10. SOCIO-HYGIENIC AND PSYCHO-PHYSIOLOGICAL ASPECTS OF THE PROFESSIONAL DYSADAPTATION OF THE POPULATION OF THE ALTAI REGION IMPACTED BY NUCLEAR WEAPONS TESTING IN THE SEMIPALATINSK AREA

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In this article we discuss the data from two studies of populations who were exposed to radiation from the testing of nuclear weapons in certain areas in Russia.

Introduction: The first study

Experimental and clinical research of the impact of smaller doses on the central nervous system has revealed both functional and structural changes in human brains (see: Meshkov et al., 1993) According to the data obtained by the Russian state medical dosimeter register (**RSMDR**), persons who have been exposed to nuclear radiation suffer from a set of different diseases. Among these victims, a total of 23.8 percent suffers from diseases of the nervous system and the sensory organs, which stands in second place after diseases of the respiratory organs (40.5 percent). Psychic disorders amount to 15 percent that ranks in fourth place after diseases of the digestive organs which totaled 15.9 percent (see Radiation and Risk, 1992; Krasnov et al., 1992). This set of diseases is obviously of polygenetical origin, in which not only radiation but other factors also have great importance. According to the "risk concept" (see Porfiriev, 1990; Sergeev, and Pegov, 1992) all the factors may be subdivided into natural and social; at present the importance of the latter in pathogenesis is insufficiently explored.

The problem of psychological changes has been widely discussed. Based on the results of a clinical survey and from frequently used questionnaires such as the one by Taylor, the authors note that psychic autistication exists together with neurological complaints (e.g., poor sleep, often occurring weariness, weakened memory and disorders of the reproductive function). At the same time we have practically no data on objective diagnostic of the conditions of the major psychological functions (such as attention, memory and operative thinking), and of the general intellectual capacity for work. Data on personality is also missing.

Before undertaking research in the Altai region, we conducted a study of people who were exposed to similar doses of radiation typical for the people who lived in the Altai region during the nuclear weapon tests at Semipalatinsk This was for the purpose of specifying the possible mechanisms of professional and social dysadaptation occurring as a distant aftereffect of irradiation by heavy nucleotides The goal of this research was to establish the complex psychophysiology of risk, that is, the risks that contribute to the professional dysadaptation of people. We also wanted to develop recommendation for the reduction of such negative effects.

Methodology

The experimental group consisted of fourteen persons (age 27-54) who were exposed to 15-40 BERs during the 1986-1989 period. The research was conducted in 1994 at the Diagnostic and Surgery Institute. We took into account the tendency of a weakening of learning and remembering new material, and the difficulties in switching to a different form of activity. The main experimental activity consisted of psychometric tests (standard loading tests) aimed at an evaluation of sensomotorical and calculi-logical components of behavior. Since these components are basic for most technological specialists, they can serve as a criterion for the capacity of a person for work. These tests can provide us with a quantitative evaluation of the conditions for the major psychological functions (such as attention, short term memory and operative thinking), which also happen to be a quantitative criterion for neurological or psychiatric diagnoses.

In the experimental study we used the following tests:

(1) There was a test on "the reaction to a moving object" (***RMO***) which was aimed at obtaining an evaluation of the sensomotorical component of behavior. In this test the person using the control knob has to fix an object moving on the screen at the moment when it crosses a certain prefixed line. Fifteen test situations are exposed during one experimental session. The results of the experiment are indicated by a coefficient of the productivity of sensomotorical activity, that is, **CP** s-m, which is calculated by dividing the number of correct reactions by the total number of test situations. This coefficient is an indication of attention on the part of the subject.

(2) There was a test on "the arithmetic calculating in auto-tempo" which aims at an evaluation of the calculi-logical component of behavior as well as of short term memory functions and operative thinking. The procedures used includes the following: a series of different colored digits is exposed on the screen. The person being examined then either adds or subtracts the two following numbers, depending on the color of the latter and keeping a short term memory of the previous number. The subject should also print his answer on the keyboard. Digits are exposed one at a time, and the time interval between two expositions is not limited (auto-tempo). Yet the person being examined knows that he should work as fast as possible because the time characteristics affect the final result. During one experimental session, a series of "n" digits are exposed with the number of correct calculations "N" and the average time of calculation "T" being registered. Then the final result may be presented as a coefficient of the productivity of the calculi-logical component of activity. **CP** c-1 can be presented as: **CP** c-1=N/n*tn/T. The "tn" here is the minimal normative time for a single calculi-logical operation, with "tn"=one second.

(3) The "calculating in prefixed tempo" test is a modification of the test described above. It involves an intensification of the time deficit factor, created by prefixing the time interval between the two expositions of the digits (in our case this interval was three seconds). All

of the procedures for calculating the final result are identical with the previously described procedure.

All the described tests were given using a portable psychodiagnostical set called "Pleven." The availability of control norms for these tests is their major positive feature

(4) For the purposes of diagnosing personality features, we used the ***MMPI*** test (created by Hathaway and McKinley and modified in 1966, and adapted in our country in the early 1970s). This test evaluates specific personality features and the actual psychic state of the individual, by comparing the arithmetic means obtained to prefixed control norms.

A useful quality of the ***MMPI*** test is the possibility of building an average numerical profile for any group, and picked on the basis of an external criterion. It is natural to assume that in such average group profiles that are representative of the studied totality, individual tendencies will be reduced, so that an evaluation of group tendencies becomes possible.

Results of the first study

Our research revealed that the majority of experimental group members performed satisfactorily in their calculi-logical behavior in auto-tempo. Working in auto-tempo, they produced a result of **CP**=0.86-1.0, which is not significantly less than the control norm of 0.92-1.0. Yet there is a notable difference in the average time of performance; it was 2.85-7 8 seconds in the experimental groups and only 1.14-2.12 seconds in the control group. The final result in the experimental group is an average **CP**=0.298 (with a standard deviation of 0.063) which is reliable (p=0.99) and different from the results in the control group where there was an average **CP** in auto-tempo of 0.585-0.153

When forced to follow a certain tempo of activity ("Calculating in a prefixed tempo"), members of the experimental group found it sufficiently difficult to succeed. Their productivity reduced to 0.38-0.84; only a single case of complete failure and quitting the work was registered. The average time of performance naturally reduced to 1.89-2.89 seconds and the average **CP** came to be 0.334 with a standard deviation of 0.095. The control group had no difficulty in working in a prefixed time with its **CP** remaining 0.92-1.0, while the average time of performance reduced to 1.12-2.11 seconds as a result of mobilizing their psychophysiological resources. In this work regime, the average **CP** of the control group was 0.615 with a standard deviation of 0.153 that is also reliable (p=0.99) and higher than the results of the experimental group.

The "Reaction on the moving object" test also revealed significant differences between the results of the experimental and the control group. The productivity of the experimental group was nearly two times less than in the control group There was for the experimental group a **CP**=0.289 in the *RMO* test with a standard deviation of 0.120, and in the control group a **CP** =0.501 with a standard deviation of 0.144, which is a reliable difference (using T criterion, p=0.99)

The age factor proved to be important. However, it cannot be completely evaluated since there were only a small number of subjects in the experimental group. Yet we can mention a certain tendency, that is, people who were 20-30 years old when exposed to radiation, exhibited the best results in all the tests given.

The results of the ***MMPI*** test are presented as individual profiles and the average profile of the studied group. As a general tendency, we noted an ascending peak on Scale 2 (anxiety and depressive tendencies) together with a descending low on Scale 9 (anxiety denial). There is also a certain upward incline on Scale 5 (femininity) and an ascending peak on Scale 8 (autistication). Certain factors express the features characteristics of the studied group. These include the loss of particular interests, indifference and apathy, difficulties in establishing interpersonal relations, a deficit in maintaining active intention, drive suppression, etc. At the same time, feminine features are also expressed such as sensitivity, feminine behavioral features, anxiety, inclination to subdepressvive emotional states, subjective feelings of weakness, and lack of support and protection.

The average group most clearly shows an ascending peak on the scale of autistication. This fact may be interpreted as the result of development of strong and rigid negative emotions because of relatively insignificant frustrations. There is also an obvious escapist tendency toward establishing and keeping a psychological distance between the surroundings and one's inner world. The idea of social surrounding can be seen as the source of intensive negative emotions and a lack of concrete patterns of behavior in different situations. The understanding of social expectations may be interpreted as a growing disintegration of social communications. Experimental group members who are older than 50 years show an ascending peak on Scale 3 (repression of anxiety producing factors), which proves the presence of selfish and hysterical tendencies in behavior. This is typical for elderly persons.

A complex analysis of the changes in the intellectual work ability of experimental group members along with an examination of the ***MMPI*** test results provides us with evidence on some pronounced tendencies. These are.

1. There is a sharp descent of attention, short term memory and operative thinking to a level comparable to the norms for children at the age of 10-11 years. The sharpness of this descent is so great that it cannot be interpreted as the result of functional or socially caused changes, but only as a sign of obvious organic brain disorder (apparently of a capillary nature), resulting from a distant aftereffect of heavy nuclear radiation exposure during the period of 1986-1989.

2. The results of personal testing show two general tendencies: one is a growing depression, anxiety, autistication, and disintegration of social communications, and the other is a "loosening" of the nucleus of the personality that is typical for old age but rather untimely for mature and work capable members of the experimental group.

Pulling together all the data we acquired, we postulated an accelerated or premature aging syndrome that would occur after being exposed to 15-40 BERs The main sign of this syndrome is a degradation of psychological and reproductive functions. This syndrome produces a rather complex situation of social and professional dysadaptation. On the one hand, a person with such a syndrome notices a deterioration of his capabilities, and this generates anxiety and depression. On the other hand, the society of which this person is a member (though his family, colleagues, friends, etc.) imposes on him levels of expectations normal for his biological age given the absence of external signs of degeneration.

When we speak of the "loosening" of the nucleus of the personality, we mean a process of deformation in the hierarchy of motivational values. These are very stable in adulthood and much more plastic in childhood and old age. This comes as a loss of professional and other dominating life orientations, along with a growth of suggestibility, emotional lability, partial deterioration of critical estimates of one's own state together with definite hysterical features. In cases where the person's capabilities and the external social expectations applied to him do not coincide, there is a development of tension in interpersonal relations, frustration, and anxiety and depression.

The materials and volume of investigation in the Altai Region: The second study

The questioning of respondents were conducted at enterprises, organizations and institutions at Gorno-Altaisk and the Maima settlement.

The analysis of the social-hygienic conditions involved was based on a special questionnaire created by Meshkov and Tokareva. This took into account the development of risk groups that consisted of the people who lived in the Altai region during the carrying out of nuclear weapon tests in the Semipalatinsk area.

An estimate of personal qualities was obtained by using the Spielberger-Khanin scale. The analysis showed that the level of professional dysadaptation of the persons exposed to radiation was indicated by a failure of emotional, volitional and intellectual control, and an inclination to be frustrated as a result of psychological and physical stress. The nervous-psychic instability of this group may be the result of a manifestation of latent compensatory premorbid pathology An assessment of personal qualities was obtained through the use of a "Prognosis" questionnaire

The experimental group included the inhabitants of Gorno-Altaisk and the Maima settlement who lived in the Altai region during 1949-1962 and in 1965, and who were exposed to radiation effects during nuclear weapon tests conducted in the Semipalatinsk area. The migration that occurred during this time period as well as the living, nourishment, health and professional conditions that were present, were considered in the special questionnaire.

The control group also included people who arrived in the Altai region after the atmospheric nuclear weapon tests took place. It is important to note that the experimental group included also persons who lived during 1949-1962 and in 1965 at the Semipalatinsk region in Altai Krai

We obtained 147 usable questionnaires from 174 respondents. This situation was expected when we first planned the investigation since this was the first time such work was ever conducted in the Altai region. All the usable questionnaires were classified according to gender, age, profession, and time and place of living.

Results of the second study

The respondents were distributed according to gender and age in the following way (see Table 1).

As can be seen from the table, the groups studied consisted of 59.6 percent men and 63.7 percent women of working age. In addition, 30.2 percent of the respondents were pensioners, although some of them continued to work during the investigation. As to education level, our respondents were distributed in the following way: high 38.9 percent, specialized secondary 34.7 percent, secondary 12.4 percent and incomplete secondary 14 percent.

The specially developed questionnaire included a number of questions that enabled us to assess the living conditions, the frequency of change in professional life, the subjective reactions to the physical burdens and psychoemotional circumstances, as well as the morbidity of the people examined. The subjective estimates of physical and psychoemotional burdens are presented in Table 2.

According to the data obtained, those persons who lived in the Altai territory and while working at their profession during nuclear weapon tests, gave "heavy" (or strong) subjective estimates of their physical burdens and psychoemotional stress. Among the total number of persons who lived in the Altai region during the tests, 86.9 percent of them (40.8 percent of the women and 46.1 percent of the men) changed their profession or post. In the control group the comparable rate was 77.8 percent, which is 10 percent less. This latter category consisted of twice as many women (51.8 percent), as men (25.9 percent).

It is important to note that the frequency of change in profession or post in the studied groups was dependent on age. These results are shown in Table 3. As can be seen from the Table, changes of profession in the control group took place before the age of 35, and between the ages of 46-50, which is consistent with other data reported in the literature. After the age of 55, members of the control group did not change their professions. A different tendency was observed in the experimental group. In that group, most of the men changed their profession after 60 while the majority of women did after 40.

Table 1

The description of the respondents according to sex and age (%)

Sex	Age intervals (years)							
	<35	35-40	41-45	45-50	51-55	55-60	>65	Total
Male	4.3	8.5	14 9	8.5	10.6	12.8	40.4	100 0
Female	11.1	19 4	12.5	13.9	9.7	9 7	23.6	100.0
Total	8 4	15.1	13 4	11.8	10.1	10.9	30.2	100.0

Table 2

The levels of physical loading and psychoemotional stress, experienced by the respondents during the work (%)

Groups	Physical loading				Psychoemotional stress			
	light	middle	heavy	total	weak	moderate	strong	total
E*	14.4	56.7	28.6	100.0	13.5	60.4	26.1	100.0
C*	23.1	65.4	20.5	100.0	15.4	69.2	15.4	100.0
Total	16.0	58.4	25.6	100.0	13.9	62.0	24.1	100.0

* E - experimental group, C - control group

Table 3

Profession or post change frequency (%)

Sex	Age intervals (years)													
	<35		35-40		41-45		45-50		51-55		55-60		>65	
	E	C	E	C	E	C	E	C	E	C	E	C	E	C
Male	-	42.8	-	-	-	-	5.7	42.8	8.6	14.3	5.6	-	80.0	-
Female	12.9	50.0	6 4	-	25.8	-	-	50.0	25 8	-	6.4	-	22.6	-

In both the experimental and control groups we studied the distribution of the levels of reactive anxiety (RA), personal anxiety or emotional stability (ES), together with the probability of nervous breakdown(PNBD). The frequencies shown depended on such factors as gender, age, profession and social conditions as is shown in Tables 4-13.

Table 4 below shows that a quiet condition at the moment of inspection was typical for the older men and younger women. A condition of moderate anxiety was common among men older than 56, but the women surveyed had such a condition at all ages with a tendency to increase at the older ages. A condition of high anxiety was reveal more often within men of age 60 and while with women this index distributed equally between the young, the average, and the old. In the control groups, quietness and moderate anxiety were shown mostly by those in the earlier ages.

A level of moderate anxiety is high among the women under 40, but in the control group, for those less than 35. For the men in the control group, such a condition was typical for elder persons while high personal anxiety within the same group was at its maximum for those at the age of 60. Among the women the highest index of anxiety was in those under 45 years of age. At the same time, the index of the emotional instability was high within the women in the control group.

Analysis of Table 5 shows that in the experimental group, the onset of aging coincided with a rise in the level of both reactive and personal anxiety (at least for the men). In the control group, men, independent of age, displayed similar low and moderate RA and moderate and high PA. Independent of age, women in the experimental group displayed somewhat evenly, a low, moderate and high RA. A high level of PA is characteristic of women in the 33-35 age category. In the control group, the majority of women under the age of 35 at the time of the study, displayed high levels of reactive and personal anxiety. As shown in Tables 6-7 the pattern of respondents according to RA and PA levels depends on professional orientation.

The total (100 percent) in Table 6 is the result of a summing up of both RA and PA perceptions of the respondents of selected professions in both experimental and control groups (i.e., the summing up of all the elements of each line of the table). But Table 7 represents the sum of the elements within each line of the table separately for RA and PA responses.

Tables 6-7 show that the most quiet groups among the respondents with respect to RA were engineers and financial employees in the experimental group, and geologists in the control group. Within the professional group (Table 7) the most quiet were financial employees (in experimental groups) and geologists (in control groups). Executives (managers) and skilled workers in the experimental group also displayed a high level of both RA and PA (see Table 6).

The level of nervous-psychic instability (NPI) is an important index that allows us to expose singular signs of premorbid personal disorders, and to evaluate the probability of their

Table 4

The age distribution of respondents with different levels of RA and PA

Sex	Age	levels											
		RA						PA					
		low		middle		high		low		middle		high	
		E	C	E	C	E	C	E	C	E	C	E	C
M	<35				25.0						33.3		
	35-40												
	41-45		25.0			16.7						16.7	25.0
	46-50	50.0	25 0		25.0					16.7		16.7	25.0
	51-55		25.0		25.0	16.7				16.7	33.4		25.0
	56-60	25.0		50.0	25.0					16.7		16.6	25.0
	>60	25.0	25.0	50.0		56.6				50.0	33.3	50.0	
F	<35	17.6	66.7	7.2	57.2	25.0	100.0			20.0	50.0	9.1	64.3
	35-40	17.6		7.1						30.0		4.5	
	41-45	23.5	16.6	7.1								22.7	7.1
	46-50	11.8	16.7	21.4	28.6	25.0					37.5	18.2	21.4
	51-55	5.9		14.3	7.1	25.0				10.0	12.5	13.6	
	56-60	5.9		21.4						10.0		13.6	
	>60	17.6		21.4	7.1	25.0				30.0		18.2	7.1

Table 5

The distribution of respondents considering their RA and PA levels

Sex	Age	l e v e l s											
		RA						PA					
		low		middle		high		low		middle		high	
		E	C	E	C	E	C	E	C	E	C	E	C
M	< 35				100,0						100,0		
	35 - 40												
	41 - 45		50,0			50,0						50,0	50,0
	46 - 50	50,0	25,0		25,0					33,3		33,4	33,3
	51 - 55		33,3		33,3	33,4				33,3	33,4		33,3
	56 - 60	33,3		33,4	33,3					33,3		33,4	33,3
	> 60	14,2	14,3	14,3		57,1				42,8	14,3	42,9	
F	< 35	16,7	22,2	5,6	44,4	5,6	5,5			11,8	23,5	11,8	52,9
	35 - 40	75,0		25,0						75,0		25,0	
	41 - 45	66,6	16,7	16,7								83,3	16,7
	46 - 50	18,2	9,1	27,3	36,4	9,1					30,0	40,0	30,0
	51 - 55	20,0	40,0	20,0	20,0					20,0	20,0	60,0	
	56 - 60	25,0		75,0						25,0		75,0	
	> 60	37,5		37,5	12,5	12,5				37,5		50,0	12,5

Table 6

Distribution of various professional groups of respondents considering the aggregate RA and PA levels

Profession	levels											
	RA						PA					
	low		middle		high		low		middle		high	
	E	C	E	C	E	C	E	C	E	C	E	C
Engineers & other technical workers	32.6	20.0		15.8	9.1						7.4	25.0
Financial employees	16.3	20.0	7.1						12.5	9.1	14.8	5.0
Geologists	5.3	30.0	7.1	26.3					6.2	18.2	3.7	35.0
Physicians & teachers	21.0	10.0	14.3	21.0	27.3	100.0			31.3	18.2	11.1	10.0
Middle medical employees	11.1	10.0	21.4	10.5					12.5	9.1	18.5	5.0
Executives	5.3	10.0	28.6	15.8	36.4				12.5	27.3	25.9	10.0
Skilled workers	8.4		14.3	10.5	27.3				25.0	18.2	25.9	10.0

Table 7

Distribution of various professional groups of respondents considering RA and PA levels

Profession	levels											
	RA						PA					
	low		middle		high		low		middle		high	
	E	C	E	C	E	C	E	C	E	C	E	C
Engineers & other technical workers	14,3	28,6		42,8	14,3						28,6	71,4
Financial employees	62,5	25,0	12,5						25,0	12,5	50,0	12,5
Geologists	10,0	30,0	10,0	50,0					9,1	18,2	9,1	63,6
Physicians & teachers	30,8	7,7	15,4	15,4	23,1	7,6			41,7	16,7	25,0	16,6
Middle medical employees	40,0	10,0	30,0	20,0					20,0	10,0	50,0	20,0
Executives	7,7	7,7	30,8	23,0	30,8				15,4	23,1	53,8	7,7
Skilled workers	30,0		20,0	20,0	30,0				30,0		50,0	20,0

development and their display in action and behavior. People with NPI need a complete psychiatric and psychological examination. People who show a moderate probability of NPI also require serious professional attention. They need to be systematically observed because in extreme situations, the probability of an NPI display will rise. This condition should be considered when a question of professional capability is decided, especially in risky occupations (drivers, for instance). Considering this fact, we studied if the probability of NPI appearance depended on such factors as gender, age and profession. The results we obtained are presented in Tables 8-11.

An analysis of Table 8 shows a tendency in the experimental group for NPI probability to increase with the onset of aging. In the control group, the number of mature persons having a moderate probability of NPI appearance in extreme situations is rather large. Considering this fact, we undertook a study of the distribution of NPI display probability in different professional groups. (See Table 10-11).

It is obvious that medical workers and skilled workers (drivers included) show high and moderate levels of NPI. Mangers rank next to them. The experimental group as a whole demonstrates a moderate and high probability of showing NPI. Naturally, we may conclude for such people the necessity of complex and thorough psychiatric, psychological and other examinations. These people form a definite risk group and dynamic medical observations are definitely required.

When evaluating the probability of NPI display, we also took into consideration the family status of the group members. Three categories were distinguished:

1) single persons;
2) unmarried/divorced persons, but living with children;
3) married couples (with or without children).

The results of the study of these categories are presented in Tables 12-13.

The analysis of the data in Tables 10 and 11 proves that the administrative executives and skilled workers from the experimental groups have a higher level of RA and PA. The largest number of persons with moderate and high NPI was observed in the experimental group among medical personnel, skilled workers and qualified drivers We should note that all persons who lived in the Altai region during the carrying out of the nuclear weapon tests had the highest risk according to the criterion of high probability of nervous-psychic frustrations

The social-hygienic and psychophysiological investigations showed that the differences in levels of reactive anxiety (RA), personal anxiety (PA) and nervous-psychic instability (NPI) in the experimental and control groups. The assessment of RA, PA, NPI indices were conducted taking into account such dimensions as gender, age, professional specificity, social conditions and other factors

Table 8

The distribution of respondents considering the levels of probability of NPI

Sex	Age	probability of neuro-psychic frustration					
		low		middle		high	
		E	C	E	C	E	C
M	<35				20.0		
	35-40						
	41-45			20.0	20.0		
	46-50				20.0	25.0	
	51-55		50.0		20.0		
	56-60			20.0	20.0		
	>60		50.0	60.0		75.0	
F	<35						
	35-40				61.5	5.0	33.4
	41-45			15.4	15.4	15.0	
	46-50		3.3	7.6	23.1	15.0	33.3
	51-55					15.0	
	56-60					25.0	
	>60			15.4		25.0	33.3

Table 9

Age distribution of respondents with various NPI probability

Sex	Age	probability of neuro-psychic frustration					
		low		middle		high	
		E	C	E	C	E	C
M	< 35				100,0		
	35 - 40						
	41 - 45			50,0	50,0		
	46 - 50				50,0	50,0	
	51 - 55		50,0		50,0		
	56 - 60			50,0	50,0		
	> 60		14,3	42,8		42.9	
F	< 35		14,3	21,4	57,1		7,1
	35 - 40			75,0		25,0	
	41 - 45			28,6	28,6	42,8	
	46 - 50			12,5	37,5	37,5	12,5
	51 - 55			40,0		60,0	
	56 - 60					100,0	
	> 60			25,0		62,5	12,5

Table 10

The distribution of various professional groups of respondents considering their different NPI probability

Profession	probability of neuro-psychic frustration					
	low		middle		high	
	E	C	E	C	E	C
Engineers & other technical workers			7.1	5.9	4.3	80.0
Financial employees		22.2	21.4	5.9	13.1	
Geologists		22.2		41.2	4.3	
Physicians & teachers		22.2	35.7	17.6	13.1	
Middle medical employees		11.2	21.4	17.6	13.1	
Executives		22.2	7.1	11.8	21.7	
Skilled workers			14.3	11.8	30.4	20.0

Table 11

Distribution of NPI probability among various professional groups of respondents

Profession	probability of neuro-psychic frustration					
	low		middle		high	
	E	C	E	C	E	C
Engineers & other technical workers			14,3	14,3	14,3	57,1
Financial employees		22,2	33,4	11,1		33,3
Geologists		20,0		70,0	10,0	
Physicians & teachers		15,4	38,5	23,0	23,1	
Middle medical employees		20,0	30,0	20,0	30,0	
Executives		8,3	25,0	25,0	41,7	
Skilled workers			23,1	15,4	53,8	7,7

Table 12

The distribution of respondents with different family status within experimental and control groups according to the levels of RA, PA and NPI (%)

Levels of RA, PA and NPI probability	Family status					
	singles		singles with children		married couples	
	E	C	E	C	E	C
RA						
low	50,0	22,2		33,3	48,5	42,1
middle	25,0	77,8	33,3	66,7	27,3	52,6
high	25,0		66,7		24,2	5,3
PA						
low						
middle	25,0	33,3	50,0		41,2	33,4
high	75,0	66,7	50,0	100,0	58,8	66,6
NPI						
low		12,5			5,9	31,2
middle		75,0	50,0	100,0	47,0	50,0
high	100,0	12,5	50,0		47,1	18,8

Table 13

The distribution of respondents within respective levels of RA, PA and NPI according to their family status (%)

Levels of RA, PA and NPI probability	Family status					
	singles		singles with children		married couples	
	E	C	E	C	E	C
RA						
low	6,9	6,9		3,4	55,2	27,6
middle	3,1	21,9		9,4	28,1	31,2
high	9,1				72,7	9,1
PA						
low						
middle	4,0	12,0	4,0		56,0	24,0
high	6,7	13,3	2,2	6,7	44,4	26,7
NPI						
low		12,5			25,0	62,5
middle		17,6	3,0	8,8	47,1	23,5
high	16,0	4,0	4,0		64,0	12,0

The result of the analysis (taking into account gender and age) showed that senior men more often have higher personal anxiety in the experimental compared to the control group. Women in the experimental group showed this indicator more often at the age of 35-45. These women showed nervous-psychic instability more often than the control group.

Tables 12 and 13 show that the highest figures of PA and RA levels and NPI probability are observed mainly within experimental groups of singles, singles with children and married couples. Maximal values for the same parameters within the framework of the family status were observed for married couples.
The analysis of these tables also reveals that single persons with children, and married couples from the experimental group have lower levels of PA compared to those in the control group.

In summary, we can say that practically all the persons who have lived in the Altai region during nuclear weapon tests in the Semipalatinsk area, have higher levels of RA, PA and NPI. Therefore, we refer to this group as one of higher risk according to criteria such as nervous-psychic instability and the need for medical help, social protection and rehabilitation. The intragroup differences caused by factors other than the radiation is comparable with those in the control group. The research results obtained make evident the reality of the stated problem and the necessity of having profound investigation on this problem

General conclusions

1. The results of both studies revealed that people with distant aftereffects of small doses of radiation exposure, showed a significant level of social and professional dysadaptation and higher level of personal anxiety, reactive anxiety and nervous-psychic instability.

2. Among men from the experimental group, there is (compared to those in the control group) a greater increase of PA and RA levels with the onset of aging. The women in the experimental group displayed this tendency more often at the age of 35-45. In the control group, an absolute majority of women under 35 years of age, showed high levels of PA and RA.

3. We proved that managers and skilled workers from the experimental group displayed a higher level of PA and RA. High level of RA was also displayed in the control group by medical personnel, teachers and those from the engineering staff, and by teachers in the experimental group. The greatest number of people with moderate and high level nervous-psychic instability in the experimental group was observed among medical personnel and skilled workers (drivers included). All members of the experimental group showed moderate and high probability of NPI display

4. Independent of family status, the greatest indicator of RA and NPI was observed in the experimental group. Thus, single persons from the experimental group displayed

maximum PA. Single persons with children and married couples from the experimental group showed lower levels of PA, compared to those in the control group.

5. Persons who lived in the Altai region during the nuclear weapon tests in the Semipalatinsk area are the group at higher risk according to the criteria of nervous-psychic instability and the need for medical protection and rehabilitation.

11. ELIMINATION OF MASS DESTRUCTION WEAPONS AS A RISK FACTOR FOR THE ENVIRONMENT AND HUMAN HEALTH

V. M. Lupandin

Introduction

An enormous stockpile of mass destruction weapons (MDW) has been accumulated in the world during the fifty post-World War II years. nuclear warheads and chemical and bacteriological weapons as well as the means for their delivery (such as missiles carriers and propellants, nuclear submarines, etc.). The problem of their elimination has become a global challenge facing the contemporary world. This task is aggravated by the unpreparedness of the countries in possession of such weapons to sort them out, the lack of safe disposal technologies, the vagueness of environmental and health consequences, and also the problems of a purely economic nature in the case of the countries of the former Soviet Union. The existence of both economic and political crises is a major roadblock in the problem of MDW storage. It is equally acute for every country of the former USSR deploying such weapons. The problem of radioactive waste disposal in the majority of cases concerning MDW production and elimination is still a matter of grave concern.

At the same time, research is fairly rudimentary into the various aspects of the MDW disposal-oriented problem, such as its impact on the environment and health in particular. There have been no publications dealing with the problem of medium range missiles RSD-10 (better known as SS-20s in the West) destruction, either in this country or in the United States. This is so despite the on-site presence of inspectors throughout the period of missile destruction (1988-1991). Reports on the destruction of medium range missiles in the US (Pershing-2) are also missing despite the fact that many states refused to give permission to carry out operations of destruction on their territories. The absence of independent, nongovernmental research in this field, both in the United States and in the counties of the former Soviet Union, are especially disturbing. While in Russia, some reports have been available on the destruction of the RSD-10 missiles, nothing is known about the way mass destruction weapons are stored and what kind of damage is caused by their storage to the environment and health of the population in the Ukraine, Kazakhstan and Byelorussia

There is a traditional anxiety felt by research workers in the face of this challenge. There is also their voluntary refusal to probe into the developments underway in the military defense sphere even though they are analyzing ecological accidents as they happened. For example, that rather than secrecy alone remains as a hindrance into various aspects of the MDW disposal problem, for example the finding of " yellow" mutants in the Altain Territory, the growth of congenital developmental anomalies from 1989 on in the Astrakhan oblast (region) as well as the loss of 30 to 50 percent of the harvest in 1989

A major role in the research efforts covering different aspects of MDW disposal belongs to sociologists. The facts related to social processes such as secrecy, censorship, forcing out, making use of unawareness, the illiteracies of individuals carrying out dangerous operations, the manipulation of public consciousness, and disinformation. These remain a prerogative for a sociological survey. The importance of this part of the work is emphasized by the fact that many strategic methods to manipulate public consciousness are common both for the countries of the former Soviet Union and the United States and also other countries in the west.

The study whose results are analyzed in the present article was carried out with the consultative assistance of research associates at the Organic Chemistry Institute and the HeteroOrganic Compounds Institute of the Russian Academy of Sciences.

A Brief Description of the Studied Areas

(A). The city of Salavat in Bashkortostan is a major center for the petrochemical production of liquid rocket engine propellant. The latter has been produced since 1966 in the so-called shop (plant) #38 owned by the state enterprise *Salavatnefteorgsintez*. The following three highly toxic components were produced: heptyl, hexyl and diethylamine. In the 1966-1972 period, the waste from that chemical plant very likely was dumped and polluted the environment. In 1972, a cavity was made with the help of an underground nuclear blast at the depth of 2,200 meters to pump chemical waste in the village of Ilyinovka, 17 kilometers from Salavat. This area was studied in 1988 in collaboration with the Social Hygiene and Healthcare Economics Institute.

(B). The Akhtubinsky district of the Astrakhan oblast was the site of the Kapustin Yar cosmodrome with space entry functions since 1946. Starting in 1949, several tests of nuclear devices in the atmosphere were conducted in the vicinity of the village of Urda In the 1988-1991 time period the destruction of RDS-10 missiles was carried out. The major pollutants were: heptyl and a combustion product of solid rocket propellants with a high probably of dioxane formation and toxic metals.

(C). The Harabalinsky district also in the Astrakhan oblast is the site of the Ashuluk air defense firing range (and also the former air defense range of the former Warsaw Pact countries). This air defense rocket firing range has functioned there since 1946. Since 1993 it has been the air defense rocket firing range of the Ministry of Defense of the Russian Federation. This site also covers the territory of several districts (raiony) of Gurjevsky Province. From Kapustin Yar to the Caspian shores, there is a heptyl depot in the eastern part of the Harabalinsky district. Since 1991 it has functioned only on the territory of the Harabalinsky district.

(D). The Azgir atomic proving ground was used for underground tests of nuclear devices between 1966 and 1979. Since 1979, there have been all kinds of waste disposal undertaken. High levels of alpha- and beta-emitting isotopes have been

registered in the cavities in the ground. The major factor is radiation. However, chemical pollution due to the emergency release from drill holes cannot be excluded either. The most powerful outburst was observed in June, 1989 The last one took place in 1993. This proving ground is situated on the territory of Kazakhstan within six kilometers of the Russian border, and about 30-40 kilometers from the Volga-Akhtubinsk river flood plains.

The Methodology and Instruments of the Study

The following means were used to collect data: questioning of the population, and clinical interviews with specialists (such as physicians, veterinarians, phytopathologists, ichthyologists, hydrologists, radiologists and others). The use of this method became possible after 1991 after the disintegration of the Soviet Union.

In addition, there has been the analysis of statistical data collected by district hospitals, regional and district veterinary departments and plant protection stations as well as those from the Regional Healthcare Committee and the Ecology Committee. There has also been research data from the Taifun production complex and other institutes involved in the missile destroying operations. Also available were the results of research into the ecological situation in the Ashuluk firing range and the Azgir proving grounds that had been conducted in 1991 by the special department of St. Petersburg University. There were also the results of research conducted over a 10 year period in the city of Salavat by the Social Hygiene Institute of the Russian Academy of Medical Sciences. Finally, we also had publications from the local (district and regional) newspapers, and letters of readers sent in response to the published articles on the subject of the study published in popular journals.

Discussion of the Study Results

The research carried out has demonstrated that the most serious damage to the environment and human health was caused by the Azgir atomic proving grounds where underground testing of nuclear devices was carried out. Therefore, this requires a special discussion.

The history of the development of this proving grounds remains for the most part unclear and even contradictory. According to official assertions, from 1964 on, this location functioned as a VNIIEPh site (Arzamas-16) for the purposes of conducing underground nuclear bursts that were used to look at activities affecting the lives of people (e.g., the burying of all types of waste and for the storing of gas condensates). However, the author has obtained information from various independent sources proving that the site started to be used in 1950 as a branch of the Lermontovo ore enrichment plant (Pyatrigorsk) to mine reprocessed uranium What kind of work the plant carried out in Azgir before 1966 remains unknown. There are also data available questioning the fact that the proving grounds were employed from the beginning to conduct underground explosions in the interests of the people. Our data provide

definite evidence that Azgir was used as a site for the underground test of nuclear devices.

However, irrespective of whether it was a unit for studying some aspects of the civilian economy or a military testing ground, unplanned powerful and superpowerful nuclear bursts were exploded there. The most powerful outburst was an explosion in November 1979 that led to the formation of an artificial lake of nuclear origin, and to the wholesale extinction of horses in the winter of 1979-1980 on the vast territories of Western Kazakhstan. At present, all blast holes are getting filled up with water that could lead to chemical reactions and create explosions in the cavities. Such an explosion did take place in June 1989 in blast hole #3 when not less than 200,000 cubic meters of waste stored there, was blown out. This powerful, accidental outburst makes it possible to explain the loss of vegetation and animals, and the growth of morbidity in the summer of 1989 registered in Astrakhan oblast. It is most likely that the cloud formed by the outburst from the hole went north towards the missile destruction site at the Kapustin Yar space center, and was subsequently pushed back south, leading to irradiation of the territory of the Harabalinsky district and the area close to the village of Michailovka. However, 10,000 hectors of scorched earth are not fully explained. This area was the nearest to the Azgir proving grounds. An analysis of illnesses among the resident from the area closest to the Azgir proving grounds shows that in this case there was a radiation impact on the population (a high rate of morbidity and mortality due to cancer and leukemia).

Therefore, the expectations of Arizamas-16 nuclear physicists that they could produce camouflaged bursts in the salt domes of the Caspian region, have failed to be justified. Every explosion was accompanied by environmental destruction and radioactive pollution. The expectations that it would be possible to produce stable and waterproof caverns with localized radiation substance on their bottom turned out to be also unjustified. Attempts at waste disposal in such localities are fraught with great danger to the entire Caspian Plain. There is also information, although unconfirmed by other sources, that another outburst of waste dumped in one of the blasted holes, took place in 1993.

The danger of the Azgir proving ground is further aggravated by its immediate proximity to the Kapustin Yar and Ashuluk rocket firing ranges, thus not excluding a possibility of missiles deviating from their target course falling on the territory of the entire Caspian region. Dust storms not uncommon in this region may also pose a threat by winds carrying radionuclides and plutonium to the Volga-Akhtubinsk river flood plains.

As far as the impact of the activities of the Kapustin Yar space center on the environment and health, it is possible that the only direct evidence of the RSD-10 missiles negative impact is on the infant birth rate growth (it was in the range of 30 percent) in the Ahhtubinsky district, and the growth of general morbidity among the population of the Harabalinsky district since 1989. There was an increase in the number of congenital malformations by 1991 with a rate of 33.4 per 1,000 against the average

rate of eight cases per 1,000 in the Russian Federation. One can talk with greater certainty about the fallout from the destruction of missiles in the case of "yellow" infants in the Akhtubinsky district. A strong resemblance can be noted here to the morbid effect on infants in the Talmensky district of the Altai Territory.

The growth of pathology is a common feature, despite the fact the destruction of missiles has been brought to an end, indicated by the evidence of toxic substances penetrating food chains (most likely stable chloro-organic substances including dioxine produced during ammonium perchlorate combustion). Meager information provided by the Kapustin Yar firing range command about the growth rate of oncological diseases of thyroid gland, blood among the town population including children and the missilemen of the range after the destruction of missiles, is of special interest. Taking into account the average age of the residents (37-38 years old), their higher educational standards and good medical care, the growth in the morbidity rate, cannot be connected to anything but the destruction of missiles.

Despite the roadblocks raised to attempts to forecast the consequences of environmental pollution on the territory of the rocket firing ranges, it is clear the problems remain acute. Although the destruction of missiles has been discontinued, the morbidity of the population is bound to grow further. Likely to rank first on the list are oncological diseases primarily affecting hematopoietic and lymphatic systems, and lesions of the liver and the central nervous system.

The analysis of materials from the medico-ecological monitoring of missile destructions (drawn from Taifun and the Biophysics Institute of the Healthcare Ministry), has emphasized that serious concerns were expressed at the very first stage about the pollution of the Volga-Akhtubinsk flood plains with toxic substances and heavy metals. However, all calculations were made on the basis of various substance content in the solid rocket propellant without taking into account the new, more toxic substances produced, such as dioxine, in the process of their combustion. The greatest attention was paid to the possibility of a general toxic effect because of the fear that it might cause a negative attitude and protests against the destruction of missiles in Kapustin Yar. If the conclusion about the general toxic effect of the missile destruction operations is recognized as a fact, then the major mechanism of the influence of the demolition products can be explained by the presence of a factor fraught with both cancerogenic and teratogenic, mutagenous and immune consequences. These are the properties of dioxine. Its appearance in the environment can be attributed to ammonium perchlorate combustion.

The greatest damage to health was evidently suffered by missilemen personnel themselves and their offsprings. American inspectors who observed the operations in the destruction of the missiles from August 1988 to May 1991, may have suffered too. The spread of oncological diseases is likely to be noted among them, including leukemogenesis among their children born after their return from the former Soviet Union. A well-defined growth of yellow infant numbers since 1989 in the Akhtubinsky

district also shows evidence of toxic products from the missile destructions with first and foremost dioxine penetrating the soil, vegetation and food chains.

The problem of the violation of human rights in the employment of civilians unaware of the dangers of working under conditions of radioactive and other pollutions, proves to be an important item among various social aspects of the operation of the nuclear missile testing grounds.

Summary of the Major Results of the Study

1. The demolition of RSD-10 missiles from 1988 to 1991 through blasting them in clusters on the ground, had a damaging effect on the environment and human health. Long lasting hotbeds of contamination have been formed in the missile destruction areas. The main way of penetration by toxic products into the human body as a result of the destruction operations seems to be water sources and vegetables (and animals) products grown in the area of the operations, high water lands and marshy soils.

2. The products of the missile destruction have mutagenous, cancerogenic, teratogenic and immune effects. The main type of pathology that affects human populations includes malfunctioning of the reproductive system, anemia in pregnancy, liver degradation, effects on the central nervous system, and blood in newborns with subsequent speech disorders and low learning ability among 50 percent of the children.

3. The picture of morbid influences on the human body corresponds to the ill effect of dioxine. In all probability, dioxine is produced during ammonium perchlorate combustion in the process of the destruction of missiles Dioxine is likely to have a damaging effect in combination with heptyl, heavy metals as well as radionuclides (Talmensky district).

4. In Astrakhan oblast the destruction of missiles at the Kapustin Yar space center in the summer of 1989 was combined with a sudden outburst of waste of an unknown nature from hole #3 at the Azgir proving grounds. This led to environmental pollution in the Astrakhan oblast the loss of vegetation, death of animals, and a 100 percent increase from 1989 to 1991 in the morbidity rate of the residents of the Harabalinsky District.

5. The prolonged operation of the Ashuluk proving grounds has led to the creation of a long-lasting hotbed of contamination of heptyl, thallium and heavy metals on the vast territory of Western Kazakhstan.

6. The high rates of oncological morbidity and mortality because of cancer among the residents of the villages of Azgir, Asan and Bulkuduk have been due to the radioactive pollution of soils, vegetation, animals and some sources of water supplies. However, a possible combination of the (internal and external) radiation effect and the chemical factor (waste disposal at the firing range/proving grounds, and missile destruction products) cannot be excluded.

5. The Prospects for Further Research of the MDW Elimination Problem

Research may play a major role in the control of the process of eliminating mass destruction weapons, their proliferation and stockpiling, and including their production under conditions of conversion. The role of sociological research into social aspects, such as the victims among the civilian population, professionals and servicemen, the violation of human rights, the manipulation of public opinion on the part of scientists and nuclear physicists in particular, is of overriding importance. Our research has also dramatized the existence of an important international aspect of the problem, the possibility of combining the efforts of Russian and American sociologists in coping with the problem of controlling MDW proliferation.