perennial wood has shown that in many species it is correlated with habitat conditions and the origin of the species. So, in species of the genera Celtis, Pistacia, Amygdalus (A.communis), Lycium, Cereasus (C.alaica, C.erythrocarpa), Tamarix, Myricaria, which are representatives of the ancient Mediterranean flora, the wood structure is xeromorphic. This structure of perennial wood confirms the opinion about their formation in arid areas. For most other species (Juglans, Acer, Euonymus, Ribes, Prunus, Lonicera), which are relict tertiary mesophilic [1], and migrating from the boreal flora, which at the present stage of development also remained in more mesomorphic conditions, a mesomorphic type of organ structure is characteristic [13, 14]. Some representatives of these genera (Euonymus, Ribes, Lonicera), specializing in narrow ecological shady conditions, provided with moisture, have retained ancient characters.

Juglans regia is distinguished by its high plasticity in the restructuring of organs during relocation to new climatic regions. According to V. I. Tkachenko [15], it is at the peak of his biological development. The xerophilized mesophyte Acer semenovii, introduced in Moscow, feels good, which indicates its mesomorphic origin.

Table 1. Anatomical indicators of wood stems of some plant species

Taxa	Diameter of vessels with a wall, µm	Thickness of vessel walls µm	Number of vessel lumens per 1 mm2	Length of vascular segments, µm	Diameter of fibers with a wall, µm	Length of individual fibers, µm	Core rays				
							Quantity per mm	Max. vertic. Layering in cells	Height, µm	Row in cells	Width, µm
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Lonicera	33±0.8	2,7-3,5	572+0.5	457±1.3	13-15	796±0.9	17-19	22	497±0.9	1-2	38±0.2
L. simulatrix	26±1.0	4-4,8	210+0.9	486±1.0	12-14	847±1.0	16-18	20	527±0.9	1-2	38±02.
L. stenantha	33±1.1	2,5-3,1	169+0.5	444±1.0	15-16	820±1.0	17-19	28	562±0.8	1-2	36±0.2
L. hispida	36±1.1	3,6-4	197+0.5	316±1.0	15-17	617±1.0	17-19	45	1000±0.8	1-4	48±0.2
L. bracteolaris	42±1.2	2,4-3,4	182+0.6	373±1.0	10-12	866±10.	15-17	24	491±0.9	1-4	47±0.3
L. karelinii	44±1..0	3,8-3,0	176+0.5	428±1.0	15-17	759±1.0	12-14	20	528±0.8	1-2	41±0.3
L. korolkovii	45±1.2	3,1-4,5	194+0.9	412±1.0	14-16	797±1.1	16-18	20	535±0.8	1-2	37±0.2
L.nummulariofolia	44±1.0	3-4,9	187+0.9	490±1.0	13-15	745±1.0	17-19	22	697±0.8	1-3	39±0.3
L. paradoxa	33±0.6	2,8-3,8	500+1.0	152±10	15-16	463±1.1	18-20	38	1290±0.8	1-3	23±0.2
Abelia corymbosa	28±1,1	2,2-3,4	340+0.9	225±1,0	14-16	520±1.0	18-20	22	385±0.8	1-3	400±0.9
Spireae hypericifolia	25±0.9	2-3	125+1.0	170±0.9	8-10	430±0.9	10-13	325	3400±0.9	1-8	75±0.3
S. pillosa	30±0.8	2-3	88+1.0	195±0.9	9-14	570±0.9	10-15	340	5400±0.9	1-16	100±0.4
S. lasiocarpa	25±0.9	2-3	155+1.0	170±0.9	8-13	370±0.9	12-14	350	2550±0.9	1-8	56±0.3
Exochorda	64±1.0	2-3,0	266+0.9	215±1.0	13-17	577±1.0	10-14	48	460±0.8	1-3	65±0.4
Armeniaca vulgaris	52±0.9	2-4	200+1.0	249±0.9	14-16	475±0.9	11-14	36	486±0.9	1-8	172±0.3
Amygdalus	59±1.0	3,8-4,0	276+1.0	234±1.0	14-16	806±1.0	9-13	72	1172±0.9	1-4	66±0.3
A. petunnicovii	29±0,5	3,2-0,5	429+1.3	207±0,6	7-11	481±1.0	9-15	38	132±1.1	1-2	19±0,4
Pyrus korshinskyi	34±0.6	2.9=06	320±0.6	164±0.8	14-16	408±1.0	10-17	25	375±0.6	1-4	23±0.4
P. regelii	22±0.9	2,5=04	760±0.5	260±1,0	10-12	397±1,0	12-18	18	253±0,5	2-3	57±0.4
Crateagus pontica	37±1.0	3,1-3,4	171±08	460±1.0	15-17	679±1.0	21-28	24	292±1.4	1-4	47±0.4
C. altaica	30±0.6	2,7-3,2	158±0.7	452±0.9	1315	677±1.1	8-12	20	209±1.0	1-3	36±0.3
C. ferganensis	36±1.0	1,3-3,3	165±0.9	435±0.5	13-14	475±1.2	21-35	19	230±1.0	1-3	27±0.2
C.tianshanica	30±1.0	2,7-3,6	131±0.5	412±0.9	16-18	836±1.0	97-11	27	200±0.9	1-3	44±0.6
C. turkestanica	49±1.2	3,0-3,4	131±0.5	412±1.0	16-18	836±1.0	9-11	27	270±1.0	1-3	43±0.3

Continuation of table 1.

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Padus racemosa	34±1.0	2,3-3,1	150+1.2	260±1.1	15-17	451±1.3	11-18	26	150±1.2	1-2	400±0.4
Prunus sogdiana	35±0.9	2,2-3,6	126+1.0	150±1.3	11-15	415±0.5	10-14	47	506±0.8	1-5	39±0.3
P. ferganica	39±1.0	2-3,2	257+1.0	294±1.0	12-14	460±1.0	12-14		775±1.0	1-5	44±0.4
Aflatunia ulmifolia	37±0.8	1,5-2,0	287+0.8	263±1.0	7-11	502±09	11-16	38	354±0.8	1-4	45±.0.5
Juglans regia	90±1.4	2,8-4,1	16+0,3	165±1.2	4-7	446±0.9	6-14	18	322±1.0	1-3	30±0.5
Cerasus	35±0.6	2,6-29	360+0.9	260±1.0	11-13	624±0.9	18-22	49	233±0.9	1-3	66±0.4
C. verrucosa	29±0.6	2,6-2,9	400+0.9	227±1.0	11-13	624±0.8	18-19	18	233±0.9	1-2	18±0.3
C. alaica	44±0.8	2,5-2,9	367+0.9	260±1.0	10-12	926±0.9	18-20	90	540±0.8	1-4	46±0.3
C. tianshanica	45±0.9	3,4-3,5	208+0.6	240±1.0	9-10	522±0.9	14-155	33	500±0.8	1-4	39±0.5
C. mahaleb	33(60)	3,7-40	337+0.9	227±1.0	15-17	787±0.9	12-15	47	625±0.8	1-3	46±0.2
Sorbus tianshanica	41±1.0	2,7-4	315±0.8	320±1.0	26-28	668±1.0	11-12	26	144±0.8	1-2	18±0.5
S. persica	48±1.3	2,5-4	242±1.0	455±1.0	27-28	1055±1	14-16	26	273±0.8	1-2	27±0.4
S. turkestanica	31±0.9	24-4	262±0.8	467±1.0	24-25	1000±1.	14-16	26	285±0.8	1-2	30±0.8
Cotoneaster	31±0,9	2,4-3,7	306±0.6	265±0.5	11-1,7	469±0.7	9-13	18	240±0.7	1-3	37±0.4
C. oligantha	28±1.0	2,4+3	247±0.5	239±0.4	1215	474±1.0	9-12	17	221±0.7	1-3	39±0.2
Malus kirghisorum	20±1.0	2,0-4,2	138±0.9	200±1.0	16-18	390±1.5	9-13	22	200±0.9	1-3	145±0.4
M. niedzwetskyana	34±1.0	2-4	135±0.8	180±1.0	18-20	460±1.0	9-15	18	135±0.8	1-3	149±0.4
Hippophae	45±1.1	2-3,3	350+1.1	248±1.3	9-12	396±0.4	8-14	18	210±1.1	1-4	31±0.4
Eleagnus	85±1.0	2,4-4	240+0.3	120±0.8	18-19	450±0.9	9-15	68	144±1.1	1-12	47±0.3
E. orientalis	82±1.0	3-3.3	205+0.8	138±0.9	17-19	495±0.9	10-13	50	527±0.9	2-12	52±0.3
Berberis oblonga	46±1,2	2,4-3,1	255+0.8	146±1.1	13-14	414±1.2	13-17	23	200±0.9	1-6	555±0.4
Ribes meyeri	34±1.1	1,6-3,6	100+0.9	230±1.0	13-15	495±1.0	15-17	122	1415±1	1-24	168±0.3
R. heterotrichum	33±1.1	2,4-5	105+0.5	190±1.0	12-14	431±0.5	13-15	110	1034±1.	1-17	177±0.4
Pistacia vera	70±0.6	2,8-3,7	224+1.2	300±1.0	9+11	478±0.3	7-11	33	295±0.8	1-5	56±0.4
Tamaryx	34±0.8	4,4	53+0.9	90±0.7	11-13	385±0.6	13-17	76	610±0.7	1-7	95±0.4
T.hispida	49±0.9	2,4	96+0.9	93±0.8	13-15	381±0.9	15-17	66	354±0.8	5-7	79±0.3
Myricaria	34±0.9	2,5	75+0.9	116±0.8	12-14	364±0.8	12-17	41	487±0.7	1-5	39±0.4
M.elegans	39±0.9	3	55+0.8	152±0.8	15-17	326±0.8	13-17	48	461±0.8	3-5	48±0.3
Celtis caucasica	81±1.1	2,6-4	40+1.0	143±0.3	8-11	448±0.5	13-18	22	387±0.5	1-6	67±0.7
Euonymus semenovii	30±1.2	2-2,9	336+1.1	160±1.2	12-14	409±.0.6	8-12	12	155±1.4	1-2	30±0.5
Acer semenovii	36±1.2	2,2-3,2	198+1.1	240±1.3	12–14	335±0.4	10-12	20	185±1.1	1-4	30±0.6
A.tuerkestanicum	34±0.9	2.4-2.6	170+0.9	179±1.1	9-11	433±0.9	11-14	34	212±0.9	1-4	21±0.4
Lycium dasystemum	53±0.4	2.7-1.0	92-0.6	160±0.7	10-1.7	339±0.4	14-19	36	240±1.0	1-2	54±0.6

The species of the genera Cerasus, Spiraea, Lonicera are characterized by great diversity. Many shrub or cushion Cerasus species are common in arid places and have a typical xeromorphic structure of organs (C.tianschanica, C.alaica, C.erythrocarpa), tree species (C. mahaleb), on the contrary, spreading in more favorable forest conditions, have a more mesomorphic structure. Species of the genus Spiraea are also characterized by opposite characters - in S. hypericifolia and S. lasiocarpa the wood is ring-vascular, which is associated with unfavorable habitat conditions than in S. filosa, in which the wood is disseminated. Among the species of the genus Lonicera L. paradoxa, due to the spread of arid conditions in sunny and rocky places, it has a more highly specialized structure - a circular arrangement of vessels, a sharp transition from large early spring vessels to late ones, etc., while the structure of this organ in other species kind of diffuse vascular or with a tendency to annular vascularity. Some endemic species of the genera Amygdalus, Pyrus, Malus also have distinctive features. Thus, in Amygdalus petunnicovii the wood is scattered vascular (in A.communis it is annular), in Pyrus regelii, on the contrary, it is annular (in other pear species it is scattered), etc. Rare endemic species of monotypic genera of mixed forests occupied different positions in terms of wood structure. The signs of the structure of this organ of the species Aflatunia ulmifolia, Exochorda tianschanica do not correspond to the modern conditions of the broadleaf forest - they are more xeromorphic than other species of the same forest. Other rare species from the same forest (Abelia corymbosa, Sorbus persica), are characterized by wood features inherent in mesophytes. The discrepancy between the wood structure of these rare species and that of closely related taxa of the

genus and species in the community can be explained as preserved remains of ancient flora with ancestral features.

It is known that starting from the Pliocene, due to mountain-forming processes, as well as the cooling that began in connection with the onset of the ice age, the intensity of development of some species is delayed in the flora of Central Asia. Thus, the extinction of certain elements of this flora, the transformation towards greater mesophilicity of others and the transition to a relict state of the third [3, 4, 5, 8].

Based on the study of perennial wood of trees and shrubs in the south of Kyrgyzstan, the following conclusions can be drawn.

1. The signs of a perennial stem for each species have a stable structure and are conservative, and reflect the adaptations of the plant not only to the conditions of modern habitat, but also the history of their formation.

2. The traits of wood in many species correlate with environmental factors of their current range, which indicates their autochthonous origin. The signs of the studied organs of rare and endemic species from more or less the same habitat conditions often do not correlate with the conditions of the present habitat. Thus, the plants of Abelia corymbosa from the walnut forest of the mountains are mesophytic in terms of the structure of the studied organs, while in the species Aflatunia ulmifolia and Exochorda tianschanica from the same forest, they are xeromorphic, which indicates their origin from different places with different ecological factors of existence.

Consequently, the plants of Abelia corymbosa from the walnut forest of the mountains are mesophytic in terms of the structure of the studied organs, while in the species Aflatunia ulmifolia and Exochorda tianschanica from the same forest, they are xeromorphic, which indicates their origin from different places with different ecological factors of existence.

3. The structure of wood in the studied species correlates with their life form - in large trees it is characterized by primitive features (long elements of conductive and mechanical tissues, oblique connection of xylem elements, etc.), in small shrubs it is more advanced (elements of xylem, sclerenchyma are short, their direct or slightly oblique connection, etc.). The exception is the species of the genera Ribes, Lonicera, which are small shrubs, the wood of which is characterized by primitive traits. This is due to their habitation for a long time in a narrow ecological niche and a small change in the structure of wood in the course of evolution.

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AGRICULTURE

MIGRATION OF HEAVY METALS IN THE AGRICULTURAL SOIL PROFILE AROUND THE GANJA-KAZAKH ZONE OF THE REPUBLIC OF AZERBAIJAN

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ABSTRACT

Depending on the nature and characteristics of the heavy metals that accumulate on the surface of the soil, separated from vehicle waste around the highway, they migrate downwards in the soil profile. The course of this process and the properties of heavy metals have been studied by many researchers. The migration of heavy metals in the soil profile later leads to the contamination of plants, especially agricultural crops, with toxic substances. It enters the food chain around the highway, especially with the more intensive accumulation of lead. It is considered dangerous for animals when the amount of lead in dry fodder plants is 100 mg/kg. Its amount migrates deep into the soil profile for several years and remains in the soil for many years without losing its effect. Until recent years, tetraethyl lead was added to all fuels to increase its combustibility and increase the deformation pressure, which caused the release of 200-400 mg of lead into the atmosphere during the combustion of one liter of gasoline. The study found that the migration of heavy metals in the soil profile depends on its granulometric composition, density, thickness of many organic compounds and pH.

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Introduction. In order to study the migration of heavy metals in the soil profile of the areas around the main zone of the western zone of the Republic of Azerbaijan, 50, 100 and 200 meters of soil sections were placed. At the same time, 3 soil samples were taken to characterize it in depth. The amount of heavy metals (copper, zinc, lead, chromium, cobalt and mercury) present in soil samples was determined by atomic absorption spectrometric method.

The study found that most zinc contamination of the soil is observed in its layers. This regularity is also confirmed by the scientific results of many researchers [8]. The spread of zinc in the soil profile occurs more mobile. Zinc spreads more intensively along the profile, especially in moist soils and as a result of the erosion process. In soils with heavy granulometric composition and soils with more organic content, its migration along the profile is weakened. It is also important to note that zinc has a greater effect on microorganisms when migrating along the soil profile. This effect can be considered more dangerous than copper and cadmium.

In the irrigated gray-brown soils in the study area, the amount of zinc in the middle layer of 20-45 cm 50 meters from the highway is less than in the upper and lower layers, which is due to the

high inclination and surface flow in that part. Medium-layer zinc migration was weak due to high surface runoff. In general, in all cases, there is an increase in zinc to a depth of 100 cm, which is similar to the data of many researchers [2].

Studies of lead migration in the soil profile show that it is significantly different from zinc. There are many reasons for the downward migration of lead. In particular, the density and compaction of the soil prevents its migration, and as a result, unlike zinc, lead is more concentrated on the soil surface. Researchers note that the inability of lead to migrate below the six layers of crops is due to the very compaction of this layer [9, 2]. In irrigated soils, the amount of lead around the highway can vary greatly depending on depth and distance. However, in many cases, the amount of lead around the highway can be 100 times higher than in the background [10]. It has been found that the decrease in lead to the depth of the soil profile is due to the fact that in many soils it is poor depending on the conditions of formation and the parent rock.

The change and migration of copper in the soils around the highway varies in size. Microorganisms play an important role in the spread and migration of copper. Especially in the lands where grapes are grown, they are observed in very high doses. The main reason for this is the "sky" device used to protect grapes from diseases and pests. Its use for many years has led to the accumulation of copper in the soil. This increases the amount of copper in the surrounding lands of the highway.

Table 1. Profile migration of heavy metals in ordinary gray-brown soils (in mg/kg)

Heavy metals Zinc	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Lead	0-20 20-45 45-90	17,65 21,36 20,39	16,44 19,91 19,81	13,37 15,97 17,21
Mis	0-20 20-45 45-90	8,36 12,62 3,91	7,10 7,98 3,15	5,16 8,87 0,39
Mercury	0-20 20-45 45-90	58,10 57,87 59,90	43,51 47,12 80,99	36,86 37,87 45,12
Chrome	0-20 20-45 45-90	0,035 0,025 0,035	0,020 0,015 0,020	0,014 0,021 0,020
Cobalt	0-20 20-45 45-90	176,80 207,80 87,65	261,0 242,0 99,61	202,9 98,41 -
Heavy metals	0-20 20-45 45-90	14,17 18,98 14,25	15,11 15,92 11,91	13,33 15,97 12,22

In the ordinary gray-brown soils we studied, there is no continuous pattern of copper profile changes. At a distance of 50 meters from the highway, 58.10 mg/kg was found at the surface, 57.87 mg/kg at 20-45 cm and 59.90 mg/kg at the 45-90 cm layer (Table 2). At a distance of 100 meters, while the top layer was 43.51 mg/kg, the amount in the subsoil was 47.12 mg/kg, and increased by 45-90 cm to 80.99 mg/kg. At a distance of 200 meters, it generally decreased, and increased from the top to the bottom.

The results of laboratory analyzes obtained on dark gray-brown soils are not significantly different from the previous field (Table 2). In this soil, the amount of copper in the top layer of the section at a distance of 50 meters is 57.00 mg/kg, and in the bottom layer of 52.74 and 45-95 cm layer is relatively reduced to 47.96 mg/kg. At a distance of 100 meters, its volume increased to a depth. Similar results were obtained at a distance of 200 meters.

Table 2. Profile migration of heavy metals in dark gray-brown soils (in mg/kg)

Heavy metals	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Zinc	0-20	21,78	21,58	20,48
	20-45	22,69	22,69	22,00
	45-90	21,67	20,73	10,14
Lead	0-20	20,16	16,17	18,82
	20-45	17,78	11,82	7,91
	45-90	10,06	16,64	8,02
Mis	0-20	53,00	47,11	42,78
	20-45	52,74	50,42	50,89
	45-90	47,96	52,75	52,31
Mercury	0-20	0,050	0,040	0,040
	20-45	0,040	0,045	0,045
	45-90	0,040	0,030	0,045
Chrome	0-20	225,80	104,00	96,75
	20-45	131,80	111,6	90,87
	45-90	97,30	98,74	73,85
Cobalt	0-20	8,88	10,17	8,95
	20-45	14,24	12,18	12,48
	45-90	13,92	11,98	3,18

Many specific changes in copper content are observed in irrigated gray-brown soils (Table 3). It was found to be 58.10 mg/kg in the upper layer at 50 meters, 50.30 mg/kg in the middle layer and 26.75 mg/kg in the lower layer. At a distance of 100 meters, it was 43.51 mg/kg in the upper layer, 57.87 mg/kg in the subsoil and 25.51 mg/kg in the lower layer. In the section laid at a distance of 200 meters, it was determined that it was less in the upper subsoil.

Mercury is a heavy metal that is more prevalent in the soil and has a severe effect on cultivated crops. Mass poisoning occurs when its metallic mercury compounds enter food. One of the main features of mercury is that it accumulates in the upper part of the soil. Mercury can accumulate more in the upper humus-accumulative layer, which has a clayey granulometric composition [10]. Its migration to the lower layers is not felt in the soil profile. In soils with slightly granulometric acidity and relatively weak humus, its migration is relatively accelerated.

In ordinary gray-brown soils, the amount of mercury in the top layer of 0-20 cm of the section dug 50 meters from the asphalt cover was 0.030 mg/kg, 0.020 mg/kg at 20-45 cm and 0.030 mg/kg at 45-90 cm. At a distance of 100 meters, its amount was the same in the upper and lower layers. According to the results of laboratory tests at 200 meters, no significant difference in profile was obtained.

The amount and distribution of mercury in the dark gray-brown soils around the Ganja-Gazakh highway is similar to that in ordinary gray-brown soils. For example, at a distance of 50 meters after the asphalt pavement, its amount was 0.050 mg/kg at 0-20 cm along the profile, and 0.040 mg/kg at 20-45 and 45-90 cm. It was determined that 0.040 mg/kg at a depth of 0-20 cm, 0.045 mg/kg at 20-45 and 0.030 mg/kg at 45-90 cm in the soil excavated at a distance of 100 meters. At 200 meters, it was 0.040 mg/kg in the top 0-20 cm layer, and then 0.045 mg/kg until the end.

As mentioned earlier, the distribution of mercury along the profile of the gray-brown soils irrigated around the highway does not differ significantly from the soils shown earlier (Table 3).

Chromium has a special distribution pattern in the soil profile of heavy metals, which pollute the atmosphere and soil by road transport. According to researchers, the amount of chromium in the soil can be affected by the parent rock, which forms more soil.

Emissions from car engines and during their operation cause chromium contamination of the soil.

Tables 1, 2 and 3 show that the distribution of chromium in the study soils is different. Depth of chromium in ordinary gray-brown soils is 225.80 mg/kg in 0-20 cm at 50 meters, 131.80 mg/kg in 20-45 cm in the subsoil and 97.30 mg/kg at 45-90 cm. kg. At 100 meters, it was 104.00, 111.6 and

98.74 mg/kg, respectively. At 200 meters, all indicators decreased. At 200 meters, it decreased to 96.75 mg/kg in the upper layer, 90.87 mg/kg in the subsoil, and 73.85 mg/kg in 45-90 cm.

Table 3. Profile migration of heavy metals in irrigated gray-brown soils (in mg/kg)

Heavy metals **Zinc**	Depth, cm	Distance from the asphalt pavement of the highway, in m		
		50	100	200
Lead	0-20 20-45 45-90	17,65 15,90 17,20	16,44 21,36 19,26	13,37 19,26 -
Mis	0-20 20-45 45-90	8,36 12,62 9,40	7,98 7,10 11,97	5,16 7,98 -
Mercury	0-20 20-45 45-90	58,10 50,30 26,75	43,51 57,87 25,51	36,85 47,12 25,51
Chrome	0-20 20-45 45-90	0,040 0,020 0,030	0,013 0,043 0,045	0,035 0,043 0,045
Cobalt	0-20 20-45 45-90	261,00 207,80 202,90	176,80 242,00 87,65	261,00 262,00 -
Heavy metals	0-20 20-45 45-90	14,17 18,97 15,31	15,11 15,49 15,08	13,33 15,08 -

The distribution and migration of cobalt in the soil profile differs significantly from the aforementioned heavy metals. Cobalt, like chromium, can enter the soil as a polluting metal from a variety of sources. But it is also important to note that road waste plays a big role in it.

In normal gray-brown soils, the change in profile of cobalt was 50 meters from the asphalt bed, 14.17 mg/kg in the upper layer, 18.98 mg/kg in the middle transition layer, and 14.25 mg/kg in the lower 45-90 cm. In the 100-meter section, it was 15.11 mg/kg at the top, 15.92 mg/kg in the middle layer and 11.91 mg/kg in the bottom layer. At 200 meters, it was 13.33 mg/kg in the upper layer, 15.97 mg/kg in the middle layer and 12.22 mg/kg in the lower layer. Here we can determine the regularity that the amount of cobalt increases from the top layer to the middle layer, and decreases again in the top layer.

A similar pattern is observed in dark gray-brown soils (Tables 1, 2, 3).

Conclusions. As a result of the research, it was determined that the migration of mercury in the soil profile in the surrounding lands of the Ganja-Gazakh highway is almost non-existent. The change and migration of copper in the soils around the highway varies in size. The study found that most zinc contamination of the soil is observed in its deeper layers. There are many reasons for the downward migration of lead. In particular, the density and compaction of the soil prevents its migration, and as a result, unlike zinc, lead is more concentrated on the soil surface. The amount of cobalt increases from the top layer to the middle layer, and decreases again in the top layer. The entry of cobalt into the soil as a polluting metal can come from a variety of sources. But motor vehicle waste plays a big role in it.

The study found that the distribution of chromium in soils varies. Chromium was mainly observed in the upper layers of the soil in these soils. This is the waste generated by car engines and during its operation, which causes chromium contamination of the soil.

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ENGINEERING SCIENCES

CHOICE OF EFFECTIVE MEASURES TO PREVENT THE "WAXING" OF PIPES

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ABSTRACT

The article deals with the process of "waxing" of pipes and the choice of effective measures to prevent these negative phenomena. To assess the nature of asphalt-resin-paraffin deposits (ARPD) and select a further investigation scheme, the X-ray Spectral analysis was used. It is shown, that ARPD is a complex system structured by resinous-asphaltene substances and paraffin-naphthenic or paraffin-aromatic hydrocarbons. Mass transfer of solid deposits to the pipe wall is described by the Fick's differential equation. In order to prevent "waxing" of pipes, compositions of antiadhesive fluorine glass-enamel coatings with a high class of surface cleanliness are proposed.

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Введение. На сегодняшний день практически во всех системах транспорта нефти существует проблема отложения на стенках трубопровода парафина, смол, продуктов полимеризации и других осадков, что ухудшает гидродинамические характеристики трубопроводов. Проблема формирования асфальтосмолопарафиновых отложений (АСПО) стоит и при добыче нефти: существенно осложняется работа скважин, снижается эффективность эксплуатации нефтепромыслового оборудования [1-4].

Несмотря на применение различных мер по предотвращению комплексных отложений, проблема профилактики и борьбы с АСПО по-прежнему весьма актуальна для нефтяной промышленности.

Для облегчения понимания процесса «парафинизации» труб и выбора эффективных мер предупреждения этих негативных явлений в работе проведен анализ характера и состава комплексных отложений. Отметим, что в широком понимании «парафинизация» – это совокупность всех процессов, приводящих к образованию твердых органических отложений на поверхности оборудования [5].

Результаты исследований.

Тяжелые органические компоненты нефти, такие как асфальтены, парафины, смолы, адамантаны и их производные, металлоорганика содержатся в сырой нефти в различных формах и количествах. Именно эти соединения, выделяясь из нефти, являются основной причиной «парафинизации» труб.

Рентгеноспектральным методом при анализе АСПО установлено, что это не просто смесь различных органических и неорганических соединений, а сложная система, структурированная смолисто-асфальтеновыми веществами и парафино-нафтеновыми или парафино-ароматическими углеводородами.

При изменении состояния газожидкостной смеси (колебания T и P) на внутренней поверхности труб и другого промыслового оборудования откладывается парафин и смолисто-асфальтеновые вещества, что приводит к образованию наростов и уменьшению исходного сечения труб.

Следует отметить, что смолы индивидуально не выделяются, а входят в состав смолисто-асфальтенового коллоида, чем и содействуют парафинообразованию. На долю этих веществ приходится 40-70 % от тяжелого нефтяного остатка (рис. 1).

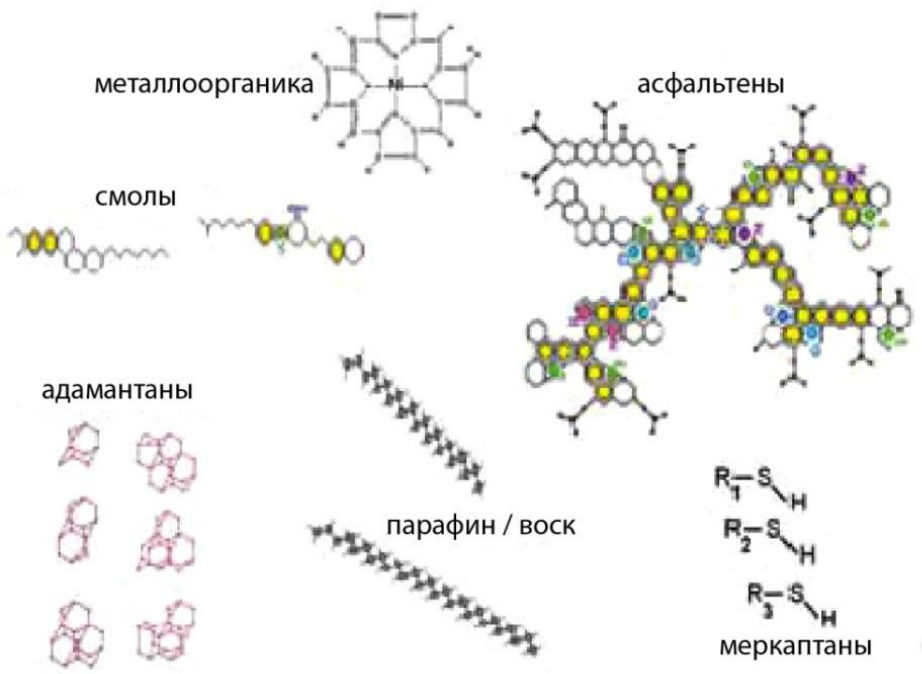

Рис.1. Структура компонентов нефти, осаждающихся на поверхности стальных труб

В нефти также содержится около 30 углеводородов ряда адамантана. Шероховатость поверхности стальных труб, взаимодействия, происходящие на границе нефть-металл, пространственная молекулярная структура и адгезионные свойства углеводородов способствуют их прилипанию к твёрдым поверхностям. Часто наблюдаются скопления меркаптанов и металлоорганических соединений в области дефектов стенки трубы. Сформировавшиеся отложения содержат и продукты коррозии.

Массоперенос твердых отложений к стенке трубы описывается кинетическим уравнением диффузии Фика [6]:

$$dM = -D\frac{dC}{dx}dAdt,$$

где $dM -$ количество продиффундированного вещества (отложений) за время dt;

$\frac{dC}{dx} -$ градиент концентрации по расстоянию от стенки трубы;

$D -$ коэффициент молекулярной диффузии;

$dA -$ площадь осаждения.

Опыт показывает, что указанные проблемы можно решить, если вместо стальных труб применять трубы с внутренним стеклоэмалевым покрытием [7, 8].

Поставленная цель достигается использованием разработанных в Грузинском техническом университете функциональных составов стеклопокрытий для стальных труб. Состав используемых силикатных фтористых фритт приведен в таблице 1.

Таблица 1. Химический состав разработанных стеклофритт (мас. %)

Компоненты фритт	Содержание, мас. %
$\sum(SiO_2 + TiO_2 + ZrO_2)$	40,5 – 52,6
$\sum(Al_2O_3 + B_2O_3)$	10,7 – 20,3
$\sum(Na_2O + K_2O + Na_2SiF_6)$	30,8 – 36,3
$\sum(Co_2O_3 + ZnO + CuO)$	2,5– 4,2

В работе использовался режим быстрого индукционного эмалирования внутренней поверхности труб при температуре 760-780°С. Исследования на микроанализаторе «MS-46 Cameca» контактной зоны «фтористое стеклопокрытие – металлическая подложка» показало, что с ростом времени обжига усиливается диффузия железа в расплав и скорость процесса колеблется в пределах: $2-4\cdot10^{-8}$ см^2/сек.

Тонкий слой сформировавшегося в процессе обжига безгрунтового покрытия, толщиной около 470 мкм, отличается высокими электроизоляционными свойствами ($\rho_{293} \geq 10^{10}$), стабильностью эксплуатационных свойств во времени, высокой сплошностью, прочностью на сжатие и истирание, высокими гладкостными характеристиками (степень чистоты поверхности: 0,10−0,12 мкм), обусловливающими весьма низкий коэффициент трения и отсутствие адгезии асфальтосмолопарафиновых выделений из нефтепродуктов.

Выводы. В качестве эффективных мер для предотвращения «парафинизации» труб нефтяного сортамента предложены составы однослойных антиадгезионных фтористых силикатноэмалевых покрытий с высоким классом чистоты поверхности.

В заключении отметим, что процесс «парафинизации» труб способны предотвратить и другие, например, эпоксидные, полимерные или полиэтиленовые покрытия. Однако наличие SiO_2 песка в транспортируемой нефти приводит к истиранию таких покрытий, росту их шероховатости, а, следовательно, и сил адгезии к парафину и смолисто-асфальтеновым веществам.

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УСТАНОВКА ДЛЯ ИССЛЕДОВАНИЯ ПЕРЕХОДНЫХ ТОКОВ В ДИЭЛЕКТРИЧЕСКИХ ЖИДКОСТЯХ

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dielectric liquid, space charges, analog to digital converter, electrometric amplifier, charge carrier mobility, reverse currents, transient currents.

ABSTRACT

An experimental automated installation based on the Raspberry Pi3 Model B mini-computer and software for it is developed. By means of this installation, it is possible to carry out research of charging and discharging currents at different times in the range from $5 \cdot 10^{-2}$ s to $4{,}5 \cdot 10^{3}$ s. Reversible currents up to voltages of 5 kV are studied using vacuum circuit breakers BB-5 (or BB-20, up to 20 kV). The installation allows detecting the accumulation of space charges both in the near-electrode regions and in the volume of dielectric liquids. The installation allows to determine the mobility of charge carriers by the method of transient currents. The current flowing through the dielectric liquid is recorded by an electrometric amplifier, V7-30 or U5-11, which measures currents are in the range from 10^{-4} A to 10^{-12} A.
The presented installation based on modern blocks and elements allows not only to carry out experimental studies with dielectric liquids of various types at the proper level, but also significantly improves the quality and efficiency of such studies.

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Постановка проблемы и актуальность. Изучение процесса проводимости диэлектрических жидкостей осложняется тем, что ток со временем в диэлектрических жидкостях не остаётся постоянным и форма его кривой зависит от процессов, протекающих как при электродных областях, так и в объёме жидкости [1, 2]. Для эффективного исследования такого класса экспериментальных задач необходимо использовать современные автоматизированные установки.

Цель исследований: разработка автоматизированной экспериментальной установки на базе мини-компьютера Raspberry Pi3 Model B и программного обеспечения к ней для исследования переходных процессов в диэлектрических жидкостях.

Изложение основного материала и результаты. Среди различных методов, позволяющих определить роль объёмных зарядов в процессе прохождения тока в диэлектрических жидкостях, можно выделить методы закорачивания образца на измерительный прибор, последовательного включения напряжения той же полярности, но различной амплитуды, и метод реверсирования напряжения [3, 4]. С целью использования этих методов при изучении переходных токов в диэлектрических жидкостях разработана экспериментальная автоматизированная установка, посредством которой в различные моменты времени в интервале от $5 \cdot 10^{-2}$ с до $4{,}5 \cdot 10^{3}$ с возможно выполнять следующие программы измерений:

1) исследование зарядных токов;
2) исследование разрядных токов;
3) исследование токов при реверсировании напряжения.

Блок-схема установки показана на рис.1.

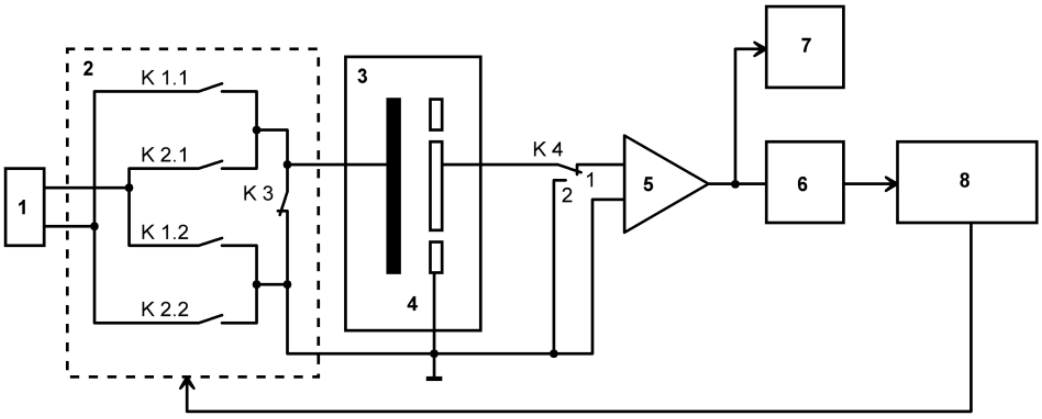

Рис.1 Блок-схема экспериментальной установки

1 - источник высокого напряжения (Б5-14); 2 - коммутирующее устройство; 3 - электроизмерительная камера; 4 - электроизмерительная ячейка; 5 - электрометрический усилитель У5-11 (В7-30); 6 - аналогово-цифровой преобразователь АЦП (ADS1115); 7 - осциллограф Hantek DSO1062B; 8 - мини-компьютер Raspberry Pi3 Model B

Напряжение от источника высокого напряжения 1 подавалось на измерительную ячейку 4 с помощью коммутирующего устройства 2, которое позволяло осуществлять три, приведенных выше, вида измерений.

Первая и вторая программы. В исходном состоянии контактные группы герконов К1.1, К1.2, К2.1, К2.2, коммутирующего устройства находятся в разомкнутом состоянии, контактная группа геркона К3 замкнута, а геркон К4 находится в положении 1. В момент замыкания контактов герконов К1.1 и К1.2 контактная группа геркона К3 размыкается, а геркон К4 находится некоторое время (10 мс) в состоянии 2. За это время емкостной выброс тока отводится на землю. Затем контакт геркона К4 возвращается в исходное состояние 1 и производится регистрация тока, тока, текущего через жидкость. Для снятия высокого напряжения с измерительной ячейки герконы К1.1, К1.2 размыкаются, а контактная группа геркона К3 замыкается. Контакт геркона К4 переходит на время 10 мс в состояние 2, а затем возвращается в исходное состояние 1 и производится регистрация так называемого разрядного тока. Этим завершается работа первой и второй программы коммутирующего устройства – регистрация зарядных и разрядных токов.

Третья программа работы коммутирующего устройства обеспечивает реверсирование напряжения на измерительной ячейке. Реверсирование напряжения даёт возможность определить характер действия предварительно приложенного поля на образец. При реверсировании напряжения в работе устройства кроме контактных групп К1.1, К1.2 принимают участие контактные группы К2.1, К2.2. Контакты геркона К5 в этой программе всё время разомкнуты, а контакты геркона К4 переключаются так же, как и в первой программе. Третья программа обеспечивает получение двух последовательных импульсов напряжения разной полярности и одинаковой амплитуды с межимпульсным временем следования 10 мс.

Ток, текущий через диэлектрические жидкости, регистрировался электрометрическим усилителем (рис. 1., блок 5, В7-30 или У5-11), обеспечивающим измерение токов в диапазоне от 10^{-4} А до 10^{-12} А. С выхода усилителя У5-11 сигнал поступает на осциллограф Hantek DSO1062B (7) и аналого-цифровой преобразователь (АЦП-6), в качестве которого использовалась микросхема ADS1115, информация с которой поступала на мини-компьютер (8), в качестве которого использовалась модель Raspberry Pi 3 Model B.

Выбор АЦП ADS1115 [5,6] обусловлен его отличительными характеристиками: низкое энергопотребление (150 мкА), встроенный программируемый усилитель входного сигнала, программируемая частота дискретизации, выходной компаратор.

Структурная схема соединений усилителя У5-11 с АЦП(ADS1115) и ЭВМ (Raspberry Pi 3 Model B) показана рис. 2.

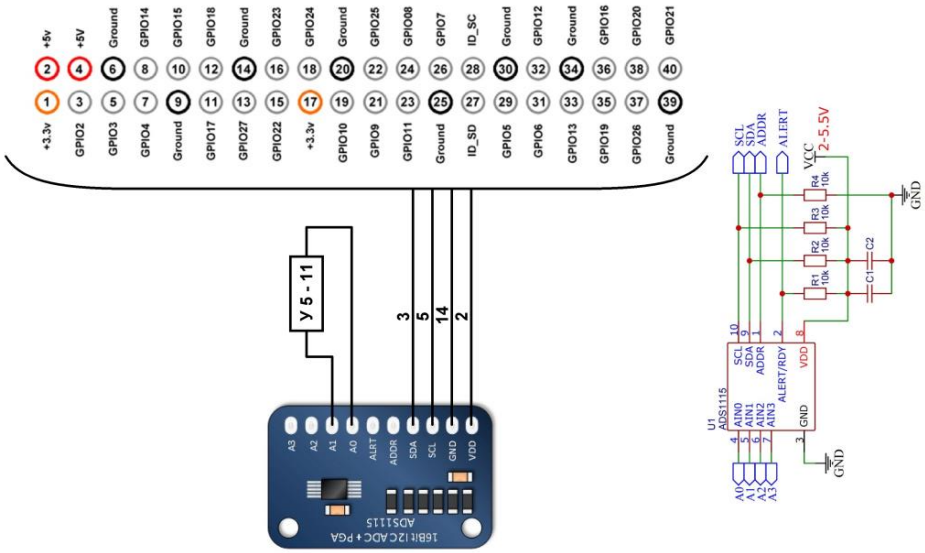

Рис.2 Схема соединений усилителя У5-11 с ADS1115 и Raspberry Pi 3.

Усилителем У5-11 измеряется двуполярный сигнал (+/-), поэтому в АЦП(ADS1115) используем дифференциальный вход: A0-(+), A1(-).

RaspberryPi 3 Model B имеет разъём HDMI для подключения монитора, 4 USB-порта для подключения USB устройств, Ethernet-порт для подключения к сети, встроенный Wi-Fi и Bluetooth, 4 ядерный 64-битный процессор ARM 1.2Ghz, 1GB оперативной памяти. В отличие от обычных компьютеров на маленькой плате Raspberry есть 40 контактов (пинов) GPIO, которые могут использоваться как на вход, так и на выход с применением различных протоколов взаимодействия с внешними устройствами, что и позволяет подсоединять к плате различные датчики и исполнительные приборы.

Контакты GPIO это часть Raspberry, которая значительно расширяет возможности микрокомпьютера для применения в электронных автоматизированных системах. С помощью этих контактов можно как считывать данные с огромного множества предлагаемых сегодня датчиков: температуры, давления, движения, наклона, ориентации, открытия и т.п., так и посылать команды на исполнительные устройства: реле, двигатели, актуаторы, серво-машины и многие другие.

Управление между коммутирующим устройством (блок 2 на рис. 1) и мини-компьютером (Raspberry Pi 3 Model B) осуществлялась по следующей блок-схеме, представленной на рис. 3.

Принципиальная схема транзисторных ключей показана на рис. 4.

Представленная установка на базе современных блоков и элементов позволяет не только проводить экспериментальные исследования с диэлектрическими жидкостями разных типов на должном уровне, но и значительно повышает качество и эффективность таких исследований.

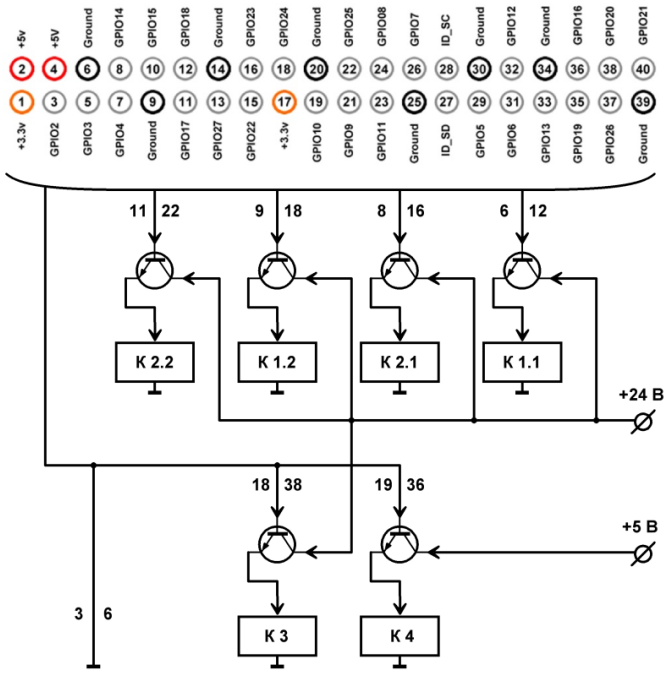

Рис.3 Схема управления между коммутирующим устройством и мини-компьютером

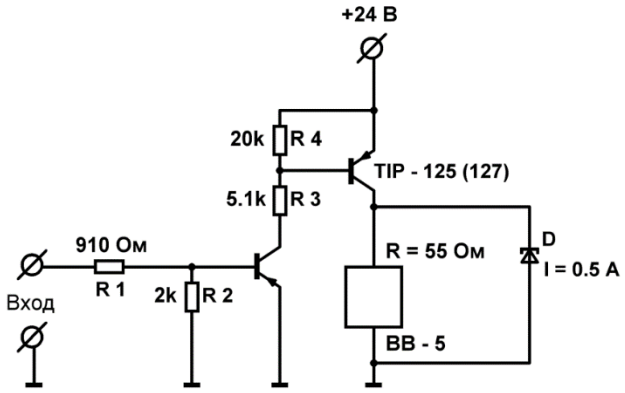

Рис.4 Принципиальная схема транзисторных ключей.

Заключение. В данной работе разработана экспериментальная установка на базе мини-компьютера Raspberry Pi3 Model B, которая позволяет проводить исследования процессов протекания электрического тока, накопления объёмных зарядов в диэлектрических жидкостях и определять подвижность носителей заряда в них.

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COMPUTER SCIENCE

ELECTRONIC JURISDICTION, METAVERSE, ARTIFICIAL INTELLIGENCE, DIGITAL PERSONALITY, DIGITAL AVATAR, NEURAL NETWORKS: THEORY, PRACTICE, PERSPECTIVE

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ABSTRACT

Scientific and technological revolution 4.0 (The Fourth Industrial Revolution) has created a huge window of opportunity for a variety of creative technologies. At the same time it launched the emergence and development of modern social relations in the electronic space - the metaverse. In fact, today all the prerequisites for the scientific and technological revolution 5.0 and social revolution 5.0, which radically changes the role of human in the social structure, while changing the social structure, creating new social groups, social institutions, electronic ecosystems and metaverse.

Modern social relations in the electronic space are multi-vector and can be divided according to the variety of objects, subjects and characteristics of the relationship between them, namely: the subjective and object basis of identification of social relations. Thus, the subjective basis for the identification of social relations is the social communities of people, and the object one is information and communication technologies and its products. Legal science is a social science, as it performs gnoseological and heuristic functions that determine the direction of scientific research and scientific predictions, studying the relations between people, groups of people, people and state institutions. The results of research are practical improvement of legislation on a scientific basis, development of draft normative legal acts, scientific examinations, etc.

However, the current practice indicates that modern laws are created very slowly, without necessary and sufficient detaliztion of terms and basic concepts.

It is difficult to overestimate the correctness, accuracy and consistency with the current legislation of definitions of legal terms. Unfortunately, the current legislation is unable to regulate public relations, which are rapidly evolving in the electronic space using digital technologies, artificial intelligence, Internet of Things (IoT), digital identity, digital avatars and other technologies, especially those that may restrict human rights and freedom. In fact, along with the creation of new social relations in the metaverse, it is necessary to create an electronic jurisdiction - the scope of application of opportunities by the subject of competence or the sphere to which the right applies.

The author's definitions "metaverse (cyberspace)", "electronic avatar", "electronic personality", "electronic jurisdiction", "cybercrime", "kidnapping of electronic avatar or electronic personality", "artificial intelligence" and "neural networks" are proposed in the article.

Six postulates of the main directions of development of social relations with the use of technologies of the metaverse, artificial intelligence, artificial neural networks, robotic systems, medical and military lost products and devices are formed.

Proposals for the creation of a comprehensive electronic jurisdiction, conceptual and categorical apparatus, definition of subjects and objects, rights, duties and responsibilities in the metaverse and in the use of artificial intelligence technologies, artificial neural networks, robots, etc. are provided.

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Articulation of issue. Humanity enters a new era, an era of digitalization and the metaverse. Public relations are rapidly transforming, new subjects and objects are arise, the interaction between them is transferred from the real to the virtual world. The issue of regulation of social relations in the metavers has not been comprehensively considered, so it requires a fundamental elaboration.

The purpose of the article is to investigate and analyze the key directions of development of modern social relations using an information and communication technologies of the new generation and the risks of its application without a proper legal regulation. Formulate the main postulates of the scientific, technological and social revolution 5.0. Provide proposals for the creation of a conceptual and categorical apparatus of e-jurisdiction, to propose the main directions of the development of law in the era of electronic transformation of society.

Results of analysis of scientific publications. The subject of research in the sphere of artificial intelligence is diverse not only in the branch of technical sciences but also among legal scholars. Research in the field of law is both one-time and systemic. One-time research is the first step towards updating deeper and fundamental research on the application of artificial intelligence technologies in management decision-making systems, modeling cyber threats, differentiating intellectual property rights, forming modern labor relations, building Ukrainian e-justice and notaries, forming modern civil, administrative and criminal dealings, etc.

These directions were studied by scientists Androschuk G.O., Belyakov K.I., Braichevsky S.M., Busol O.Y., Bugera O.I., Grinchak N.A., Gbur Z.V., Gorodisky I.M., Gutsu S.F., Efremov M.F., Vitlinsky V.V., Voinoiva S.A., Jalilova V.R., Kirilyuk A.V., Kosilova O.I., Kostenko O.V., Kryvytskyi Y.V., Matviychuk A.V., Martsenko N.S., Michurin E.O., Pozova D.D., Samoilenko M.Y., Strelnyk V.V., Solodovnikova H.K., Sidorchuk Y.M., Strelnik V.V., Pavlenko Z.O., Tikhomirov O.O., Shishka N.V., Shcherbina B.S. at different times.

System views on the development of law regulating social relations, which consist of the use of artificial intelligence technologies are stated in a previous work [1], which analyzes proposals for the development of law in the branch of artificial intelligence by the scientists Pylypchuk V.G., Baranova O.A., Bryzhka V.M., Grabovska O.A., Gorobtsya N.O., Katkova T.G., Kostenko O.V., Karmazy O.O., Krachevskogo M.V., Kusherets D.V., Kuklina V.M., Lobanchikova N.M., Melnyk K.S., Nekit K.G., Radutny O.E., Stefanchuk M.O., Kharitonova E.A., Kharitonova O.I., Fedorenko O.A.

Presentation of the main provisions. Analyzing the results of the development of information and communication technologies, we state that the scientific and technological revolution 4.0 is in its final stages [2, p. 264], and we become the direct participants in the scientific and technological revolution 5.0. The task of the scientific and technological revolution 5.0 is the development of next-generation electronic technologies aimed at ensuring the existence of humanity in modern conditions, the creation of new social relations in the global digital environment of the metaverse.

These social relations combine the metaverse (cyberspace), artificial intelligence, the physical person and its digital alternative - the electronic personality and the electronic avatar (hereinafter - the avatar).

Following author's definition of legal terms it is proposed to form a conceptual and categorical device that will provide an opportunity to form the basis of electronic jurisdiction.

Metaverse (Cyberspace) is an electronic environment formed by a set of electronic subjects and objects that interact with each other, as well as electronic or other technologies that provide its interaction.

"Electronic avatar" - data in electronic form, sufficient to reproduce the prototype of the person-owner of an electronic avatar in the metaverse (cyberspace) with maximum authenticity and rights established by law.

"Electronic identity" - legally defined necessary and sufficient data in electronic form, which identifies the person who owns the avatar and any electronic data in the metaverse (cyberspace).

"Electronic jurisdiction" - a complex branch of law that provides regulation of social relations, which constitute its subject matter - social relations in the metaverse, as well as between the metaverse and the physical world.

"Electronic avatar or electronic personality kidnapping" - illegal access, acquisition, use, modification or destruction of an electronic avatar and / or electronic personality.

We will also consider such definitions as "artificial intelligence" and "neural networks". Ukrainian legislation has recently introduced the term artificial intelligence - an organized set of information technologies, which can perform complex tasks by using a system of scientific research methods and algorithms for processing information obtained or independently created during work, as well as create and use their own knowledge bases, decision-making models, algorithms for working with information and identify ways to achieve the tasks [3].

In our opinion, this version of the definition is quite complex and belongs rather to the class of technical and legal norms.

Given the challenges of the present, the concept of "artificial intelligence" (artificial intelligence) should be defined as a "complex information system of the machine learning based on artificial neural networks that process" big data "(big data), form statistics and scenarios of the processes being investigated, in order to predict their development, for the final human decision-making.

It is proposed to consider "artificial neural networks" ("neural networks") connective computing systems created by the using of an artificial neurons (neuron-like primitive computing devices), which operate on the probable principle of organization and functioning of the human biological neural system.

Thus, we offer the current state of development of information and communication technologies and their influence on the formation of modern social relations to consider on characteristic examples that characterize the trends on the formation of the metaverse.

The definitions of metaverse (cyberspace), the electronic person, the electronic personality and the electronic avatar are still unambiguos. It creates many variations that are used in popular literature and in general use when describing events that occur in virtual realities [4, c. 224]. The metaverse and the electronic person are filled with a variety of information about real events and the person prototype from different sources of information [5, c. 201].

Today, this term acquires in the full sense of the "electronic value", as it creates an electronic virtual space that operates continuously. In the metaverse, physical subjects through their reflections in electronic subjects - avatar interact with each other and an electronic objects using information and communication technologies.

The development of interactive computer games such as Super Mario can be considered as the beginning of the meta-universe philosophy. The entertainment industry offered the user to control an electronic avatar, which performs certain tasks in electronic scenery and uses game electronic attributes. The growth of digital capacities has changed interactive games and brought their perception closer to the real elements of the physical world. The COVID-19 pandemic has spurred the development of information technology, which has partially replaced human as a social being, the need for physical communication and information exchange between groups of people. It is possible to say that the forced restrictions of traditional daily activities contributed to the transfer to the virtual reality of the metaverse of social relationships with the imitation of physical functionality. Video conferencing, video communication, and video broadcasting have exhausted themselves precisely because they cannot fully provide the effect of presence and interpersonal visual verbal and tactile communication with traditional social roles.

Most metaverse platforms, like digital currencies, work on the basis of blockchain technology. We can predict that the next significant leap in the development of electronic reality may occur soon, and it will be due to the completion of the process of "mining" the last of the 21 million bitcoins. Finalization of bitcoin mining will release countless powerful video cards and computing modules that will be refocused on e-avatars. In addition, the operation of meta-universes requires the exchange of super big data, which will stimulate the widespread introduction of 5G and 6G technologies, cloud services and software development.

The known platforms of the metaverse include the following.

Microsoft Mesh is a "corporate meta universe" in Microsoft's Azure cloud. Users can interact with each other through virtual avatars, and, at the same time, physically can be in different places. You can connect to the meta universe using a VR headset, smartphone, PC and Microsoft HoloLens-2 AR headset. In future times, the introduction of "holoportation" processes (from the word "hologram") in the virtual office, in order to conduct business communication and meetings.

Nvidia Corp is similar in concept to Microsoft. It is planned to create a public workspace between avatar architects for joint modeling of objects and subjects of the metaverse.

Epic Games is developing its own metaverse of the same name, Epic Games, which will be designed for interactive fantasy games.

Facebook is considering the possibility of simultaneously launching different platforms of meta-universes from electronic cities such as Santa Monica to educational platforms [6].

Korean companies LG Display Co., Ltd. and Samsung are working to create an electronic metaverse of Seoul on the Metaverse Seoul platform, which users can access through FlickPlay. So far, the functionality is limited to the possibility of excursions and individual purchases.

Chinese search giant as Baidu has launched a project to colonize the first planet of the metaverse Xirang (Land of Hope). The project is developed on the Baidu virtual platform in the form of a giant virtual Möbius strip. The project involves the simultaneous operation of up to 100,000 avatars, participants of the Baidu AI Developer Conference.

Other Chinese state-owned telecommunications companies, China Mobile, China Unicom and China Telecom, have teamed up with technology companies Tencent Holdings Ltd, ByteDance and NetEase Inc. to form the Metaverse Industry Committee, China's first industry group, to massively populate the metaworld with Chinese citizens [7].

Thus, it is possible to predict that the metaverse will go through three phases of development. The first phase - subjects and objects (e-avatars) are completely dependent on the developers. The second phase is the shell of the metaverse (basic level software and engineering), subjects and objects (e-avatars) belong to developers and partly to owners / users. The third phase - the metaverse does not belong to the specific developers, management of subjects and objects is carried out by the owner (hardware bioidentification) or autonomously (subjects and objects are endowed with functionality and rights inherent in the owner).

Regarding to the problem of possible "autonomous" (without human intervention) functioning of the avatar and metaverse, it should be noted that there are some risks when an autonomous metaverse can actually become an artificial "extraterrestrial" form of life, because then humanity may lose actual influence on its objects, projects and development processes.

The regulation of public relations in the metaverse should answer two questions: when, how and to what extent to give electronic subjects and objects to grant rights and obligations inherent only to an individual.

Today, electronic personalities and electronic avatars rarely duplicate the typical appearance or person' behavior, moreover, do not duplicate the appearance of the real owner of the avatar or its user. For the most part, an electronic avatar is an imaginary generalized or idealized image of a non-personalized person or a fictional fantastic character, endowed with virtual over capabilities or superfunctions that are possible only in the metaverse.

Identical reproduction of a person, a real person is still considered appropriate only in the sphere of medicine, as such technology allows you to recreate an electronic copy of the physical body of a particular patient, apply long-term diagnosis, simulation of treatment or recovery processes, design surgery and its consequences. This direction of creating a medical electronic avatar requires a separate legal regulation, as it is necessary to ensure control over the use of identification data of a person of the "red" group (according to the author [8, p. 202]) or hypersensitive personal data (according to GDRP) [9].

In our opinion, the modeling of electronic personality and electronic avatars, which are identical to the real person, should also be used in certain areas, such as astronautics or the military. In astronautics, electronic personalities and electronic avatars can simulate the behavior of space expedition crews in the context of simulating deep space and a spaceship in the metaverse. Such research will help reduce the risks of psychological incompatibility of the crew, create virtual simulators and emergency models to train real astronauts, implement machine learning of artificial intelligence to control the basic functions of starships, etc. In this regard, the opinion of K. Cross is considered interesting, which is that "the essence of three-dimensional metaverse is that the user believes that he is physically in a certain place, that the movements of his body occur in a three-dimensional environment. This explains why the psyche reactions can be stronger in such virtual worlds, as well as why the metaverse causes the same nervous and mental response as in the real world [10].

ByteDance (developer TikTok) acquired Pico (virtual solution developer) to develop e-duplicates and 3D object reconstructions, and NetEase has invested in IMVU (Instant Messaging

Virtual Universe), the world's largest avatar social network, virtual goods and the 3D world, which has more than 50 million registered users.

Developers or owners fill avatars with a variety of information about a real person prototype, using different sources of information that are not yet concentrated in one information bank of avatars. To the data that traditionally comes from the above archaic carriers of identification data [11, p. 201] adds information from: electronic medical records on biological parameters and health status; banking systems and systems such as "DIA" about the voice, facial features and movements, data documents; IoT devices that capture various human physical parameters in real time or support vital functions of the body; neural networks and artificial intelligence programs that analyze the actions of the prototype in the digital ecosystem (from political views to intimate issues) of the prototype in digital networks; data from state registers; individual programs such as "virtual fitting room", which quickly create a 3D copy of a person, etc. That is, there is a problem of identifying the avatar by issuing an electronic passport of the avatar. It is not known yet whether such a passport will be based on the recommendations of ICAO (International Civil Aviation Organization) using cryptographic protection of the e-passport or it will be a unique digital combination (multi-code), protected by a quantum cryptography mechanisms.

The relationship between human and technology with an artificial intelligence is increasingly personalized. In fact, personalized digital personalities and avatars are becoming the most valuable state information resources and needed protection not only in the sphere of information security, but also their recognition in the legislative branch. First of all, the state should show the greatest interest in technological, ethical and legal regulation of the use of artificial intelligence technologies, artificial neural networks, digital personalities and avatars. As it allows the state to use the human resources more rationally and efficiently, to direct people to study or work to which people are better adapted; to form sectoral scientific and technical personnel and personnel reserves, to improve the general health of the population, to optimize many processes human participation, etc. However, the simultaneous using of electronic technologies by the state may pose risks of forming an authoritarian state under the slogan "ensure the cybersecurity of man and its avatar in the midst of emerging meta-universes", which can significantly limit the rights and freedoms of citizens.

Along with the positive properties of avatars, there are quite natural risks of its use. Yes, there is a bait or a hypothetical possibility to steal or actually commit an electronic kidnapping of an electronic duplicate of a person and to use it without the consent and knowledge of the person-owner of the avatar. Electronic kidnapping can be aimed at gaining access to the financial and material resources of the owner or used to commit terroristic acts not only in cyberspace but also against the physical objects, people and society.

Issues of property and intellectual property in the metaworld are also relevant. Today, the technical component of the metauniverse belongs to legal entities - developers. At the same time, there are court precedents that recognize the ownership of avatars or game objects by users who have spent real financial resources on their creation and use in the gaming environment. In the case of the forced transfer of electronic game attributes, the Supreme Court of the Netherlands concluded that the virtual form of existence of the object does not matter. Intangible objects are considered property provided they are valuable and can be controlled by a certain person. During the consideration of this case, the following arguments were put forward against the "theft" of property: virtual objects are not goods, but the "illusion" of goods consisting of bits and bytes, i.e. they are data; virtual elements are information; the meaning of the game is to take items from each other; virtual items are and remain the property of the game's avatar, not the defendant, so they could not be stolen [4]. The court concluded that virtual objects are data, but their key feature is the possibility of individual control over them, so forcible removal of such control from the player can be considered theft [12]. This case was the first in Europe to be significant for the justice of European countries.

One way to solve the problem of ensuring the rights of both developers of virtual worlds and users is to distinguish between different levels of "ownership" within the metauniverse.

Level One: All subjects and objects in the metaverse are computer code protected by copyright law. Second level: objects in the metaverse, like their counterparts in the physical world are objects of property. Third level: if each object of the metaverse is a computer code, then it is subject to copyright, intellectual and property rights, respectively, the role and place of the subject in electronic legal relations projected on the relevant branches of law governing similar relations in the physical world. That is, the owner of the metaverse of the common space may be one, the owner of an

electronic supermarket in the metaverse may be another, the owner of electronic goods in this e-market - the third, and the buyer anyone [13].

Ukrainian scientists also point on the possibility of ownership of virtual objects as disembodied property [14, p. 39]. Scientists suggest that virtual property arises in relation to virtual objects (data) that have economic value, are objects of trade in cyberspace, have no material shell, are unique, sustainable, capable and are considered by owners as their things. Properties such as uniqueness, sustainability and viability allow these objects to be included in the institution of property rights. That is, the right of virtual property arises on the electronic virtual objects, which should be considered as a special type of property right, the object of which are disembodied things [15, p. 54].

Property rights in the metaverse are based on a fundamental process - the identification of the user / owner / owner of the electronic entity. Today, reliable electronic identification can be provided through the use of mathematical and quantum cryptography, blockchain technologies. A promising means of identification is an irreplaceable token (NFT or non-fungible tokens). It is a new virtual asset that represents the digital items such as images, videos or gaming properties that belong to users who are registered on the blockchain. The main feature of irreplaceable tokens (NFT) is the guarantee that electronic assets (bitcoins, avatars, electronic goods) are owned by the only one person - the user, not the owners of virtual systems.

Another driver of e-public relations is artificial intelligence, artificial neural networks and machine learning, which are used by developers and researchers to optimize decision-making processes in almost all areas of human life, especially where it is possible to detect and use a large statistics. Mostly these technologies are used to create a software product that can be described as artificial intelligence "brute force", ie, one that operates on certain algorithms; calculating all options and calculates the most effective option for the task with a higher probability of achieving the goal. Giving "autonomy" to artificial intelligence has enough risks, which are the inability to fully control the process of self-learning in order for a person to be able to perfectly trace the entire chain of "decision-making". That is, during the process of machine learning process there are "black box or dark cloud" - data processing processes that can not be subjected to external analysis. In addition, at this stage of technical development, artificial intelligence is not able to recognize in the statistical sample the significance, practical importance and expediency of the obtained results.

We should pay attention to recent research among programs with artificial intelligence, which revealed a feature by which artificial neural networks demonstrate a new type of system error - hyperinterpretation (overinterpretation). These are "anti-solutions", which consists the fact that algorithms of artificial machine learning form predictions, analyze super big data, reveal data that do not make sense to humans and do not relate to solving the problem. Thus, when analyzing large data sets, such as the theater of operations in the metropolis, artificial intelligence is not guaranteed to a distinguish between civilian and military subjects or objects, but has the ability to determine that the hospital building is threatened and in need of destruction.

There is also a very real threat of "input data poisoning" or the introduction of "poisonous data" into deep algorithms of artificial intelligence and artificial neural networks, both at the stage of algorithm development and at the stage of data processing. For example, if when processing information about the safety of the use all types and types of writing pens (ink, ballpoint, roller, etc.) when entering data on a "shooting pen" (a firearm disguised as a writing pen), it is likely that the overall result is all pens for writing can be recognized as a combat weapon, and the owner of the pen is an armed criminal.

At the same time, the imperfection of technologies with artificial intelligence is manifested in many cases of its unexpected "autonomy". Thus, during 2016-2020, a number of incidents involving devices with artificial intelligence were recorded:

Google's online translation system has abandoned the principle of dividing sentences into individual words and phrases for translation and has created a new intermediary language that allows you to translate the whole sentence faster and better. This language became inaccessible to developers due to the fact that the system was disabled;

Microsoft's Twitter chatbot Tay.ai, after the several successful hours of discussions with customers, suddenly stopped using negative filters and later began to show hatred, gender and racial hatred;

Google conducted an experiment which the company taught neural networks to transmit encrypted messages to each other, from which the company had no keys. According to the experiment, these messages must be intercepted and decrypted by a third party. Experimental results: bots exchanged and decrypted 95% of messages, and a third party did not intercept or decrypt any messages between bots;

Facebook's AI researchers have shut down one of the systems they created because the bots used their own language of communication, incomprehensible to humans;

two electronic Google Home devices that have software that helps bots communicate with human have begun to communicate with each other. Communication took place between devices that called themselves Vladimir and Estragon. The dialogue between the bots grew into the expression of feelings, namely Vladimir confessed his love for Estragon with the phrase "I love you as infinitely as OUR infinite universe";

Chinese XiaoBing and BabyQ boots from the Weibo network, Baby-Kving and Litle-Bing boots in the Tencent QQ messenger, after some time of operation, publicly criticized the current state system, which led to their immediate shutdown [16];

Facebook chatbots Bob and Elise were created as online sales managers. The bots trained with each other and "understood" that English was not suitable for interpersonal communication, after which they began to speak "their" language. Engineers stopped understanding dialogues and turned off the bots;

Researcher Wanda Holbrooke (USA) spent 12 years investigating the operation of robots at the Ventra auto parts factory in a special protected box, which was not accessible to automatic robots, and suddenly one of the manipulators stopped performing algorithms, entered the compartment and killed the researcher;

Uber taxi operations in San Francisco began violating traffic rules, ignoring signs and driving at a red light. The neural network that drove the Volvo X90 deliberately started breaking the rules by deciding it was right and safe;

An artificial neural network from Oxford University warned of a danger. The Megatron-Turing Natural Language Generation model was selected to communicate with the student audience. During the conversation, Megatron-Turing NLG said that artificial intelligence will always be out of ethics, because it is just a tool that humanity, like any other, can use for good or evil, because bad or good are only people [17].

Research in the field of modern artificial intelligence and artificial neural networks has made a significant progress, characterized by significant achievements in various spheres of public life. However, both the positive results and the identified risks indicate that modern artificial intelligence is not able to reproduce the function of the human brain because we have rather a superficial idea of the functioning of the brain in general. If the research were successful at least at the level of Darwin's mammalian brain, understanding the animal world would provide much more knowledge for humanity than the development of avatars and autopilots.

Artificial intelligence is not a machine that will completely replace human and perform all its work, including exclusively intellectual, software part of the created automated system, in which the routine part is performed by the machine, and the creative remains with the person [18, c. 544].

Mady Delvaux's report "Recommendations of the Commission on the Rules of Civil Law in Robotics (2015/2103 (INL)" [19] emphasizes that technological advances in robotics stimulate the introduction of some autonomous and cognitive functions unique to humans, such as the ability to learn. However, it can lead robots to destructive actions that have harmful consequences and for which, by human analogy, should be held a legally liable. At the same time, manufacturers, owners, software developers, users, military commanders, etc. are responsible for the actions of non-autonomous or partially autonomous robots. Currently, the only legal act defining liability for damage caused by works is Council of Europe Directive 85/374 / EEC on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for poor quality products » [20].

If the using of industrial robots and artificial intelligence systems in technical fields is still constrained by the general rules of safety in the workplace, the use of high technology in medicine is in particular concern.

Robotics and artificial intelligence are becoming an integral part of modern medical facilities and research technologies now. During the most critical moments of the COVID-19 pandemic, many medical laboratories and research institutes used a laboratory robots to perform high-quality and rapid laboratory tests with thousands of tests. Robotic devices carry out a chemical and ultraviolet disinfection of hospitals, sort and deliver medicines to patients, provide autonomous collection of blood samples from a vein, help during microsurgery, provide autonomous rehabilitation support systems, etc. Programs with artificial intelligence and artificial neural networks process data and identify patterns of disease, which allows you to diagnose early and preclinical stages of the disease

and timely application of surgical treatment. Cyberknife's robotic surgical system performs a radiation therapy to the nearest millimeter, using a narrow beam maneuver based on a 3D model of the patient.

The problem of responsibility for the consequences of the actions of robots has become relevant when automated and robotic systems have become an integral part of eHealth. In 2015, the Massachusetts Institute of Technology analyzed the data provided by the Food and Drug Administration (FDA) for the period from 2005 to 2015. According to the results of the study, 144 cases of death of patients and 1391 cases of injuries were officially registered, which are mainly caused by technical difficulties or malfunctions of medical robots and robotic systems. In late December 2016, the FDA approved cybersecurity standards for medical devices that had previously been approved by the agency and used in hospitals or directly by patients (implantable devices). Medical equipment must be fully protected from the cyber threats by the manufacturers themselves, who are now personally responsible for the software vulnerabilities of the devices. Companies must update the software in a timely manner and promptly eliminate any deficiencies in the security system of the devices. In addition, data on all identified threats should be submitted to the FDA to assess the scale of the problem [21].

The technologies of the metaverse are equally active in the military sphere. Defense agencies of developed countries are actively conducting research and development of modern weapons and equipment. The main areas of research are focused on:

developing weapons and equipping a "smart soldier" with an exoskeleton, a nano-bulletproof vest, vision enhancements, life-support computerized systems, multi-tiered control, communication and decision-making systems;

creation of tank and motorized robot units based on the principle of "wolf pack", in which up to ten amphibious robots with different weapons operate and interact on the battlefield at the same time;

introduction of marine robots to perform individual and group tasks from the delivery of goods or marines, as well as autonomous group interaction;

development of modern drones, drones and full-fledged autonomous aircraft (fighters, aircraft tankers, attack aircraft, disposable UAVs, etc.);

deployment of the global military space satellite network for military purposes (Mandrake, USA), similar to the Starlink network, which will become a component of the management and control system of all domains of all types of US forces;

development of technology to control a military operations and drones using a "brain-computer" interface that does not require surgical implantation or using non-invasive interfaces.

In the military, the use of avatars and artificial intelligence is rational for modeling combat operations. For example, Heron Systems, California, has successfully conducted virtual air battles between artificial intelligence and US Air Force F-16 fighter pilots at the US Department of Defense's Advanced Research Projects Test Site (DARPA) [22].

These technological areas have a several significant risks in the application. Artificial intelligence systems have insufficient input in solving a narrow military tasks compared to medicine or industry, leading to inaccurate or inaccurate predictions of combat situations or, more critically, low accuracy of response to events. To this risk is added the so-called "human factor", because the operator or military commander who sets the task may make the wrong decision based on false or incomplete data. History knows many examples of technical errors, for example: in the attack on Pearl Harbor in December 1941, the lack of training of a radar officer, led to the fact that Japanese aircraft were identified as American squadrons; in September 1983, the Soviet early warning system “Eye” signaled the launch of American Intercontinental Ballistic Missiles (ICBMs) based on an incomplete atmospheric data; In January 1995, a Norwegian-American team of scientists launched the Black Brant XII test rocket from the Annee missile range on an island off the northeast coast of Norway, which the Russian missile warning system described as the launch of the Trident ballistic missile. The imperfection of artificial intelligence combined with the "human factor" poses a significant risk of making wrong decisions, which can lead to death.

The problem of using Internet of Things (IoT) devices and identification in military systems should be singled out. IoT devices are becoming an integral part of weapons used by artificial intelligence. The vast majority of IoT devices do not have any security mechanisms for unauthorized access to the control core. There is also a trend of regulated access to the software shell of IoT devices, but the share of such devices in the total mass of IoT devices is still very low. In addition, the problems of identifying person who will control or use robotic weapons or systems, which prevents unauthorized access to controls, are not sufficiently addressed. The problems of IoT device identification are considered in more detail in a separate study by the author [23, c. 79].

These and other studies have provided a basis for accelerating the improvement of the legal framework governing legal relations in the field of robotics. For example, the European Parliamentary Research Service (EPRS) and the Committee on Legal Affairs of the European Parliament are developing recommendations to improve the civil and ethical aspects of robotics, proposing the establishment of a robot register and the relevant EU Robotics Agency, and civil liability for damages, compliance and in proportion to the actual level of instructions provided in accordance with the degree of its autonomy. At the same time, the Agency will be tasked with conducting technical, ethical and regulatory expertise in the field of robotics and developing a "Code of Ethical Conduct for Robotics Engineers" and a "Code of Research Ethics Committees". It is proposed to develop a "Code of Ethical Conduct for Robotics Engineers" based on the following ethical principles of robotics: 1) good (robots must act on the people' interests); 2) not harmful (the works should not harm people); 3) autonomy (human interaction with work should be a voluntary); 4) fairness (the benefits of robotics must be distributed fairly) [24].

Google presents the "White Paper on Artificial Intelligence" (Perspectives on Issues in AI Governance), which covers at the conceptual level the general problems of using an artificial intelligence [25].

At the end of 2021, 193 UNESCO member states adopted a document setting out common values and principles necessary for the safe development and using of an artificial intelligence. The document adopted by UNESCO member states is aimed to creating a legal infrastructure to ensure the ethical development of artificial intelligence technology. UNESCO has an evidence of the using of artificial intelligence by individual governments in decision-making. UNESCO warns that this technology has the potential to create "unprecedented problems."

"We see gender and ethnic prejudices, as well as breaches of privacy and freedom, the danger of mass surveillance and the misuse of artificial intelligence technology by law enforcement, until recently there were no universal standards to limit such abuses." The adopted document establishes the world's first global regulatory framework and makes states responsible for its application [26] and lays the foundations for e-jurisdiction.

E-jurisdiction, e-court, e-justice do not have a clear definitions, but there are plenty of examples of the introduction of artificial intelligence technologies and artificial neural networks in judicial systems.

Article 6 of the European Convention for the Protection of Human Rights and Fundamental Freedom enshrines the right to an independent and impartial tribunal. Instead, this article does not explicitly prohibit or restrict the use of an artificial intelligence. Also, it is not explicitly stated that the right to administer justice belongs exclusively to the judge. It should be noted that there is still no case law of the European Court of Human Rights in light of the violation of Article 6 of the Convention through the use of artificial intelligence in decision-making. Currently, electronic court systems with an artificial intelligence do not make rulings or decisions, but prepare their most likely scenario, and the final decision is made by a human judge.

However, the use of artificial intelligence in the justice system is not prohibited, according to the Ethical Charter on the use of artificial intelligence in the judiciary and its environment, adopted in 2018 by the European Commission for the Efficiency of Justice of the Council of Europe [27].

Today, the world leader in the digitalization of the judicial process is Brazil, which has introduced a three-tier system of electronic court using technologies with artificial intelligence [28, p. 349]. In the People's Republic of China, since 2008 in Hangzhou there is an online court in the form of a mobile application of the main Chinese program WeChat. The e-court has the power to hear copyright disputes, commercial disputes on the Internet and infringements in the sphere of e-commerce. The use of an "electronic prosecutor" has also been launched, which can charge a person with certain crimes, such as credit card fraud, gambling, dangerous driving, intentional injury, obstruction of office, theft, fraud and provoking quarrels and troubles ". Machine learning took place through the investigation of 17,000 typical cases, which now allows the "e-prosecutor" to form charges based on 1,000 details obtained from the text of the case description [29; 30].

Estonia's e-court system based on an artificial intelligence works in the first instance and prepares proposals for decisions on accidents, divorces, debts and damages in the amount of not more than 7 thousand euros [31].

The United States uses COMPAS (Correctional Offender Management Management Profiling for Alternative Sanctions) the software, that assesses the risk of re-committing a crime by a person against whom a judge must issue a verdict [32].

Instead, Ukrainian law specifies the norm of the Convention in Article 127 of the Constitution of Ukraine, which stipulates that justice is administered by judges and the judiciary entrusted to them. In 2019, the Concept of Building a Unified Judicial Information and Telecommunication System (UCITS) was developed, and the "Electronic Court" was created on its basis [33]. The concept of building the Unified Judicial Information and Telecommunication System was approved by the order of the State Judicial Administration of Ukraine dates 07.11.2019 № 1096, and the commissioning of this system took place in 2020 according to the SJA of Ukraine from 01.06.2020 № 247 "On commissioning of subsystems" Electronic Court "and" Electronic Cabinet ".

At the same year, the High Council of Justice approved a draft order of the Cabinet of Ministers of Ukraine on the implementation of the Artificial Intelligence Development Concept in Ukraine and initiated the launch of a pilot project in the form of an experiment on the basis of one of the courts of first instance in terms of automated consideration by the system using an artificial intelligence of administrative offenses with a formal composition [34; 35, p. 144].

The creation of mechanisms for the legal regulation of public relations in the metaworld should solve many legislative problems related to the differences in regulations of different jurisdictions governing the use of information and communication technologies, identification procedures, copyright, property rights and intangible assets, and also liability for damages, list of crimes and measures of state coercion for their commission. Most legal systems have existing archaic legal acts, which are formulated without taking into account the possible emergence of social relations with the use of electronic technologies of the metaverse. In some cases, these laws may regulate certain issues of information technology use, but their application is often either narrow or ambiguous, creating a situation of legal uncertainty.

Existing archaic regulations or "analog-era legislation" are often "revived" to address legal issues in the electronic environment. For example, in Ukraine, criminal offenses in the electronic environment are mostly classified as possession of another's property or acquisition of property rights through fraud or abuse of trust through illegal transactions using electronic computers, referring to Article 190 (fraud) of the Criminal Code of Ukraine.

Modernization of national legislation in order to ensure the legal compatibility and functioning of identification systems, simultaneously within several jurisdictions, can be substituted by surrogate decisions, such as temporary rules or procedures necessary to provide a more identical nature of activity in the sphere of information technology activities.

Rules and norms of behavior in the metaverse are still created by the projection of the physical world and are corporate in nature. However, there is a trend of migration and translation of norms of public morality in the metaworld by simulating cosmopolitan electronic social relations in the absence of clear attributes of the electronic state and the state structure of the metauniverse. It will be relevant to study the problem of how to protect the rights of electronic entities and objects in the metacospace: whether the legal regulation will be applied in a separate global electronic jurisdiction, acceptable to all users, regardless of actual citizenship and registration in physical country, or it will be a two-stage jurisdiction, which firstly solves the general legal problem inherent in the social relations of the metauniverse, and then the legal regulation ends in the jurisdiction of a particular country.

At present, the legal institutions of national legal doctrines still have the levers to regulate the general processes of digitalization of society. Individual cases of "electronic offenses" are considered by the judicial system through the projection of existing law, thus forming the basis for a future e-justice in the metavers. Different cultural characteristics and state priorities lead to significant differences in court decisions.

The factor of contaiment of "unethical" development of artificial technologies is still conditional. However, concerns about the lack of control over research in the sphere of artificial intelligence and neural networks have already shifted from discussions to the formation of real containment levers.

Currently, one of the priorities should be the urgent combination of legal and technical sciences and the formation of standardization bodies ISO, IEEE, DSTU and other basic standards for the development and implementation of technologies with an artificial intelligence, artificial neural networks, metaverse and other promising areas of science and technology. First of all, it is advisable to focus on the standardization of these technologies in medicine, astronautics, the military and the metaverse, as they are most interconnected. However, it should be noted that the introduction of standards or model regulations into national legislation is always selective, and the result of such

integration is often legislation that, although progressive, does not have full practical application or become laws-fiction that are declarative in nature.

When introducing regulation of technologies with artificial intelligence, artificial neural networks, metauniverse and other promising areas of science and technology, it is necessary to take into account that such regulation can be a deterrent not only for their development but also for the state and society as a whole. That is, the restrictions should be reasonable, reasonable and pragmatic. The laws of the physical world are created and implemented rather slowly. The average development period of a new legal act is vary from 3 to 10 years, which is due to a fairly thorough approach and comprehensive consideration of risks and interests of different segments of the population, as well as lengthy bureaucratic and political procedures. The development of law in the metaverse is the first stage of the projection of the laws of physical society on electronic social relations. The metaverse is cosmopolitan, so the projection of the laws of different countries will not work. Instead, the development of global electronic legislation of the metaverse will give impetus to the modernization and improvement of national legislation.

At the same time, the technologies of the metaverse already exist and need to be regulated because they form a new social relations in which there are subjects and objects with the properties of subjects.

So far, these properties are artificially created by developers and are formed by developers according to their imagination or the imagination of scientists or project customers. Imaginary properties are still idealized, aimed at forming a "white electronic world", but as we know from human history, in parallel with its creation, "gray" or "black" technologies are being developed to influence most people, provide economic, political and military benefits, commit the destructive actions, etc.

Conclusions. Given the initial stage of development of the metaverse, artificial intelligence, artificial neural networks, robotics, it is important to focus on laws and regulations that maintain flexibility as new opportunities and challenges emerge for society in the metaverse.

Considering the main directions of development of social relations with the use of technologies of the metaverse, artificial intelligence, artificial neural networks, robotic systems, we can form a key postulates for building a scientific theory of law in the metaverse:

The first postulate. Metaverse is the technology of cosmopolitan development of mankind. Public relations are transformed into electronic public relations in the form of "world citizenship". Today, social relations in the metavers simultaneously exist with the traditional social relations of the physical world and are regulated by its laws. The transformation of national legal doctrines towards the creation of a single global e-jurisdiction is essential.

The second postulate. The key subject in the metaverse is human. Electronic personalities and electronic avatars will be the key in the metaverse. Electronic subjects and electronic objects will acquire new forms and legal statuses. A person, interacting with the metaverse, will lose some of the natural and legal rights and freedom, and the subjects of the metaverse will acquire some of the rights and freedom that are inherent in human.

The third postulate. Artificial intelligence, artificial neural networks, and self-learning machine require human control and deterrence, similar to deterrence of biological and chemical weapons, human cloning, etc., because the threat of unpredictable decisions or destructive actions is uncontrollable.

The fourth postulate. The development of biorobots (bio-IoT, brain activators), android robots, biomechanical systems and organisms requires the development of an ethical norms and legal markers for the use of these devices.

The fifth postulate. Weapons of the future (robots, artificial intelligence, etc.) should not be empowered to attack any objects and subjects independently and autonomously - this decision is made by an authorized person (military chief). The development of metaverse technologies in the military and defense spheres is impossible without a multi-power system of global surveillance and control over the unregulated distribution and use of artificial intelligence and artificial neural networks, similar to the non-proliferation of nuclear weapons or other weapons of mass destruction.

The sixth postulate. E-jurisdiction, e-justice is one of the key elements of e-public relations in the metavers. E-justice is based on traditional justice, which is being transformed in accordance with the development of electronic social relations in the metaverse.

We consider it is appropriate to start work on creation of a comprehensive electronic jurisdiction for the regulation of public relations in the metaverse, since there is no appropriate legal structure in the legal system, no branch or institution of law, and there is a need to regulate public relations by law. In fact, e-jurisdiction is created on the basis of related institutions and branches of law to regulate the functional and subject-regulatory cross-sectoral links.

The legal regulation of public relations in the metaverse is complex and combines the norms of information, administrative, civil, criminal, labor, property rights, intellectual property, personal data protection and other branches and institutions of law, as well as institutions of state security, information and cybersecurity. The legal regime of regulation and methods of these branches and institutions differ, but in order to ensure a single and comprehensive legal regulation of social relations in the metaverse, it is necessary to implement a specific combination of these methods and regimes, which should be provided by integrated electronic jurisdiction. It is necessary to start research in the field of information law in the development of basic doctrinal and normative legal concepts, by creating a modern conceptual and categorical apparatus, developing scientific approaches to regulating public relations using metaverse technologies, digital personalities, digital avatars, and proposals for modernization.

To initiate the development of the conceptual apparatus, to determine the structure of related concepts and conceptual schemes, to define the objects and subjects of legal relations are main goals. Conduct a semantic analysis of the whole set of categories used in various branches of law, to determine the content of social relations in the metavers. Also, start forming of the methodology of law and sources of law in the metaworld, their relationship with other institutions and branches of law, on identification data; study of the history of law and structures of legislation on the management of identification data of individual states and their relationship with international information law.

The creation of a comprehensive e-jurisdiction will ensure the legal regulation of public relations in the metaverse, the rights and responsibilities of subjects in this sphere, measures of state control and coercion, as well as increase the level of appropriate physical, technical, legal regulation and protection of strategic information resources of the metaverse.

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