Radioecological Research of Our Time: Socio-Psychological Aspects

M R Arpentieva 1, E A Bogomolova 2, I V Gorelova 3, T V Kivlenok 4

1 Department at the Theory and Methods of Physical Education, Ugra State University, Chekhov str., 16, Khanty-Mansiysk, Khanty-Mansi Autonomous Area - Yugra, 628012, Russian Federation
2 Department at the development and education psychology, Tsiolkovskiy Kaluga state University, Razin str., 26, Kaluga, 248023, Russian Federation
3 Chair of Accounting, Analysis and Audit, Volgograd Institute of Management, a branch of the Russian Russian Presidential Academy of National Economy and Public Administration, Gagarin str., 8, 400131, Volgograd, Russian Federation
4 Department of Civil Law and Process, A.G. Stoletov and N.G. Stoletov Vladimir State University, Gorkiy str., 87, Vladimir, 600000, Russian Federation

E-mail: mariam_rav@mail.ru

Abstract. Radioecology is a scientific discipline which studies how radioactive substances interact with nature; how different mechanisms affect the substances’ migration and uptake in food chain and ecosystems. Investigations in radioecology might include aspects of field sampling, designed field and laboratory experiments and the development of predictive simulation models. This multi- and interdisciplinary science combines techniques from some of the more basic, traditional fields, such as physics, chemistry, mathematics, biology, and ecology, with applied concepts in radiation protection. The main structural element of the system for ensuring radioecological safety of biocenoses and the population is radioecological activity in a number of areas: radioecological monitoring of territories, radiation survey of facilities, compilation of radiation and hygienic passports of territories, decontamination of identified foci of radioactive contamination, neutralization of radioactive waste, collection and removal of radioactive waste from the territory of the settlement people, maintenance in a safe state of the structures of the atomic industry laziness and facilities long-term (centuries-old) storage of radioactive waste, their accounting, forecasting the radiation situation in the controlled area, the development and implementation of measures for the prevention of accidents. At the levels of organizational and personal security, radioecological activity includes such areas: radioecological monitoring of territories and production capacities of organizations, radiation survey of organizational facilities, compilation of radiation and hygienic passports of their territories, decontamination of identified foci of radioactive contamination, personal hygiene and prevention of hidden, repeated exposures of employees / inhabitants of the contaminated region, neutralization of “leaks”, and removal of radioactive waste disposal from the territory of human settlements, radioecological competence / human culture and organization, strengthening of personal and organizational radioecological safety: formation of personality and organization of a "safe type", that is, human skills and knowledge, production technologies and personnel management systems that avoid or correct dangerous and potentially dangerous actions of a person or a group, development and implementation of measures to prevent emergencies at the level of a person oh and
organizational security and safety: the formation and strengthening of relations in the organization/community, allowing promptly correct or avoid errors that could lead to a dangerous emergency situations. The leading moment in this case is the upbringing and development of a safety culture, including the psychological safety of employees of nuclear industry enterprises.

1. Introduction
Radioecological studies form the basis for estimating doses and assessing the consequences of radioactive pollution for human health and the environment [18; 19; 20; 21]. Development of scientific-technical progress and the Foundation of human impact on the environment, unsustainable use of natural resources, pollution of the elements of the ecosystem led to the deterioration of the ecological situation and set the task of formation and development of the safety culture at the individual and organizational level. Radiation ecology or radioecology as a science took shape and began to develop in the middle of the 20th century due to the environmental pollution by radioactive substances as a result of nuclear testing, nuclear waste, nuclear accidents and nuclear facilities. It is a science that investigates the specifics of the existence of living organisms and their communities in conditions of presence of natural or man-made radionuclide contamination: it involves the study of the behavior of radionuclides in ecosystems and their components (soil, vegetation, animals, communities) and the effects of ionizing radiation on the biota and human [21; 22; 23; 24; 25].

2. Discussion
Being different in nature, causes and consequences, radiation accidents generally reduce to the fact that ionizing radiation arises that disrupts normal life activity of people and nature [2; 3; 11; 26; 27; 28; 29; 30, etc.]. In addition, non-catastrophic, but intensive changes in radiation radiation are observed in connection with the activity of various "cosmic" objects, including fluctuations in solar activity and changes in the shells of the Earth under the influence of technological "revolution" and other, disturbing biosphere, atmosphere, etc., the life of humanity. As for the "military atom", the accumulated weapons of mass destruction are sufficient for the multiple extermination of all living things, but, in spite of this, the arms race continues. Currently, the world's ammunition looked like this: Russia - about 5,000 nuclear warheads deployed, about 8,000 - in reserve or waiting for destruction, the US - about 2,500 deployed, about 7,000 - in reserve or waiting for destruction for, China and Britain - about 300 warheads in each country, Israel, Pakistan and India - about 100-200 warheads. In addition to ammunition, these are huge territories for the disposal of nuclear weapons and nuclear fuel waste, landfills and affected areas, etc. I.E. Vorobtsova and colleagues write that "At present, ionizing radiation is a global environmental factor". However, as they say, "Despite the numerous radiobiological studies, many questions concerning both the evaluation of absorbed doses in uncontrolled human exposure and the long-term medical and biological consequences of low doses per person remain unresolved" [8, p.39]. L.S. Koretskaya notes that "The Chernobyl accident caused many serious radiation effects almost immediately. Human, to the radiation, from the nuclear power generation to the medical uses of radiation diagnosis or treatment [15, p.177]. Even less studied are the effects and results of the effect of radiation growth on the biosphere and the atmosphere as a whole. Therefore, as S.A. Geraskin, "To assess the consequences of radiation impact on the surrounding nature, it is necessary to clearly understand what biological effects can be observed in different radioecological situations and at different levels of biological organization. The primary effects of radiation exposure are formed at the molecular-cellular level. Unfortunately, ... the patterns of the formation of effects at the higher levels of biological organization are not reduced to the elementary mechanisms of the biological effect of man-made pollutants "[9, p.44]. Empirical, including "Experimental evidence that radiation effects can occur at the population and ecosystem levels have been obtained ... from three sources: nuclear weapons tests, experiments using powerful sources of ionizing radiation, major radiation accidents. Experiments conducted in the USA, Canada, France and the USSR made it possible to describe the dynamics of radiation damage and postradiation recovery in
cenoses of various types ... Typical reactions of plant cenosis for high dose irradiation are the reduction of species diversity, change in the dominance of species, a decrease in plant productivity and a change in the structure of the biological community "[9, p.44]. The phenomenon of "lifting anthropological stress" is also known: the changes in cenoses under the influence of a sharp disappearance from the territories of inhabitation and growth of human animals and plants, previously purposefully or spontaneously suppressing the reproduction and development of biocenoses and / or certain of its representatives.

3. Results

In the study of the role of ionizing radiation, its primary - immediate, secondary - delayed and tertiary - longitudinal effects - in the life of man and the planet, scientists come from several models [20; 21; 22; 25; 28; 29; 30; 31; 32].

The first model, traditional, connects actual and less, delayed, violations in the life of man, society, nature directly with the "dose of radiation", a measure of "contamination" of the territory of residence. This model assesses the immediate and secondary risks of radiation emissions, infections, "strikes", focusing primarily on monitoring the condition of immediate victims of the disaster and rescuers. The range of interrelations and aspects studied is initially narrowed: from immediate assistance and ongoing parallel with it the study of the state of people with radiation sickness to the development of general concepts of the theory of safe vital activity, based on the model of prevention and correction of radiation accidents, based on the concept of "radiation dose". An example of modern research in this field is the study of oncological and somatic mutagenesis "at the gene level" in various contingents of people exposed to radiation in small and large doses: nuclear industry workers, accident liquidators at nuclear power plants, residents of areas contaminated with radionuclides "(Kyshtym, Chelyabinsk, Sverdlovsk and Kurgan regions, Bryansk, Kaluga, Orel and Tula regions in Russia, Kyrgyzstan and Ukraine, Kazakhstan, as well as Japan and other countries) [6; 13; 12, p.52]. Most of the primary research focuses on cases of terminal and terminally hazardous exposures of liquidators and other persons who were in the minimum proximity from the accident site. However, over time, assessment of the "genetic" and other forms of "echoes" of accidents and radioactive contamination, including somatic disturbances as a result of radiation exposure in large and small doses of radiation and mental disorders resulting from being in the contaminated zones became more and more relevant. The importance of their research is associated with the fact that "... namely somatic mutations are the key events of radiation carcinogenesis and ... can play an important role in the development of a number of non-oncological diseases "[12, p.52]. Researchers note that "... despite significant efforts to address this problem, the medical consequences and the underlying biological effects of radiation exposure in small doses are not fully understood. Even less studied are the consequences associated with the Chernobyl syndrome, psychological radiophobia and other mental health disorders of the victims, including those associated with the social stigmatization of healthy and sick people who have experienced their experience in a radiation-contaminated environment. Researchers found, for example, that "In the group of individuals with the highest levels of unstable and stable chromosomal aberrations ... cardiovascular ... and endocrine diseases are more often ... compared with the same indices in the group with the lowest aberration frequencies. At the level of the trend ... an increased frequency of pathologies of the gastrointestinal tract ..., urogenital ... and musculoskeletal ... systems "[8, c.40]. Likewise, the mental consequences of the relationship between the state and society to catastrophes and infections, their consequences for people, which influence the state of the latter not less, but even more than radiation, are also extensive. This is exactly what the "discrepancies" in the pictures of secondary and primary morbidity and "morbidity waves" in liquidators and other victims say: a person, a community of people, as well as a biocenosis, is able to compensate for a large extent to violations at the physical level, provided its security at the social and psychological level. Naturally, in the "radiation dose" model, these aspects of the security of a large place do not occupy.

The second model, gradually gaining the main attention of researchers, assesses the delayed, long-lasting effects of radiation damage and / or exposure to contaminated sites / objects, from the research
of the "genetic echo" to the "Chernobyl syndrome" studies as a component of stigmatization of people who happened to be in one way or another in the zone of radiation damage. The object of attention of researchers are all victims, including potential ones, the spectrum of reflected relationships and studied aspects is significantly expanded in comparison with the first model. In this model, primary and secondary radiation effects are studied in ecological systems in general. "Primary radiation effects, according to scientists, depend on the radiosensitivity of the components of the species ecosystem and, depending on the dose, can vary from a slight inhibition of development to the death of organisms and the ecosystem as a whole" [9, p. 44]. Obviously, "... when irradiated ... sufficiently high, the dose of the most radiosensitive species will die, the development of other species will be suppressed, and for radio-resistant species such a dose will be safe or even stimulating. This creates the prerequisites for the formation of secondary radiation effects in irradiated ecosystems. " These effects "combine different processes inherent in nature, associated with radiation-induced mismatch of functional bonds between components of the biocenosis ... an example of secondary radiation effects is the oppression of radiosensitive and intensive development of radio-resistant species" [9, p.44]. At the same time, the consequences of secondary radiation effects can be much larger and more significant than direct, primary radiation effects, thus, "the following violations of ecological relations are observed: (1) changes in the microclimate and edaphic conditions; (2) violation of synchronism in the development of ecologically related groups of organisms; (3) unbalanced food chains; (4) the change in competitive relations as a result of differences in the radiation resistance of species. ... imbalance of ecological links and oppression of the development of radiosensitive species can lead to the formation of ecological niches open for immigration of new species [9, p.44-45]. Scientists note the systemic nature of the reaction of the environment to irradiation: "... many features of the ecosystem response to stress are determined not by the characteristics of the action of a particular factor, but by inherent properties of the ecosystem. ... The ratio of doses received by a person and other representatives of a biota depends significantly not only on the ecology of the species, but also on the type of radioactive contamination and the period of irradiation [9, p.44]. Moreover, they depend on the activity, the quality of human life and generality: "... The effect of radiation exposure depended on the stage of ontogeny at the time of the onset of irradiation and was expressed to the greatest extent in persons exposed to radiation in the prenatal period of development. In the case of postnatal radiation, only a part of the population (about 15%) reacted to the radiation effect by increasing the number of gene mutations ... this pattern was noted in several independent groups: the liquidators of the Chernobyl nuclear power plant accident, workers in the nuclear industry and residents of areas contaminated with radionuclides "[12, p.52 ].

A separate model that enhances the integrative orientation of the second model is devoted to stress problems. According to the researchers, "At present, the question of quantifying the contribution of stress and radiation to the development of mental ... disorders of liquidators of large-scale radiation accidents remains open" [14, p.60]. Despite the relative prescription of the Chernobyl disaster, its consequences still remain palpable. In general, it is noted that similar to the "stress of exposure", the stress of staying in the zone of radioactive contamination or, even more so, of ES, the stronger the longer people stayed in the zone, and between the "excess risk" associated with the threat to life and health, and the duration of the stay of the liquidators and other persons in the contamination / accident zone, there is an inverse relationship: "Liquidators working in the accident zone for more than 6 and 12 weeks have a risk of the investigated pathology (mental disorders - AM) by 8 and 12% , than the liquidators of the control group ( <6 weeks) ... Regression analysis of radiation risks revealed a positive statistically significant relationship between the incidence of mental disorders ... and the dose of external exposure in terms of excess relative risk ... »[14, p.60]. In this context, it is interesting to consider the general content of life activities of people experiencing stress .. According to psychologists, including oncopyschologists, there is a multi-stage experience of imbalance in a person's relationship with himself and the world, the growth of life-negating aspects as one of the components of the later "Chernobyl syndrome" [2 ; 3; 7; 10]. In subsequent post-accident periods, as shown by the study of the results of almost 60-year monitoring of the health status and quality of life
of victims and participants in liquidation of consequences of the accidents at the Kyshtym Nuclear Power Plant, the Chernobyl Nuclear Power Plant, other nuclear power plants in the world, there is a need to diagnose and treat the long-term medical and biological consequences of radiation accidents [5; 11; 16; 17, p.78]. The data of long-term surveys of scientists from different countries reflect the phenomena of both early and remote post-accidental effects of ionizing radiation on morbidity in liquidators and residents of contaminated areas. However, with remote effects, the effects of ionizing radiation are usually masked for other unfavorable factors of non-radiation nature. There is the problem of the "Chernobyl Syndrome" - a condition that was first detected by the liquidators of the consequences of the Chernobyl nuclear power plant accident, exposed to a complex of unfavorable factors of radiation and non-radiological etiology. This syndrome is studied minimally. "Integral manifestation of this syndrome is the reduction in life expectancy ("accelerated aging"), described earlier as one of the long-term effects of irradiation in" damaging "doses" [17, p.78]. In comprehending the "Chernobyl syndrome" it is also noted that "... the main risk factors for this phenomenon are age during stay in the zone of radioactive contamination (the smaller the age, the higher the risk), the duration of participation in rescue work and their nature (the risk of reducing the duration life of the liquidators involved in conducting radiation reconnaissance and decontamination, higher than those who performed administrative and economic functions) "[17, p.78]. "Characteristic is the absence of a connection between the absorbed dose of radiation" and mental disorders, which indicates the predominant role of non-radiation factors in their etiology. It is about the impact of psychological and social factors on health and the emergence of the "Chernobyl syndrome": the experiences of ingratitude and disrespect, stigmatization and alienation, betrayal and disregard for the needs of people who endangered their lives and / or lost their lives and health, lost many other human goods , - destroy the harmony of relations with oneself and the world.

4. Conclusion
Therefore, the problem of studying the phenomena of the "accelerated aging" of the liquidators of the consequences of other victims of radiation accidents, the emergence and intensification of threats of oncological, psychosomatic and mental disorders as manifestations of the "Chernobyl syndrome" is so important. It is one of the most relevant for minimizing the long-term adverse effects of large-scale radiation accidents, incl. in the aspect of development on this basis of fundamentally new means of medical protection, the development of interdisciplinary, comprehensive methods of preventive and corrective care [2; 3; 10; 17, p.79; other].

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