THE HISTORY OF SOVIET CHEMICAL ARMAMENT

EXCERPT AND PREVIEW

INTRODUCTION

PART I. THE WAY TO THE CHEMICAL WAR

Part I contains the real (unknown) history of the Soviet chemical armament for the first time based on documentary material.

Chapter 1. SOVIET ARMY IS THE MOTOR OF CHEMICAL WAR

Chapter 1 is devoted to a history of occurrence of the soviet chemical weapon as means of the offensive war. The main initiator of chemical armament of the country all the years was Red (Soviet) Army. There are brought detailed data on creation and organization of soviet military-chemical service.

1.1. The Period of Civil War

Organization of the first military-chemical proving ground and high military-chemical school (1918). The fundamental decision about chemical weapon as means of the offensive war (1919).

1.2. Renewal of the Military-Chemical Service

The formation of constant military conference on CWs (1922), military-chemical committee (1924) and at last Department of military-chemical supply (1925).

1.3. The Soviet Chemical Warfare Organization

The testing of CWs near Moscow in frame of military-chemical friendship with Germany (1926). The beginning of Soviet chemical troops (1927). The formal formation of military Scientific research chemical Institute in Moscow (1928; founded in 1926). The first manoeuvres in Kiev with participation of chemical troops and using of CWs (1928). Organization of the military-

Individual non-persistent TCs: hydrogen cyanid, cyanogen chlorine, cyanogen bromine, phosgene, diphosgene. Carbon monoxide and carbonyls. Mask-penetrating TCs. Numerous mixtures of TCs: hydrogen cyanid-cyanogen chlorine, hydrogen cyanid-diphosgene, etc.

2.6. Lethal TCs of the First Generation. Persistent TCs

Individual persistent TCs: normal S-mustard gas, lewisite, thickened mustard gas, Br-mustard gas, F-mustard gas, Se-mustard gas, methyldichloroarsine, ethyldichloroarsine, nitrogen mustard, etc. Numerous mixtures of TCs: mustard gas-lewisite, mustard gas-diphosgene, etc.

2.7. Lethal TCs of the Second Generation

Individual combat phosphorous TCs (PTCs) of second generation: tabun, sarin, soman, Soviet V-gas, etc.

Chapter 3. FOREIN "PARTICIPATION"

3.1. Soviet Intelligence Service

The soviet intelligence service has provided army with the complete information on readiness of armies of West to chemical war.

3.2. Unsuccessful Industrial Help of Germany

The process of a chemical armament in Soviet Union had started in 1922-1923 after a decision to help Germany in its chemical arming by organization of mustard Gas and phosgene production on the territory of Soviet Union for needs of Reichsver. Plant in Chapaevsk.

3.3. Soviet-Germany Military-Chemical Cooperation

Joint testing of German CWs during 1926-1933 in Soviet Union - in Moscow-Kuzminki (chemical aircraft spray tanks), in Orenburg (chemical aircraft spray tanks, chemical aviation bombs, chemical land-mines), in Shikhany (chemical aircraft spray tanks, chemical aviation bombs, terrain contamination vehicles, chemical land-mines, chemical artillery shells, thickened mustard gas, etc.).

3.4. Military-Chemical Friendship with Italy

Mutual contacts and military-chemical visits in 1932-1934.

Chapter 4. CHEMICAL WEAPONS. TROOPS FOR CHEMICAL WAR

In Chapters 4 are brought the data on kinds of the chemical weapons and devices for its use, in which Red army was actively engaged at preparation to offensive chemical war in period between world wars. Here is given the information on organization of chemical troop in 1920-1940 and also about Soviet military-chemical doctrine and its evolution during the XX century.

4.1. The Systems of Soviet Chemical Warfare

Soviet systems of chemical warfare-1930, -1932, -1936, -1940.

4.2. Chemical Weapons of Artillery

Munitions for artillery (fragmentary-chemical artillery shells, chemical artillery shells) were the important part of Soviet chemical stocks (calibers 76 mm, 107 mm, 122 mm, 152 mm). Munitions for chemical mortars. Munitions for multi-rail rocket launchers.

4.3. Chemical Weapons of Land Troops

Toxic smoke candles, toxic smoke generators, chemical sprinklrs, portable terrain contamination devices, terrain contamination vehicles, special chemical tanks, chemical land-mines, etc.

4.4. Chemical Weapons of Air Forces

Evolution of chemical aircraft spray tanks from VAP-1 to VAP-1000. Chemical aviation bombs, fragmentary-chemical aviation bombs and toxic smoke bombs. Rotating cluster bombs and ampoule dispencers.

4.5. Evolution of Special Chemical Troops

Chemical battalions, chemical regiments, chemical brigades, chemical divisions and... once again chemical battalions.

4.6. Aircraft Chemical Forces

Special air-chemical regiments, air-chemical brigades, etc.

4.7. The Soviet Military-Chemical Doctrine

Chapter 5. SOVIET AUTHORITY

In Chapter 5 there is analyzed the evolution of the approach of the highest Soviet authorities to the national chemical armament. The analysis of development of an industry for chemical war in 1920th-1970th is given and also is illustrated a thesis, that in the XX century the

creation of chemical weapon's stocks was always considered by authorities as a major aim of a chemical industry.

5.1. Moving Towards the Big Chemical War

5.2. Infrastructure of Chemical Warfare

Creation of spesial chemical industry (Cl, Br, etc.)

5.3. As-industry

5.4. S-industry I

5.5. World War II

Production of 120 000 metric tons of TCs (1941-1945).

5.6. Useless Spoils of World War II

The Red Army captured in Germany four big plants for CWs production (in Dyhernfurth, Falkenhage, Ammendorf and Leknitz). The fate of German chemical plants in Soviet Union.

Chapter 6. TOWARDS THE TOTAL CHEMICAL WAR

6.1. Chemical Rearmament After World War II

6.2. Independence of Military-chemical complex (MCC)

6.3. Preparing for the Total Chemical War

6.4. The end

PART II. THE SOVIET ARCHIPELAGO OF CHEMICAL WAR

Part II for the first time contains the documentary material about creation, reinforcement and development of the Soviet military-chemical complex as a cooperation of three forces (army, industry and medicine) under the secret services supervision.

Chapter 8. ARMY IS THE LEADER OF THE MILITARY-CHEMICAL COMPLEX

In Chapter 8 there are given data about army as the military-chemical complex leader. For the first time there are unknown materials about the whole cycle of the Red Army preparation to the offensive chemical war - about different types of chemical weapon development, about the places of its testing and using, and also about of the chemical weapon depots and military camps earlier not known (It is total more than 350 points).

7.1. Military-chemical complex (MCC))

7.2. Research

7.3. The Leader Military-Chemical Institute

NIKhI, the head military chemical institute, had existed in Moscow since the 1920th. Since relocation to Shikhany in the early 60th the institute has been a test facility.

7.4. Testing of CWs

Numerous military-chemical, artillery and air proving grounds

7.5. The Military-Chemical Proving Ground in Kuzminki

7.6. The Military-Chemical Proving Ground in Shikhany

TsVKhP (the Central Military-Chemical Proving Ground) Shikhany is located on the banks of the Volga. It began to be operated as a chemical proving ground in 1928 The existence of the proving ground became known to Soviet people only in 1987 when it was opened for diplomats.

7.7. Using on the Military Camps

7.8. Transportation

7.9. System of CW-Depots

The Soviet CW stockpiles were stored at numerous depot facilities (military-chemical, artillery and air) on the territory of the Soviet Union for many years.

7.10. Workaday routine in CW-depots

7.11. The Old Military-Chemical Arsenals

In the 1929 the artillery shells with chemical filling were 5-35% of all Soviet stocks: 152 mm caliber - 15-35%, 122 mm - 30%, 107 mm - 10-37%, 76 mm - 5-20%. In the 1931 the air chemical and fragmentary-chemical bombs with chemical filling were 17-25% of all stocks.

Chapter 8. SCIENCE ON THE CHEMICAL WAY

Chapter 10 tells how science served the needs of army in its efforts on a preparation to offensive chemical war. Here the first time is given the detailed picture of participation of Soviet scientific organizations and chemical institutes in creation of Soviet powerful military-chemical potential.

8.1. The Ipatiev's Epoch

8.2. «Phosgene» in the Moscow

8.3. The Leader Institute of Chemical War

The head institute in developing TCs in Moscow, GSNIOKhT (State Union Scientific Research Institute of Organic Chemistry and Technology). Shortly before the W.W.II. it had become an institute attached to a plant, after the W.W.II it became an institute with an experimental plant. In the 1960-1970th two powerful affiliates of GOSNIOKhT were created in Volsk and Volgograd.

8.4. Academy of Sciences

8.5. The Applied Science

CHAPTER 9. THE INDUSTRY OF CHEMICAL ATTACK

Chapter 11 tells how chemical industry served the needs of army in its efforts on a preparation to offensive chemical war.

9.1. Industry of Toxic Chemicals

Industrial production of combat CWs was carried out in the Soviet Union in 1924-1987. Before and during W.W.II the capacity for large-scale production and filling of TCs existed in Russia at the minimum in 17 sites.

9.2. GSNIOKhT

The leading chemical institute in Moscow, GSNIOKhT was created in the twenties as a plant 1 (51): production of mustard gas, phosgene, adamsite, chloroacetophenone, diphenylchloroarsine, diphosgene, lewisite and other TCs; the storage of TCs.

9.3. CW Plants in Moscow and Moscow Region

Chemical plant on Triumph square: production of mustard gas and other TCs. Chemical plant 93: production of chloroacetophenone. Derbenev Chemical plant: production of diphenylchloroarsine and diphenylcyanoarsine. Chemical plant in Schelkovo: production of diphenylchloroarsine. Chemical plant Voskresensk: production of hydrogen cyanide. The filling plant 12: the filling of mustard gas, adamsite, diphenylchloroarsine, chloroacetophenone and other TCs on different chemical munitions.

9.4. CW Plant in Chapaevsk

Chemical plant 102: production of mustard gas, lewisite, phosgene, diphosgene and other TCs; the filling of TCs on different chemical munitions; the storage of TCs.

In the pre-W.W.II years the plant occasionally produced batches of mustard gas and lewisite for the needs of the army. Continuos production was carried out only during wartime. The mustard gas was produced up to 1943, the lewisite production continued throughout the W.W.II. Munitions were charged with mustard gas, lewisite, and mustard gas-lewisite mixtures. Plant's own storage facility was eliminated in the late 1950th.

9.5. CW Plant in Stalingrad

Chemical plant 91: production of mustard gas and phosgene; the filling of TCs on different chemical munitions. The mustard gas production was organized in the early 1930th. In the pre-W.W.II years individual batches of mustard gas were produced. During the W.W.II production of mustard gas and aircraft bombs charged with it was carried out till the autumn of 1942 and was not restarted afterwards. Experimental production of sarin, soman and V-gas was set up in the 1940th-1950th. Large-scale production of sarin was started in 1959, and of soman in 1967.

9.6. CW Plants in Dzerzhinsk

Chemical plant 96: production of mustard gas, lewisite and other TCs; the filling of different chemical munitions; the storage of TCs. Chemical plant 148: production of hydrogen cyanide; the filling of different chemical munitions. Chemical plant Chernorechenskiy: production of hydrogen cyanide, phosgene, diphosgene; the filling of different chemical munitions. The phosgene was produced throughout the W.W.II. The hydrogen cyanide was produced in Dzerzhinsk throughout the W.W.II.

9.7. CW-Giant in the Chuwash Republic

Current Russia's stocks of Russian V-gas are associated with the work of a newly built plant "Khimprom" in Novocheboksarsk on the shore of the Volga. Industrial production of Soviet V-gas was set up in 1972. Charging munitions was carried out till 1987-1988.

9.8. Other CW Plants

Chemical plant 761 (Berezniki): production of mustard gas. Chemical plant 100 (Stalinogorsk): production of mustard gas; the filling of TCs on chemical munitions. Chemical

plant 756 (Aniline Ink Plant, Kineshma): production of adamsite and diphenilchloroarsine. Production was set up in the pre-W.W.II years.

Production of first generation CWs was set up in Slavyansk in the pre-war years. The relevant production facility did not function during the W.War.II. So called 102-nd area of the "Kremniypolimer" plant in Zaporozhye was built in the 1970-1980th to produce CWs for the "Foliant" program (the resolution of 8 June, 1973 adopted by the CPSU Central Committee and the USSR Council of Ministers). A storage facility for future stockpiling of CWs was also built nearby. Data about the fate of those production and storage facilities are not available. The same applies to Pavlodar. Here, on the "Khimprom's" VIII production line, preparations were made for several decades to set up production of chemical munitions (aircraft bombs, artillery shells, missile warheads, even munitions for dropping from airships). It was supposed that they would be charged with Soviet V-gas and soman, which were planned to be produced at the same place.

Chapter 10. SPECIAL MEDICINE

Chapter 12 contains first publishing data about medicine participation in providing the creation of Soviet chemical weapon storage and military-chemical potential. Real priority of soviet medicine - not protection of the people, and service of army and industry is formulated. Here are brought data about human losses happened because of preparations to the offensive chemical war.

10.1. Authority and Medicine

10.2. Sanitary Control of the Projects

10.3. Sanitary Control of the CWs Production

10.4. Hygienic Standards

10.5. Sanitary-protective Zones

10.6. The minimal dozes

The fact is, that the small dozes of TCs cause chronic illnesses of the exposed people. In Russia to number of victims all participants of production of PTCs on the chemical plants in Volgograd and Novocheboksarsk concern. In Russia already the publication of the reports about a chronic poisoning of the participants of CWs production began. However these scientific results have not yet received the material realization for victims. The state not yet agrees to admit, that there is the damage to health of all participants of the Russian CWs production. As a consequence the state does not recognize of the rights of the participants of production to health restoration. So long as the Russian workers will not receive indemnification for damage to their health during the past CWs production, it is impossible to imagine a normal course of work on destruction of CWs shops, where it occurred. The absence of a guarantee of compensation of damage to the people, injured by CWs production is the second obstacle on a way of fulfilment of Convention on CWs.

10.7. Treatment?

Those persons, who participated in manufacture of mustard gas and lewisite during W.W.II, were forgotten by the Soviet/Russian State. Originally them was about 100000 person, remained about 200 persons. All those about 8000 persons, who participated in production of modern toxic chemicals (sarin, soman and V-gas), are poisoned. 5000 persons participated in manufacture of sarin and soman on the chemical plant in Volgograd and 3000 persons participated in manufacture of Russian V-gas on the chemical plant in Novocheboksarsk. However the Russian State does not intend to pay them for lost health.

10.8. The Problem of Occupational Diseases

Chapter 11. SECRET SERVICES. SOVIET UNION AS A GREATE BARRACKS

In Chapter 11 there are analyzed numerous aspects of a problem of secrecy during the Soviet Union preparations for the offensive chemical war. This goal was achieved. Owing to the soviet security service West never knew real scales of these efforts and underestimated a level of soviet readiness.

11.1. Counter-Espionage. Saved Secrets

Data about the Soviet Union's pre-W.W.II military-chemical proving grounds, CWs plants, storage sites and arsenals were poorly known for intelligence services because of total system of secrecy, enciphering, censorship.

11.2.

11.3.

A.Arbuzov and M.Kabachnik synthesized sarin in Kazan-city during W.W.II. (Arbuzov - 1943, Kabachnik - 1944). M.Kabachnik received the Stalin priz for synthesis of sarin in 1946 and Lenin priz for Soviet V-gas in 1974.

Some other Lenin prizes: S.Varshavskii, L,Soborovskii, V.Pozdnev, etc. - for of sarin (1960); S.Golubkov, V.Zimin, I.Martynov, etc. - for of soman (1972); M.Kabachnik, V.Rostunov, V.Romanov, A.Fokin, etc. - for Soviet V-gas (1974); A.Kuntsevich, V.Petrunin, etc. - for binary Soviet V-gas (1991), S.Arzhakov, S.Petrov, etc. - for Soviet incapasitant (1991).

11.4.

PART III. THE CHEMICAL WAR

Part III for the first time is devoted to Soviet/Russian chemical weapon's participation in the wars, domestic conflicts and in frame of acts of chemical terrorism.

Chapter 12. INTERNATIONAL CHEMICAL WARS

Chapter 12 is devoted to soviet chemical weapon's participation in the international wars. For the first time is described on the documentary material the preparation for chemical weapon usage in fights against Finland, Japan and Romania in 1938-1940.

12.1. World War I

12.2. Between World Wars

Conflict with Japan, etc.

12.3. The Soviet War against Finland

During the Soviet-Finnish Winter war (on November 30, 1939 - March 13, 1940) the Red Army was ready for wide application of the chemical weapons, and mainly for use of aircraft. Finland was not prepared for the chemical war. According to the data of Soviet intelligence, the gas masks in Finnish army were available only for 50-60% of military stuff. At the same time the Red Army NORTHWEST front had prepared gas masks for 100% of military stuff during two-month preparatory period before the Winter war. Pretext for use of chemical weapon by the Red Army was mythical bombing of 8-th Army headquarters by Finnish army with a hydrocianic acid aircraft bomb on December 24, 1939. The list of aims for chemical attacks against Finland was chosen during special expedition of the Red Army military-chemical service between December, 29 1939 and January 7, 1940. 18 inhabited localities were in that list. The basic aims for chemical bombing and spray of toxic chemicals were chosen at the front of 8-th Army. At the 13-th Army front there were determined aims for toxic smoke and terrain contamination by blister agents. Some aims were also prepared at the front of 7-th Army. No aims were found at the fronts of 9-th and 14-th Armies. Land and aviation units - two chemical tank battalions and three chemical bomber squadron were prepared for chemical attack at the front of 8-th Army. There was prepared the stock of chemical bombs for 474 operational flights of average-size bombers for air chemical attack at the front of 8-th Army. Also there were prepared toxic chemicals for spraying from spray tanks. And there were carried out trainings on toxic chemicals spraying from large heights. Since March 1, 1940 the 8-th Army was completely prepared for chemical attack against Finland. Actually the chemical war has not started, because the Soviet-Finnish conflict ended on March 13. The Soviet and Russian military historians had never represented to the society any data on the Soviet Union preparation for chemical war against Finland, as well as any data on preparations for the local wars in period between two World Wars.

12.4. Chemical Wars after World War II

Chapter 13. DOMESTIC CONFLICTS

Chapter 13 is devoted to soviet chemical weapon's participation in the domestic conflicts.

13.1. Civil War in Russia

13.2.CWs in the Soviet Domestic Conflicts

13.3. Tbilisi (1989)

Chapter 14. SOVIET CHEMICAL TERRORISM

In Chapter 14 are generalized numerous facts of chemical terrorism as of individual so of state. Especially in detail is considered the Soviet state chemical terrorism as the most serious danger for the Soviet Union citizens.

14.2. The State Chemical Terrorism of the Secret Services

14.3. The State Chemical Terrorism of the Industry

14.4. The State Chemical Terrorism of the Army

14.1. Chemical Terrorism in the Life

CHAPTER 15. STATE CHEMICAL TERRORISM ON DUBROVKA

Case of using of nonlethal toxic weapons (exactly incapacitants) for police purposes happened in Moscow at the end of 2002. A group of Chechen terrorists have took a lot of people, audience of the musical in the Concert Hall, as hostages (nearly 750 persons including more than 70 foreigners). The negotiations with terrorists have led to no result. There was performed an assault with use of toxic chemicals (TCs). During the attack on hostage building a wave of incapacitating ("nonlethal") TCs was pumped through the supply vent system of the hall. Almost all people in the hall - terrorists and hostages - have fallen asleep after a time. After that the assault group have appeared in the hall. The mix compounding of two (halothane and "fentanyl derivate" or another matter) or tree compounds (for instance including BZ derivate) was used as the "nonlethal" TCs. The negatives. First of all the TCs concentration obviously exceeded the concentration needed for the salvation of the fighting problem. (The authorities ahead doomed innocent people to great suffering. Many people in the Concert Hall were from risk-groups, and that "nonlethal" TCs affected them above all. And the consequences were tragic). Secondly the authorities decided not to inform anybody about the fact of chemical weapons using and about the features of "nonlethal" TCs. The rescuers and medical stuff who worked at the victims evacuation and their transportation to hospitals also remained uninformed about the TCs. In the third place, military chemists and military toxicologists, who hold all the information on questions of incapacitants fighting application, were not attracted to take part in the storm. As a consequence of these facts an unjustified number of people - 129 persons - died from poisoning with the "nonlethal" TCs during the assault. The legal grounds for nonlethal TCs application in real police practice of nowadays Russia remain unclear. According to the Chemical Weapons Convention Russia must have informed Organization for the Prohibition of Chemical Weapons about "each chemical it holds for riot control purposes" (Article III, paragraph 1e). This procedure have not been accomplished. So, the assault with "nonlethal" TCs application supposed the obligatory participation not only of the assault group, but also the participation of military chemists and toxicologists, as well as civil anesthetists, who must be fully in the know of the reasons of poisoning. In fact the majority of people died from Russian hypertrophied secrecy regarding the information about non-secret TCs.

15.1.

15.2.

15.3.

15.4.

Chapter 16. EXTRAORDINARY NORM

Chapter 16 is devoted to consequences of systematic neglect in Soviet Union by questions of safety at preparation to offensive chemical war. There are brought numerous data on fires, failures and accidents during manufacture, storage and usage of chemical weapon.

16.1. Chemical Fire in the Chuvashia - 1974

Among considerable accidents a special place goes to fire on plant "Khimprom" at the storage facility of aircraft bombs charged with V-gas that occurred on 28 April 1974. Accidents occurred with release of V-gas even after that.

16.2. Accidents in the Industry

16.3. Cases of Army Negligence

PART IV. ECOLOGY OF CHEMICAL WAR

Part IV for the first time on a soviet example gives integration of a material on influence of preparation to chemical war on ecology.

Chapter 17. CHEMISTRY AND LIFE

In Chapter 21 the approach of army and authorities to a problem of protection of the people and nature from the chemical weapon is generalized. A neglect of life and well-being of the people and environment is illustrated by examples of ecological data about numerous negative consequences of preparation of Soviet Union to offensive chemical war.

17.1. Toxic Chemicals in the Nature

17.2. Army and Ecology

17.3. Army and the Problem of Chemical Protection

17.4. Workers without Protection

Chapter 18. EXPERIMENTS OF ARMY OVER THE PEOPLE

In Chapter 18 there are discussed the questions of military-chemical toxicology. Using the documentary material earlier not known here for the first time are in detail considered data of thousands experiences on the people which were carried out in Soviet Union during preparation to offensive chemical war. There are brought evidences that Red (Soviet) Army has received the sanction of the highest management of the country for all these experiences with a conscious poisoning of the people.

18.1. Authority

The wide tests of all TCs types on people in army were conducted independently from any decisions and sanctions of military or civil medical institutions. The experiments on people with usage of the whole TCs arsenal available for the military chemists had been proceeding for many decades, and their results were generalized in numerous secret reports, which however had not become public property up to nowadays. Army were used people as the objects for tests of all TCs kinds at least up to the last year of the Soviet authority existence – up to 1991.

18.2. People-smellers

In 1920-th neither serious toxicological data about various TCs (including tear-gases and irritatnts) nor also means of their concentration in air measurement existed. The "smelling" tests became on an army norm. In particular, the biological control of a poisonous smoke was realized with use of people, who have been exposed in 60 m, 100 m and 150 m from a point of explosion from leeward side at proving ground Kuzminki, during tests of a modernized chemical 76 mm artillery shell and a 107 mm shrapnel-chemical artillery shell, on February 28, 1928. There was found out, that it is impossible to stand without a gas mask inside a cloud of irritating TC in 60 m distance from the explosion point of a 76 mm shell during first 30 seconds (up to a cloud dispersion), and after testing of a 107 mm shell - at a distance of 100 m during 59 seconds. The conclusions after testing of a 76 mm shell: "*an existing technique of determination of irritating action of shrapnel-chemical shells by human eyes and a nose cannot be considered as a criterion of a received cloud value, because it does not give data about the TC particles size*". And after testing of a 107 mm shell: "*It is possible to believe, that on a distance of 150 meters this shell gives a sufficient toxic effect*". One more example - series of tests of 76 mm shells equipped with three irritants which were carried out on December 1-5, 1929 by a method of explosion on a proving ground in Kuzminki with the aim of determination "of a period, during which it is possible to be at a place of explosion without a gas mask". The biological control of efficiency and speed of TC action was carried out on people exposed on various distances from a place of explosion ("people were placed in trenches in a direction of a wave movement, then after explosion they had left trenches in a wave direction and stood at different distances from explosion"). In 1930 the measurements of toxic-smoke TCs in air concentration by using people-smellers was organized on a scientific basis. The military-sanitary institute included in its plans an urgent theme "*TCs smell-determination in connection with choosing of the so-called chemists-smellers in military units*". It was motivated that: "*for the majority of the TC's no any indicator which could determine their presence in field conditions more sensitive than the smell was discovered till now*".

18.3. The Experiments with Mustard Gas

The experiments in which mustard gas was tested on unprotected human skin have also became the general system. As well as lewisite. The experiments with use of people skin for the test on mustard gas and lewisite have begun already in 1920. In particular, in 1932 toxicological laboratory on the proving ground in Shikhany has been solving the following problems: determination of the role of air layer at mustard gas penetration through the uniform; omparative sensitivity of rabbit and human skin to mustard gas vapour; permeability of the army boots for mustard gas; comparative study of stability of various formulas on a mustard gas basis and etc. The realization of all these programs – and about uniform, and about boots – was supposed to proceed with using absolutely unprotected bodies of rightless soldiers. The conclusion about persistent TC permeability through usual clothes of the military men was pessimistic. A drop of 25 cubic milliliters of the mustard gas-lewisite mixture in 15 minutes reaches human body through sheep-coat and soldier's blouse, as also through overcoat and a soldier's blouse, as well as through boots ("tests on people", as it was honestly specified in the report). The same drop reaches human body trough the summer soldier blouse in 1 minute.

As to comparative advantages of various mustard gas formulas "of blister action", mustard gas itself has appeared the most strongest. Basing on these experiments with people the chief of

proving ground laboratory has made such a conclusion: "In summer the technical mustard gas is the best of means for area contamination... in comparison" with its other formulas.

The creating of such a sort of tests has been a system in those years. These experiments were not unique, there were lots of them, they were carried out in different places of Soviet Union and in different time. And this way was permitted by the highest authorities of the country. In these years for determination of quality of degassing after mustard gas contaminating of military technique only one "technical" method had been used - to put a hand of the live person to a surface. As to treatment of people poisoned with mustard gas and lewisite such level of knowledge, which toxicologists had because of experiments on people, was not accessible to physicians in preW.W.II years, and the management did not aspire to it too much. Later this knowledge also did not arise.

18.4. World War II and after

In the next decades - in 1940-1980th years - a standard soviet practice of tests of the CWs on people did not contain any peculiarities, though techniques of the military chemists became more refined. As an example of tests on people in 1940-1950-th years could be accepted E.I.Viljatitzkii, nowadays the retired colonel of chemical troops. The experiments over him have been a necessary element of a service at military-chemical proving ground in Kuzminki (Moscow). Among other experiments military chemical "scientists" drew mustard gas on his skin and then studied all the degassing processes. It was much later the W.W.II. To that time from the open publications of the scientists USA (C.Auerbach and other) about investigations carried out in 1943 and in following years on a *Drosophila melanogaster* it was already known about powerful mutagen effect of S-mustard gas and of related compounds. Accordingly, soviet "scientists" should stop the barbarity, however have not stopped. The experts from Institute genetics of Russian Academy of sciences revealed the irreversible changes in chromosome set of the colonel E.I.Viljatitzkii - those chromosome aberrations, which were found out already in 1943 in USA on *Drosophila melanogaster*. And chromosome changes at E.I.Viljatitzkii have appeared just of a chemical origin (meanwhile were revealed also other - nuclear - changes owed to another episode of his service in chemical troops of Soviet Army.

18.5.

Chapter 19. MILITARY-CHEMICAL BOOMERANG

Chapter 19 is devoted to the poisoning of thousands people of the army staff during the process of army preparation for the chemical war. Separately there are considered the poisonings at development and testing of the chemical weapon, and also at its storage and usage in the process of chemical manoeuvres (battle training). Chapter 19 shows also numerous and much scaled army experiments with the chemical weapon, which in fact turned out to be experiments on natural environment of the country.

19.1. Institutes

19.2. Proving Grounds

19.3. Stocks

19.4. Troops

19.5. Military experiments over nature

There almost were no excavations during the period in between World Wars. As the only example we can show the fact of chemical weapons excavation carried out on the testing site and proving grounds Kuzminki in Moscow in October-December, 1937. According to the status formed by the 15th of November, 1937, on the polygon land part there were dug out 6855 mortar chemical shells, 751 artillery chemical shells, 75 air chemical bombs, 732 toxic smoke candles, 904 barrels with mustard gas, 277 gas-cylinders with phosgene, hydrogen cyanide and chlorine, 30 metric tons adamsite, 156 metric tons of arsenic TCs production wastes. And there were lifted up from the bottom of the polygon lake 24 barrels with sulfur mustard gas, 22 gas-cylinders with TCs, 103 artillery chemical shells, 119 mortar chemical shells. Those excavations were postponed because of wintertime, but they have never been recommenced. The normal (unhydrolysed) mustard gas was found in the soil on the territory of this proving grounds in 1998.

19.6. Scale (Military Camps, Proving Grounds, Shooting-grounds)

Ecological evaluation of CWs storage facilities and testing grounds was not made. The sites of CWs storage and testing to be dangerous and are still dangerous to personnel and local residents.

Chapter 20. POISONINGS OF WORKERS

Chapter 20 tells in detail about numerous civil victims during preparation for the chemical war. CWs production caused poisoning of the whole plant personnel. The Soviet CWs were created by the price of health of several generations of citizens. There are some populations of people, suffered by CWs production. Each plant, where people were never protected from poisoning in the process of chemical weapon production, is separately discussed.

20.1. Moscow Region

20.2. Chemical Drudgery in Chapaevsk

Mustard gas was produced on the chemical plant 102 up to 1943 and then its production was halted when injuries became impossible to prevent. Lewisite production continued throughout the W.W.II.

Thousands of people suffered from mustard gas production during W.W.II. Dozens of workers died on the job, and hundreds died after becoming occupational invalids. Most of the workers of these production facilities died during the early post-war years. The environmental influence on children's population in Chapaevsk (Samara region) was studied in 1994-1995. Author identified the syndromocomplex of pathologies typical for the children's population of Chapaevsk who live with their parents in a certain integrated environmental conditions - syndrome of pathological aging and intellectual degeneration - "the Chapaevsk syndrome" (a "control" place of Samara region was Oktiabsrsk city). Results: 1) Mothers of tested children in Chapaevsk and Oktiabrsk were practically of the same age, but young women in Chapaevsk were ill before pregnancy three times more often than women in Oktiabrsk. 2) The pregnancy and child-birth abnormality in Chapaevsk was 2-7 times as much as in Oktiabrsk. 3) The occurrence of prematurely born babies, child-births with asphyxia and hypoxia and immature babies in Chapaevsk was 2-6 times as high as in Oktiabrsk. The number of healthy new-born children (the first group of health) in Chapaevsk was two times less than that in Oktiabrsk. 3) There were observed at the background of widespread anemisation (30-60% of children in different age group) and hyposensibilisation the next prevailing pathologies: inborn defects and anomalies; affection of central nervous system, the process of metabolism, nourisment; hypovitaminosis with physical and psychic development lagging behind; oxalluria. 4) The inborn hydrocephalia was observed 6-7 times more frequently than it is allowed by the "European Register of inborn defects". The rest 18 inborn defects didn't exceed the allowable level. Nearly 20% of children born in 1991-1993 had hydrocephalic and hypertensive-hydrocefalic syndromes, which indicates the immaturity of cerebrum, it's atrophy (pathological aging). More than a half of all tested children had a perinatal encephalopatia at the first year of life. The vascular distonia of hypotonic type, asteno-neurotic syndrome, lagging behind of normal psychic development (33,4% of tested children) are widespread among older children. 5) Defect of an eye and it's dependent apparatus, defects of kidney encountered (in compare with allowed by the "Hungarian Register of Inborn defects"). Identified pathology was typical for the whole population.

20.3. Chemical City Dzerzhinsk

The following figures illustrate poor safety conditions on the plant 96: 2397 cases of mustard gas and 89 cases of lewisite acute poisoning in 1942. The acute poisoning of personnel were similar to combat conditions. In 1943, the number of acute poisoning cases decreases to 494 (mustard gas) and 23 (lewisite). During the war, the rate of mortality directly on the work place increased with time: 2 cases in 1941, 10 in 1942, 7 in 1943, 13 in 1944, and 15 in 1945. Mortality rates increased after war due to the deaths of patients who were exposed during the war. The war-time mustard gas production caused serious social problems which have not been solved till the present time. 1,580 people received medical check-ups in 1945: 846 were diagnosed with occupational diseases, 270 people considered disable of I and II category, 174 - disabled of III category. Only 290 workers were found in proper health.

20.4. The Stalingrad Battle

During the W.W.II production of mustard gas control and measuring equipment was not installed even for monitoring Chlorine levels.

Many workers were acute poisoned during sarin and soman production. As to the long-term impact of small doses of PTCs on approximately 5,000 workers, this problem simply "did not exist". Only in 1994 certain facts that were known for a long time finally made public ("The acute consequences even after 5-10 years were determined").

20.5. Novocheboksarsk

V-gas production workers did not wear pressure suits, but rather rubber suits that did not completely protect the skin from the PTCs vapor. The tightness of the equipment was not provided. Thousands of people feel that they were victims. A total of about 3,000 people participated in V-

gas production. All of them were affected by neurotropic V-gas. It turned out that, without their consent and desire, they were under a big experiment on such an influence. Doctors and scientists say now that, before the start of the production, they knew neither about remote consequences of V-gas effect on man, nor about the possibility of chronic effect on man of small quantities of V-gas. Nevertheless, nobody wants to acknowledge that such an experiment took place. Their health has been ruined. Many of them see that their work in V-gas production affected health of their children as well. Health of more than a half of the 3,000 workers who participated in production of V-gas is such that they need urgent medical examination in connection with this past production. However, they cannot be provided with such an examination. They have no rights. Only 200 people succeeded in proving the connection between the production and the deterioration of their health and defended the right to be called occupationally diseased. Only a few persons received the status of occupationally disabled. However, their rights are insignificant in comparison with the damage to their health and the sums paid in compensation are miserable. Even occupationally diseased workers are not provided with pensions and privileges comparable to those received by servicemen. The other workers cannot still prove their "contacts" with V-gas. Very often the administration didn't register such contacts, whereas the state of their health is not proof. The number of the diseased does not decrease, it grows although many years have passed since the production was stopped. Their health steadily deteriorates, the nervous system (central and peripheral) collapses, so does the liver, the heart fails. Nonetheless, nobody suggests solutions of problems related to rehabilitation of their health. Such problems are simply ignored. As for the health of their children and grandchildren born after 1972, the authorities refuse to discuss it at all.

20.6. Slaughter-house of other CWs Plants

In Kineshma on the adamsite production during the W.W.II simple safety rules have not been followed. According to testing results in 1943, the majority of personnel had serious health problems, including constant migraines, skin and respiratory diseases, etc. A third of all personnel tested positive for Arsenic in urine.

Chapter 21. RUINOUS TERRITORIES

Chapter 21 lists data on catastrophic change of an environment of all those soviet cities, where there was the long-term production of the chemical weapon. The sole existence of CWs production plants represents a large-scale impact on the people's health and ecological prosperity of the human race and the environment. CWs production resulted in serious and probably irreversible changes in the environment of adjacent areas. Large-scale production of TCs was carried out mainly in the Volga basin. The waters of Volga, Oka and Kama were supposed to play a twofold role, namely, to serve production purposes and absorb effluents. The presented episodes give an idea of types of ecological after-effects due to the past preparation for chemical war. The present population of Kineshma and Beresniki, Chapaevsk and Dzerzhinsk Stalingrad and Novocheboksarsk is facing difficult problems due to the above actions in the past.

21.1. Moscow and Moscow Suburbs

21.2. Chapaevsk

The large-scale production of mustard gas and lewisite was organized in Chapaevsk on the shore of the Chapaevka River not far from the confluence with the Volga. Production equipment worked very poorly at the plant, gas tightness of the technological equipment in the plant was not ensured. The contaminated air from shops that produced mustard gas and lewisite, was exhausted directly to the city atmosphere without purification. Waste water purification facilities as a rule did not function despite on going production of TCs themselves. Wastes were dumped directly into the Chapaevka River and from there reached the Volga. Spoilage (TCs and munitions) went to a dump, now forgotten, on the territory of the plant. After the end of the war considerable amount of CWs rejected by the army by that time was destroyed directly on the territory of the plant. Ecological examination carried out in winter 1993-1994 showed that the concentration of Arsenic in the soil on the territory of the plant exceeds maximum permissible concentration (M.P.C.) by a factor of 8,500. In the town's areas surrounding the plant the concentration of Arsenic exceeds M.P.C. by a factor of 2-10. Fifty years after the end of lewisite production, a byproduct, beta-chlorvinylarsinoxid, even more toxic than lewisite, was found in the soil on the territory of the plant and also in nearby residential areas downwind. Now this territory is polluted with arsenic and polychlorinated dioxines generated at that time. The normal (unhydrolysed) mustard gas was found in the soil on the territory of plant in the end 1990th.

The first assessment of environmental conditions and people s health in Chapaevsk area has been recently conducted. TCs and explosives production have provided practically the most

significant impact on the biosphere in the area for decades. Higher levels of mutation were registered in fish in a nearby lake. Mice caught on plant grounds had symptoms of secondary immune deficiency. Daphnia, a common indicator of clean environment, could not adjust to sewer waters - they are half-dead in 92 hours.

21.3. Dzerzhinsk

In Dzerzhinsk, on the shore of the Oka, CWs were produced by three plants.

In the years of intensive production on the chemical plant 96, the waste from mustard gas and lewisite production was dumped at the special dumping site without decontamination. Any change in wind direction affected the production area. Barrels used for packaging arsenic were buried directly on the territory of the plant. The research of impact on the Oka river through a system of lakes was not conducted.

During the war, purification of air contaminated by the mustard gas was ineffective and such air spread over a radius of 5-7 km from the plant densely surrounded by residential settlements. The issue of more effective way of mustard gas decontamination was raised in 1959. According to the data obtained in the early 60th, the concentration of pollutants in sleeping quarters of the kindergarten No.23 was equal to or greater than at the source - on plant 96.
Sand soil prevent from discharging of industrial waste by burial in the ground with karst characteristics.

21.4. Stalingrad (Volgograd)

The mustard gas production on the chemical plant 91 was organized on the shore of the Volga. The majority of the plant's discharge was dumped directly into river. The waste from production of sarin and soman was discharged after local purification stations into the so called "white sea" for permanent storage (this place is in the 7 kilometer up stream from the water collection station of Krasnoarmeisk city). There is no clay layer underneath the "white sea". As a result the rate of the penetration of waste in the ground is 8 meters deep per year. In February 1965, the dam separating the "white sea" from Volga river broke and the contents of the "white sea" were discharged into the Krasnoarmeisk water reservoir and the Volga river. The contents discharged into the river included the waste from PTCs production shops, which were accumulated for many years. As a result the surface of the river was white with a flood of dead fish as far as Astrakhan. Ecological consequences of that catastrophe and other accidents were not evaluated. According to data of analysis 1986-1988, the water in the Volga river provides negative impact on the organism of warm-blooded animals (including human).

21.5. Berezniki

The mustard gas production was organized on the chemical plant 761 on the shore of the Kama. The discharges from mustard gas production were never treated because treatment units were never built. During W.W.II the mustard gas concentration in plant effluents averaged 156 mg/liter, and frequently went as high as 329 mg/liter (solubility of mustard gas is approximately 500 mg/liter), approaching the solubility of mustard gas in water. The Kama riverbed and the plant's water collection facility were polluted due to extremely high sewage suspension levels.

21.6. Chuwash Republic

Full-scale analysis of impact on the environment of 15-year production of V-gas was not made. However, the consequences can be evaluated by the following fact. Over this period there had been 2-km sanitary safety zone around the plant, where people were not allowed to live and cultivating of agricultural products was forbidden. In the summer of 1994, seven years after stopping of production of PTCs, the zone was expanded up to 4 km.

21.7.Other

In Kineshma the adamsite was produced on the shore of the Volga. The waste from plant were not treated and were discharged directly into the Volga river.

PART V. LIQUIDATION OF THE CHEMICAL WEAPONS IN THE PAST

Part V is devoted to the evolution of views and actions of soviet authorities during the liquidation of outdated and unnecessary chemical weapon in the past.

Chapter 22 THE UNKNOWN RUSSIA

In Chapter 22 for the first time the detail analysis is given how in Soviet Union a problem of the old chemical weapon was caused. Detailed data are brought on periods and reasons of intensive destruction of the unnecessary and out-of-date chemical weapon, about volumes of the destroyed chemical weapon and the documents adjusting this practice.

22.1. How Many CWs we Had

Approximately 10-20 thousands metric tons of TCs have been produced in the Soviet Union between W.W.I and W.W.II. During W.W.II 122,400 metric tons of first generation TCs were produced, including: 76,700 tons of S-mustard gas, 20,200 tons of lewisite, 6,100 tons of adamsite, 8,300 tons of phosgene and 11,100 tons of hydrogen cyanide. Partly these TCs was charged to 4,573,600 chemical munitions.

There are no official data about the further fate of these TCs.

22.2. Where we Destroyed our CWs

No less than 120 thousand metric tons of TCs have been destroyed in the Soviet Union during the 1940-1980th. The Army is concealing from the population the locations of CWs burial sites. Past large-scale CWs destruction operations are creating numerous problems for providing secure ecological future for many regions of the former Soviet Union. Now the most of OCW remain under ground on the territory of numerous former Soviet testing sites, proving grounds, storage facilities, military camps, filling stations, production sites, etc. A large amount of OCW was dumped in lakes, swamps, rivers (including Volga) and seas (Kara Sea, White Sea, Barents Sea, Okhotsk Sea, Japan Sea, etc).

22.3. How did we Destroyed our CWs

CWs that became redundant and/or lost its combat qualities were disposed of in different ways and being carried out most intensely in five historical periods. The methods of CWs disposal used (open incineration, burial, underwater dumping) were ecologically hazardous. None of CWs destruction operations observed ecological safety regulations.

The recommendations given in "Directions for chemical artillery shells usage" in 1924 were simple: "*Defective shells are to be eliminated either by gun shots or by **burying them into soil on the depth of not less than 1.5 arshines** (1 arshine = 0.711 m. = 2 ft. 4 in. - L.F.). No shells could be thrown into the water to avoid poisonings*". The second example is about air chemical bombs transportation. The simple recommendation given in "Instructions for air chemical bombs equipped with military chemical compounds transportation and storage" told the following. During any transportation including cartage "*in case of TCs leak the leaking bomb should be separated and destroyed **by burying it into soil on the depth of not less than 1.5 meters***". There was an exclusion concerning to burial places: in case of transportation by railways "the leaking bomb is separated and ***buried in soil*** in place pointed by the railroad administration…".

Chapter 23. LOOKING FOR THE OLD CWs

Chapter 23 proves on new and earlier not known documentary material that chemical weapon was buried in several hundreds points of Soviet Union in an organized way. Among them there are more than 200 places of chemical weapon storage and also 200-300 places of chemical weapon usage during the manoeuvres. Burying of the unnecessary chemical weapon was officially considered as a way of getting rid of it. The Soviet Army has concealed from the society all the data on the chemical weapon burial places.

23.1. Voroshilov as Tracker?

23.2. The First CWs Excavations

23.3. The Stocks

23.4. The Military Camps and Proving Grounds

23.5. Voroshilov's loss

Chapter 24. LIQUIDATION OF THE CHEMICAL WEAPONS in the past

Chapter 29 tells in details about the ways of getting rid of the chemical weapon in previous (before-conventional) years. All these approaches (burying, incineration, dumping) were not ecological and they have caused a problem of the old chemical weapon on numerous territories of the country.

24.1. The Parting with CWs

CWs that became redundant and/or lost its combat qualities were disposed of in different ways; this being carried out most intensely in different periods. After W.W.II in 1946-1950 along with the underwater disposal of the trophy CWs, the army carried out liquidation of stocks of home-made ones. The next phase of CWs disposal dates to 1956-1962, the period of conversion from first-generation to second-generation CWs. Approximately 10,000-12,000 metric tons of home-made HD were liquidated. The new phase is related to destruction of chemical munitions filled with the first generation TCs in the 1970th after the first lots of munitions with V-gas were delivered from Novocheboksarsk. And at last the Soviet Army carried out large-scale transfers of

CWs in 1987-1989 from the bases where they had been stored to the seven announced arsenals. At the same time the arsenals were "erased" to dimensions that would be comparable with US stockpiles. In general, the situation with CWs burial sites is unsatisfactory. The society does not have official and adequate information regarding locations of "chemical mines" installed by military chemists in a way of past CWs burial. Therefore, the task of comprehensive assessment and remediation of burial sites have not been defined. The current situation can not remain invariable for a long period of time without hazardous effects on the population.

24.2. The Burial

On a storage near Chapaevsk City CWs produced by the plants at Chapaevsk, Dzerzhinsk and other towns have been stored there since W.W.II. In the early 1960s, at least 1,200 tons of mustard gas were disposed of by means of incineration and burial.

At the military-chemical proving grounds Shikhany 3,200 metric tones of adamcite were buried in the 1950-1960th.

24.2. The Burning

In Kambarka in 1950th approximately 2,000 metric tons of mustard gas were destroyed on the chemical storage using an open-air burning technique. Now this territory is polluted with polychlorinated dioxines generated from the burning.

On CWs arsenal in Maradykovskiy at 60th the surplus air bombs with mustard gas-lewisite mixtures have been destroyed using an open-air burning in the forest near the arsenal. Burial places of a major part of generated waste are unknown; they probably could have been washed off in the Vyatka river during vernal high waters. Now this territory is polluted with Arsenic and polychlorinated dioxines generated at that time. The recent preliminary ecological examination showed that the concentration of Arsenic in the soil exceeds M.P.C.

On CWs arsenal in Leonidovka in the late 1950th-early 1960th the surplus air bombs with mustard gas-lewisite mixtures have been destroyed using an open-air burning technique at 2,5-3 km from the arsenal. There were several destruction sites. The contents of 500 kg, 100 kg and other types of bombs were dumped into trenched, mixed with kerosene and burned. The mustard gas-lewisite mixtures penetrated through brick wall into the soil. The end of destruction process was determined by eye. Now this territory is polluted with Arsenic and polychlorinated dioxines generated at that time. Ecological examination carried out in 1996-1997 showed that the concentration of arsenic in the soil exceeds M.P.C. by a factor of 10,000. Surskoe reservoir created in 1975 is located less than 4 km from this area and is in close dangerous contact with the warehouse site. The danger is even greater due to the local hydrogeological situation (sand soil). The issue of possible emission of mustard gas-lewisite the reservoir has never been raised and researched.

Large quantities of TCs, including munitions, were destroyed in 1940th-1950th on the testing grounds near Arys' station. Mustard gas was shipped to the steppe via special railroad and dumped into pits and burned. Mustard gas was shipped in railroad tank-car from different locations, including chemical arsenal located near Chapaevsk, military-chemical arsenal in Kambarka, CWs plants in Chapaevsk and Dzershinsk, etc.

24.4. The Land Dumping

There are indications of dumping chemical munitions into rivers and swamps.

24.5.The Sea Dumping

The dumping of chemical munitions and containers filled with TCs were used in many seas - Baltic, White, Black, Barents, Black Seas and the seas of Okhotsk and Japan. Transshipment to ships was carried out at the respective ports: at Liinakhamari port by motor transport from Pechenega station for subsequent dumping in the Barents and Kara Seas (in the period of 1959-1962); at a military port in Severodvinsk for subsequent dumping in the White and Barents Seas (in the period of 1947-1956); at Posyet and Nakhodka ports for subsequent dumping in the Sea of Japan (during 1946-1961); at numerous Baltic ports (Paldiski, Tallin, Liepaja, Klajpeda, Oranienbaum, Ventspils for subsequent dumping in the Baltic Sea; (during 1945-1975). In total, the case in point includes at least 12 large sea areas, although there are hundreds of specific sites. The Navy is concealing from the population the locations of CWs dumping in the zone of Russia's economic interests. The nomenclature mainly consisted of Soviet munitions.

The Dumping in Baltic Sea. Considerable share of TCs comprised Soviet-German munitions (i.e. those captured in Germany and included to the stocks of the Red Army). The amounts of the trophy TCs submerged in the Baltic Sea - 12,000 metric tons, including 7,600 tons of mustard gas and 1,600 tons of adamsite.

The consequences of dumping. It is known that many accidents occurred in which participants of those expeditions were poisoned by TCs as a result of breaks in tightness of chemical munitions during operations on loading and unloading. For example, in 1946 during submerging of 15,859 units of old chemical air bombs the ship's crew (Soviet Pacific Fleet) was poisoned by large doses of TCs. There were numerous contamination cases related to submerged chemical munitions in the Sea of Japan, the Baltic Sea, etc. The majority of cases were caused by contact with CWs submerged in relatively shallow waters of the Baltic Sea. For example, there are reports of trawling of chemical bombs and HD canisters in the Baltic Sea. At the same time, spreading of CWs took place during such incidents when dangerous objects were "caught" in restricted areas but were dumped back in the sea in "clear" waters.

END OF EXCERPT-PREVIEW