Stalin and the Atomic Gulag

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This is the third article in Dr Medvedev's series on Stalin and the nuclear bomb (see Spokesman *67 & 68 for the earlier instalments). They have been translated by Tony Simpson.*

The birth of the uranium gulag

The main raw material of the atomic industry, uranium ore, was mined nowhere in the Soviet Union until 1942. It is therefore possible to date the beginning of the atomic era in the USSR to 27th November 1942, to the State Committee for Defence (GKO) top secret decision no.2542 'On mining uranium'. The location of uranium ore in the Tabosharsky region of Tadjikistan had been known since the beginning of the century. It was thus decided to build the first uranium mine there. The work was allocated to the State Commissariat of Non-ferrous Metals which already had enterprises in Central Asia. As a result, one of these factories was re-equipped and, already by May 1943, was producing at the rate of four tonnes of 40 per cent uranium concentrate a year. By the end of 1943, this level was expected to triple.[1] On 30th July 1943, having noticed the lack of real progress in mining and enriching uranium ore, GKO order no.3834ss enrolled several more commissariats and departments to help solve the problem. They included the committee on geological affairs and the commissariats of ferrous metals, machine construction, coal, ammunition, and others, to ensure that the uranium mine in Taboshar received the necessary equipment and cadres. The committee of higher education was charged with providing 18 physicists and chemists for constant work at the uranium mine, and 450 students for work there during the holiday period of 1943.

But this GKO directive turned out to be unrealistic. First of all, it was essential to build uranium mines to extract ore and transport it along mountain paths on donkeys and camels to the central enrichment plant in the Leninabadsky region. Students could not do such work during their holidays. V.M. Molotov, the deputy head of the GKO, had responsibility for the uranium problem, and his apparatus prepared the projects to carry out all these tasks.

Igor Kurchatov, who had already been appointed the scientific head of all the atomic projects, demanded 200 tonnes of pure uranium metal in order to begin work on the bomb: 50 tonnes for the experimental reactor, and 150 tonnes for the industrial one. To begin with, he had only 700 grams of uranium powder which had been kept from pre-war times. This presented a seemingly impossible impasse, which the leaders of the atomic project in the United States had foreseen. They had brought under their control all the world centres for mining uranium, in the Belgian Congo, in South Africa, and in Canada. These centres could not export anywhere else after Germany's occupation of the greater part of Europe.

In Europe, uranium was mined in Saxony, in the former Czechoslovakia, and in France. There were also uranium deposits in Bulgaria. The American administration knew that uranium wasn't mined in the Soviet Union. That was the main factor in their hope, which was dominant after 1943, of an atomic monopoly.

Just at the end of 1943, hopeful news was received in both the United States and Great Britain, that Germany's uranium project had also almost completely halted following the destruction by allied bombardments of the factories producing heavy water in Norway. The German project was based on reactors which used heavy water to slow the neutrons in the chain reaction, since this required significantly less uranium. By the end of 1944 it was obvious that the war in Europe would finish without the use of atomic weapons. This, however, did not stop the Manhattan project. The possession of nuclear weapons began to fulfil other functions for the United States.

For two years after the GKO decision of 27th November 1942, there was still no uranium in the Soviet Union. Volunteers to work in the uranium mines of the Central Asian wildernesses couldn't be found. Only five hundred people worked in the whole of the Soviet uranium industry by the end of 1944. There existed no living facilities nor any technological base for them. Then the geologists discovered more uranium deposits on the borders between Tadjikistan and the Uzbek and Kirghiz Republics. But these deposits were located between 100 and 450 kilometres from the enrichment plant in Leninabadsky region. Each donkey could carry only 75 to 100 kilos of ore along mountainous paths, so that their productivity was not great. Each tonne of 40 per cent uranium concentrate required about two thousand tonnes of uranium ore to be brought to the plant. Even in rich uranium ore, uranium metal constituted only a tenth of one per cent.

It was not difficult to foresee how the problem would be solved in the conditions of the Soviet economy of that time. On 8th December 1944, Stalin signed GKO Decision no.7102ss ('ss' meant 'completely secret'). In accordance with this decision, all the programmes for mining and processing uranium were transferred from the commissariat for non- ferrous metals to the commissariat for internal affairs (NKVD) and put under L.P. Beria's control. This resolved the problem of cadres. According to the next GKO Decision, also signed by Stalin, on 15th May 1945, the unified Combine No.6 was established for mining and processing uranium ore throughout the Central Asia region. An NKVD colonel, B.H. Chirkov, was appointed the first director of this combine.[2]

Having received their order for uranium workers, already, in February 1945, the NKVD leadership had taken a decision ‘about directing Crimean Tartar special (deported) migrants from the Volga region to the uranium combine, as well as qualified workers z/k, (z/k is an abbreviation for ‘imprisoned’ or convicts – author) including mining specialists, geologists, chemists, mechanics, and energy workers from other labour camps’.[3] By August 1945, under the command of Colonel Chirkov, who was soon to become a general, 2,295 prisoners were working. They were not ordinary convicts, but selected from different camps on the basis of their previous experience of minerals, mining, chemicals and technical work. Several of these were repatriated from Germany, having worked in German enterprises. There were also *Vlasovtsi* (Soviet soldiers who had been taken prisoner by the Germans and who served in the German Army under General Vlasov). However, according to a special petition of the NKVD, the Government decided ‘to exclude *Vlasovtsi* from amongst those repatriated for the PGU construction in Leninabad’.[4]

A transformation in the production of uranium was achieved. By the end of 1945, Combine No.6 had processed about 10,000 tonnes of uranium ore to produce seven tonnes of uranium concentrate. In 1946, 35,000 tonnes of uranium ore were processed. By the end of 1947, Combine No.6 consisted of seven uranium enrichment plants receiving ore from eighteen mines. 176,000 tonnes of uranium ore were processed, producing 66 tonnes of uranium concentrate. This guaranteed the production of almost 25 tonnes of uranium metal. In 1948, the production of uranium concentrate doubled. But this still did not satisfy the demands of the industrial reactor which had been built not far from the Urals town of Kyshtym. The greater part of the uranium which was loaded into this reactor in the spring and summer of 1948 consisted of uranium trophies found in Germany in June 1945, and from the established uranium mines in Czechoslovakia and Germany. Only in 1950, when the Leninabadsky combine was processing more than 600,000 tonnes of uranium ore every year, was the decisive significance of imports reduced. At this time, 18,000 people worked at Combine No.6, of whom 7,210 were prisoners.[5]

However, at the beginning of 1953, almost half of all the uranium loaded into the new generation of reactors was smelted from uranium concentrates from the Yakhimovsky uranium mines in Czechoslovakia and from the mines of the Vismut enterprise in East Germany. Until 1952, these enterprises were under the control of, and guarded by, the NKVD-MVD. The main workforce for obtaining uranium were German prisoners-of-war and citizens of German nationality interned on the territories of Hungary and Czechoslovakia. The opportunity to use German prisoners-of-war, whose numbers were approaching 50,000 in these mines in 1948, diminished from the beginning of 1950 in connection with the general decision of the Soviet Government to set free and repatriate German prisoners-of-war.

The uranium gulag widens

In 1950, the uranium mines of Central Asia produced about 80 per cent of all the uranium ore mined on Soviet territory. In addition to more than 7,000 prisoners, who required special security, several thousand people from the 'special settlements' of Crimean Tartars and Moldavians also worked there. Moldavians, mainly from Bessarabia, had, from 1948, the right to return to their homeland. However, they were illegally detained at Combine No.6 'for reasons of security'.[6] Uranium mining was one of the most closely guarded state secrets, and the return of Moldavians to Bessarabia might give rise to a leak of information. In 1950, the authorities responsible for the uranium project took a compromise decision and began to transfer Moldavian workers from facework and other conditions which were dangerous to life, to other work elsewhere in Combine No.6.

In 1946, uranium deposits were discovered amongst the rocks of Kolyma which were rich in rare metals. During the war, the number of prisoners in the Magadan region fell, partly because of the high death rate and partly thanks to the decision of the GKO and the Commander of the Far Eastern Army, General I.R. Apanasenko, to mobilise prisoners in the camps of the Far East for service in the Red Army. The camps contained many military men who had been captured in the waves of terror of 1937-38. But, in 1946, the corrective labour camps (ITL) of the Far East filled up with deported nationalists from Western Ukraine and from the Baltic regions. In 1947, uranium mines began to be built in the system known as the 'Coastal Camp' of *Dalstroy* in Magadan region. (*Dalstroy* is an abbreviation for 'Far Eastern construction system'.) The coastal camp was included in a special group of very harsh camps which was established on Stalin's personal directive 'for especially dangerous' criminals. Obviously, it was supposed that they would not usually escape to freedom. These 'especially dangerous' prisoners included those from Trotskyist, Menshevik, Socialist-Revolutionary, and anarchist organisations, as well as members of nationalist and terrorist groups and 'other anti-Soviet groups'. It was prohibited to send ordinary convicts to these 'special camps'. Their regime was very severe, but for conspiratorial reasons, or for other purposes, these camps were denoted not simply by a number, but by picturesque names such as 'Mineral Camp MVD', 'Mountain Camp', 'Lake Camp', 'Oak-Grove Camp', 'Rushy Camp', and so on.[7] In 'Coastal Camp', which fell into this very harsh category, pits and mines, which were dispersed across a vast territory, had poetic and optimistic names such as 'Hope', 'Longed-for One', 'Victory', and so on.

The Kolyma uranium ore was somewhat poorer than that from Central Asia. But, despite its significantly smaller volume of uranium production, the scale of extraction of uranium ore was very great. Just one enrichment plant was built for the preparation of uranium concentrate using a centrifuge. The process of 'enrichment' was very simple. The uranium ore was crushed by huge millstones, reduced to a pulp suspension, and put into the centrifuge. The particles of ore with a higher concentration of uranium, which is the heaviest substance to be found in the earth's core, sink quickly. The process is repeated several times, and the uranium concentrate is dried. This enrichment plant was built in a camp of the 'Coastal Group' called 'Butugichag'. Here there worked mainly Ukrainians from western Ukraine, which in 1945-1947 was actively 'cleansed' of nationalists. In 1951, the whole Coastal Camp held more than 30,000 inmates. It comprised several separate units. Not only was uranium extracted in these. There were also nickel and cobalt mines, coal mines and gold mines. In my article 'Stalin and the Hydrogen Bomb' (see *Spokesman* 68), I wrote about the practice of deporting prisoners from the atomic city of Arzamas-16, after they had completed their sentences, into 'permanent exile' in Magadan. In the documents of the Commissariat of Industrial Construction, or MVD, Arzamas-16 was given the codename 'Construction 880'. Not long ago, MVD order No.001441 of 7th December 1948 was found in the archives, which stated that '. . . All prisoners (2,000) freed from work on Construction 880 to be sent to special camp No.5'.[9] Special camp No.5 was in the *Dalstroy* system, and was known as 'coastal' or simply 'Berlag'. Sakharov wrote in his memoirs about the practice of deporting freed prisoners to Magadan.[10]

The atomic centre in the settlement of Sarovo, 75 kilometres from Arzamas, was the most secret since it was precisely there that it was proposed to carry out the actual construction for assembling atomic bombs, both for testing and for military uses. Prisoners built this atomic city, then known as KB-11. But in 1948, on 2nd and 31st May, the Presidium of the Supreme Soviet of the USSR decided on amnesties for prisoners with shorter sentences. A recent history of Arzamas-16 says that '. . . on 30th August 1948, 2,292 people were freed from prison . . .' The greater part of those freed were expected to remain in the atomic town as civilian workers. They were not allowed by the MVD to leave the territory of the atomic centre. This would have revealed the main secret of the existence and location of the atomic centre. However, the same essay on the history of the centre provides testimony about this . . . 'The prisoners freed from the camp had no supply of clothes, their attitude to work was poor . . . Many openly declared that, having served their time, they did not want to be in prison again'.[11] The fate of these 2,292 people is not spelt out in the essay. The author, L. Goleusova, does not mention it. Only the text of order No.001441 for the MVD, found in the archives in 1998, shows the real decision. The two noughts at the front part of the order number, according to NKVD and MVD practice, denote that the order was given on Stalin's own instruction.[12]

In 1951-53, new deposits of uranium ore were found in more accessible places, in the Krivorozhsky region of the Ukraine, not far from Pyatigorsk in the Northern Caucasus, in the Chitinsky region, and close to the city of Shevchenko on the shore of the Caspian Sea. A start was made on mining each of these deposits by establishing camps within vast, restricted territories. The establishment of such camps as bases for uranium mines continued for a long time after 1953. Only the introduction of explosive methods for extracting uranium ore, in the 1960s, instead of face working, and the general rehabilitation and amnesties of the Khrushchev period, curtailed this practice. But the 'uranium towns' remained secret until the beginning of 1991.

The birth of the atomic gulag

The 'atomic' gulag was essentially distinct from the 'uranium' gulag for this simple reason: significantly higher qualified workers were needed for the construction of atomic reactors, radiochemical plants and plants to separate uranium isotopes, as well as for the large number of secret scientific institutes and laboratories, than for the extraction of uranium ore.

Kurchatov's deputy at Laboratory No.2, and his first biographer, Professor Igor Golovin, in an interview with *Moscow News* in 1989 on the fortieth anniversary of the testing of the first Soviet atomic bomb, was asked, 'Was prison labour used on the atomic project?'

He replied very openly:

> 'On the very widest scale! All the establishments, mines, atomic cities, even our institute in Moscow (then Laboratory No.2, now the Kurchatov Institute of Atomic Energy – editor), prisoners worked in all these places. You've seen our club. There was a prison in that building. It was surrounded by a thick, high wall, with machine-gun towers in the corners. The building containing the first atomic reactor (or, as we then called it, the boiler), the neighbouring buildings – they were all put up by prisoners' hands. A modern, international centre for nuclear research in Dubna – its first builders were also prisoners . . . There were many thousands in our establishments. All the specialists saw, and knew all about it'.

Obtaining natural uranium and its metallurgical refinement – this is only the preliminary and simplest stage on the way to building an atomic bomb. The second stage, as was already obvious in 1940, was to separate natural uranium into the isotopes 238 and 235, of which only isotope-235, which comprised just 0.7 per cent of the mixture of isotopes in natural uranium, was suitable for the preparation of an atomic bomb. The destruction of the nucleus of uranium-235 by a blow from one neutron led to the release of two, and sometimes three neutrons, and the whole process took on the character of an increasing chain reaction explosion. But 'critical mass' was necessary for the beginning of such a reaction, since with quite small quantities of uranium the greater part of the neutrons formed at the disintegration of the nucleus fly into the surrounding space, and do not collide with new nuclei. The design of the uranium bomb is therefore comparatively simple – it is necessary momentarily, with the help of an explosive wave, to join two or three 'sub-critical' volumes of uranium-235, to give one 'critical' or 'super-critical' volume, which also contains at its centre a source of neutrons-initiators. Calculations showed that the 'critical mass' of uranium was roughly equal to 25-40 kg. For the isolation of the isotope of uranium-235, the method of gaseous-diffusion of uranium hexafluoride gas through porous barriers was developed in the USA. The light isotope uranium-235, which passes more quickly through the barriers, becomes increasingly concentrated in the gas. Because of the possible loss of gas in a very complex and many-staged system, it was essential to have several tonnes of pure natural uranium. The critical mass of plutonium was somewhat lower. However, plutonium is produced as the final result of a technologically very complex and lengthy process of the regulated reaction of the disintegration of uranium-235 in special reactors. The neutrons released in the disintegration of the nucleus of uranium-235, ‘instilled’ in the nucleus of uranium-238, form, through an intermediate reaction, the appearance of neptune-239, the nucleus of plutonium-239, with an admixture of plutonium-40. An industrial reactor using graphite as a neutron moderator required, at a minimum, about 150 tonnes of natural uranium. Nevertheless, Kurchatov decided to begin the Soviet atomic programme by building the plutonium and not the uranium bomb. This seemed more economical because of the shortage of uranium. In ‘spent’ uranium which is unloaded from the reactor, the uranium-235 content, after the separation of plutonium, is lowered only very slightly from 0.71 per cent to 0.69 per cent. Therefore, such uranium, once it had been regenerated in the radiochemical plant, served as the raw material for uranium bombs. The plant which had already been built in Verkh-Nyevinsk in the Sverdlovsk region to produce bomb-quality uranium-235, had to use regenerated and not natural uranium. But regenerated uranium contains many radioactive contaminations, which makes working with it more dangerous than using natural uranium.

Construction of both atomic centres, in Verkh-Nyevinsk (Sverdlovsk-44) and near Kyshtym (Chelyabinsk-40), was started in accordance with an instruction of Sovnarkom of 23rd March, 1946, which had been signed by Stalin. Although Kurchatov, Vannikov, Beria and other leaders of the atomic industry took initiatives on many matters, it was the accepted practice that all final decisions were signed by Stalin personally. This guaranteed the support of many other ministries and departments. At that time, the atomic projects had absolute priority in the USSR, and this was underlined by Stalin’s signature, even on seemingly trivial decisions.

The construction of Chelyabinsk-40 began long before a sufficient quantity of uranium had been accumulated for its work. In the industrial zone of this centre it was necessary to build underground a one hundred thousand kilowatt reactor, a large radiochemical plant for the separation of plutonium and the generation of uranium, a plant to produce plutonium metal in half spheres, and the waste disposal facilities for products with high and medium radioactivity and many other subsidiary manufactures. A settlement for, at that time, 25 to 30,000 inhabitants, a thermal electricity power station and other facilities were planned to be built about 10 kilometres from the industrial zone. A camp for the prisoners and barracks for the soldiers were planned to be built almost next to the industrial zone. The prisoners and military-construction units, together with the MVD troops guarding the convoys, were the first to arrive in this region. Under the MVD system, Chelyabinsk-40 had the code name ‘Construction 859’, but the reactor and radiochemical plant, which were built at the same time, were known as ‘Combine No.817’.

The nearest reserves of prisoners and special deportees were to be found in the industrial areas of Chelyabinsk. It was precisely from here, on the order of Beria, that the first 10,000 prisoners were transferred to Kyshtym, in July 1946.[14] In October 1946, the prison camp at Chelyabinsk-40 was given its own status. By the end of 1947 it already held 20,376 prisoners under the command of a general in the MVD engineers, M.M. Tsarevsky.[15] In 1948, in order to speed up the building work, the overall number of builders, prisoners and soldiers of the MVD engineering regiments reached 45,000 people. Tsarevsky, the head of the camp, which was divided into 11 sections, was at the same time in charge of all the construction of the industrial complex.

There was no real difference between the prisoners and the military-construction units. They both came under one MVD department – Industrial Construction. Both contingents were formed from former Soviet prisoners of war and repatriated workers with experience of mining and construction work in German camps. One of those who helped build Combine No.817, Anatoly Vyshimirsky, testified 40 years later:

> 'I served in the army in Sverdlovsk in the tank training regiment . . . In 1946, a battalion was formed from the soldiers and sent to the city of Kyshtym in Chelyabinsk region. Basically, it was formed from those who lived in occupied territory during the war. Among them were participants in the war. To be precise, we were all people of the second class, so to speak, because the irremovable stain of German occupation lay upon us. . . When we arrived at Kyshtym we found other battalions of military-construction workers already there. They were also former prisoners of war who had not been allowed to go home after they were freed from German camps.
>
> Many of them were no longer young; they had fought in the Military actions in Khasan, Khalkingol (Far East and Mongolia in 1938-1939), in the Finnish campaign, and even in the Civil War. One thing brought them all together – they had passed through all the circles of the fascist hell. All their guilt consisted in this. . . there were also many ordinary prisoners there . . . But our conditions differed little from the labour camps. It was as though we were all in one big camp. . .' .[16]

This picture was confirmed by another witness, Anatoly Semenovich Osipov of the Kalinin region:

> 'On 13th May 1946 our military unit (346 OPAB) was formed, and we youngsters, born in 1925-26, were sent in an echelon to the Urals to Kyshtym station. There, companies and battalions were formed from the many echelons. All the military units were codified. Our regiment was called V/Unit 05/08. . . We military-construction workers were the first to begin digging the vast pit for the foundation of "establishment No.1" under the building of then unknown construction. Then the prisoners built the walls and inside of this building. . . Frontline soldiers who had earlier been freed from German camps were immediately sorted on the basis of who they had been liberated by. There were four categories: those liberated by the Americans, by the English, or by Soviet troops, and those who had not formerly been under occupation. Those liberated by the Americans were considered most unfortunate, followed by those liberated by the English, then by the Russians, and finally there were the "clean" ones. Conditions in the barracks and food and clothing corresponded to these categories. . .'[17]

The testimony of prisoners who worked on the 'establishment' during this period paints a similar picture. I.P. Samokhvalov testified:

> 'I lived and studied in Chelyabinsk. I was arrested when I was in the 8th class, and still not 16 years old. I was tried under Article 58 paragraph 10, and given five years for so-called anti-Sovietism. To begin with I was sent to the "death colony" in Karabash. At the end of 1946, we were sent to the Kyshtym zone. . . I was allocated to camp No.9 in the working zone, where units A, B and C were being built. When the buildings were finished, vast circular capacities were installed in them. . . . I was freed there . . . but, in September 1949, they began to discharge us freed ones, both family men and singles, in cattle wagons, equipped with searchlights and in convoy. And we set off towards the East. . . We arrived at port Nakhodka. There, the whole echelon boarded the steamer *Soviet Latvia*, and sailed across the Sea of Okhotsk for Magadan. We were distributed amongst the different mines. I went to the mine called "Longed-for One", 600 kilometres from Susumon. . .'[18]

Other camps in the atomic gulag were also established on this basis, in 1946. KB-11, the first camp of prisoners, was established in May 1946 on land near the little town and monastery of Sarovo (the local population was evicted during the war to make way for a factory producing shells for Katyusha rockets). The prisoners were chosen from nearby Mordvinian camps. Here the most secret of the atomic cities, later known as Arzamas-16, was built. By the end of 1947 there were more than 10,000 prisoners in the camp.[19]

Verkh-Nyevinsky atomic town (Sverdlovsk-44), started in 1946, began the industrial separation of uranium isotopes 235 and 238 only after the first Soviet atomic bomb had been successfully tested in August 1949. At that time the camp held 10,000 prisoners. During the period of active work on this centre, in 1950-51, the number of prisoners exceeded 18,000.[20]

Sacrifices

Every reactor has a tall ventilation stack to disperse into the atmosphere the gaseous products of nuclear fission. Some of these, such as iodine-131, are successfully reduced by the filters. But it is impossible actually to fix inert gases such as kripton-85 and xenon-133 with absorbents of any kind precisely because they are 'inert'. They are simply dispersed over a wide area via the high ventilation stacks, and, thanks to the short periods of disintegration, they do not accumulate in the atmosphere. In Chelyabinsk-40 the tallest ventilation stack, 151 metres high, was at the radiochemical plant. It emitted into the atmosphere gases and dust from many other long-life radio nuclids, including uranium and plutonium. This chimney almost always emitted yellow smoke containing nitric acid, which is used during the first stage of the processing of 'burnt' uranium blocks from the reactor which are dissolved in nitric acid. The yellow smoke killed the trees for many kilometres around the industrial zone. Only prison labourers were used to build what was then the highest chimney in the Soviet Union, 11 metres in diameter at the bottom, and six metres at the top. One person, mentioned earlier, who worked in Chelyabinsk-40, A. S. Osipov, explained why:

'. . . only "condemned prisoners" with sentences of 10 to 15 years were sent there. Why "condemned men"? They had no insurance. The chimney rocked two to three metres, and there were frequent accidents as workers crashed to their death every day. . .'[21]

But the main dangers throughout Chelyabinsk-40 were due to radiation. At that time, the harmful effects of radiation were heavily underestimated, and almost nothing was known of its genetic and carcinogenic effects. The long-term effect of radiation was also unknown. Measurement and control of dosages were practically non-existent during the first months of operation of the industrial reactor and the radiochemical plant. 'Nobody knew what kind of irradiation was suffered by the workers and engineers. . .' [22] In later years, they began to use photo dosimeters – the dose of radiation was fixed by the degree of darkening of the photographic film. The precision of such dosimeters was not high, and the extent of the dose was determined after the event, at the end of the working day, or even once a week. Only high energy external gamma radiation was monitored. Respirator 'petals' to protect the lungs from radioactive dust appeared only in 1952. Special 'Regulations' on the control of conditions affecting workers' health in the combine were introduced only in 1949, following several instances of lethal irradiation. Even in 1951, workers in the radiochemical plant were exposed to average doses of 113 ber (biological equivalent of Roentgen) a year. This was 30 times higher than the current maximum permitted dose.[23]

Everyone suffered irradiation; prisoners, state workers and senior personnel. According to one of the first doctors to work at the combine, A.K. Guskova, the museum at Chelyabinsk-40 contains I.V. Kurchatov's photo-casette 'with a single-day dosage of radiation of 42 r'.[24] A dosage of 100 Roentgens could cause radiation sickness.

The contamination of all the land around the radiochemical combine was so bad that even the workers who worked outside were in danger. According to Guskova, '. . . in 1951, I, together with Dr. G.D. Baisogolov, treated 13 prisoners who had been irradiated but remained in the camp barracks. Three of them were suffering from acute radiation sickness, and one of them had suffered a fatal dose. These people suffered their exposures whilst digging a trench next to the building containing the radiochemical plant. The basic active factor was external gamma-beta-radiation from soil contaminated with nuclides'.[25]

There were many small mishaps and problems during the starting-up period and early weeks of operation of the reactor. The elimination of these problems meant that workers were deliberately exposed to fatal doses of radiation.[26] Personnel suffered a very large number of instances of exposure to radiation during the separation of plutonium in the radiochemical plant. According to the official data '. . . 2,089 workers were diagnosed with radiation sickness during the period of establishing plutonium production in the Combine'.[27] The reasons for a good number of these cases of irradiation of workers at the Combine were established in a recent article by Vladislav Larin.[28] However, any statistics for radiation problems affecting prisoners or soldier builders, rather than state personnel, are missing. Prisoners were not given dosimeters and, in this case, there simply were no norms for controlling the total doses of radiation. Nor was there any dosimeter control amongst the inhabitants living along the Techa river, into which poured the fluid emissions from the radiochemical plant. The population living around the industrial zone of Chelyabinsk-40 had no idea what was going on there. This problem came to their attention only after a massive outbreak of disease through radiation sickness amongst the inhabitants of the villages closest to the plant. As recent official reports state: '. . . Some 124,000 people living in the floodlands of the Techa river in Chelyabinsk and Kurgansky regions suffered from the radioactive pollution of the river and its banks. 28,000 people suffered from high doses of radiation (up to 170 ber). 935 cases of radiation sickness were recorded. About 8,000 inhabitants from 21 locations were resettled'.[29]

This resettlement, however, took place only in 1955. Because the 'establishment' was top secret, and its secrecy considered the priority during the years from 1948 to 1953, this meant that tens of thousands of inhabitants of the flood plain of the Techa river continued using the river water for everyday purposes, for food, for livestock, for kitchen gardens and other necessities. The health of the local population was sacrificed for the sake of secrecy.

The liquidators of the first catastrophe

The first really serious failure at Chelyabinsk-40 took place in January 1949. It was a failure which developed into a radioactive catastrophe only as a result of a decision taken by the leadership of the Soviet atomic project. The character of the catastrophe, and the reasons for it, remained secret until 1995, and the number of victims remains unknown to this day. But the number of victims among those who fought to contain this disaster was, undoubtedly, higher than at Chernobyl.

About 150 tonnes of uranium had been loaded into the first industrial reactor. On 8th June 1948, it was reaching critical mass, and was projected to generate 100,000 kilowatts by 22nd June. These reactors were for making plutonium. They were simpler in construction than the reactors of the next generation, which were built for the generation of electricity. In energy reactors it is essential to generate steam under high pressure. In military reactors water is necessary only for cooling the uranium blocks. The small, cylindrical uranium blocks, 37 mm in diameter and 102.5 mm high, were covered by a thin aluminium casing. They were installed inside aluminium tubes with an external diameter of a little over 40 mm and about 10 metres in height. In turn, these aluminium tubes were placed inside a graphite cladding. The graphite slowed the neutrons during the chain reaction, but did this only in dry conditions. The chain reaction of the fission of uranium-235 begins when the reactor has been loaded with about 150 tonnes of natural uranium. Overheating of the uranium blocks, arising from the chain reaction and the accumulation of the fission radionuclides in the blocks, is prevented by water which circulates inside the aluminium tubes. There were

1,124 such tubes in the first reactor, and it contained about 40,000 uranium blocks. During the process of the chain reaction of the fission of uranium-235, the neutrons slowed by the graphite generate plutonium-239 from uranium-238.

The process of accumulating plutonium can go on for more than a year because of the work regime of the reactor. The reactor is constructed in such a way that it is 'unloaded' by means of the uranium blocks falling from the bottoms of the tube-canals into the reservoir beneath the reactor. After immersion in water for several weeks in order to disintegrate the short-lived nuclides, the blocks were transferred to the radiochemical plant.

The behaviour of metals and, especially, of aluminium in conditions of high temperatures and powerful neutron irradiation had not, at that time, been subject to long-term experimentation. Therefore, the wetting of the graphite from the leaking aluminium tubes was completely unexpected. Aluminium undergoes severe corrosion in conditions of powerful irradiation, whilst in constant contact with water and graphite at high temperatures. This became obvious after the reactor had been running for five months, so that it was impossible for it to continue working. This was not a local, but a general failure. On 20th January 1949, the reactor was stopped. Stalin was informed about this. For those in charge of the atomic project there were two ways out of the situation: one was safe; the other demanded great human sacrifice. The safe option was simple. They ought to have unloaded the uranium blocks from the reactor, transferring them along the technical canal into the water basin, and then gradually moved them to the radiochemical plant for separation of the already accumulated plutonium.

During the breaking of all the blocks, sometimes with the use of active 'cast-offs', the thin aluminium cover could become damaged, and such blocks were not fit for secondary use. Nobody could calculate precisely whether enough plutonium had been accumulated in the uranium load in order to prepare at least one bomb. It was important to have some reserves of plutonium. But there were not enough stocks of fresh uranium for a second new load for the reactor. Besides, a complete replacement of all the aluminium tubes was essential. It was proposed to prepare the new tubes with a strong, anodal, anti-corrosive covering, in one of the aircraft factories.

The second, 'dangerous' option was to carefully extract all the uranium blocks with special 'suckers' from the top of the tubes, or together with the tubes upward into the central operating hall of the reactor. After this it was necessary to extract and sort by hand the undamaged blocks for possible secondary use. The graphite columns, which consisted of big graphite bricks, ought to have been dismantled by hand, dried out, and used again. After the new aluminium pipes with the anti-corrosive covering had arrived it was possible to load the reactor again and bring it up to projected power.

After five months of operation of the reactor, the uranium blocks were already highly radioactive, equivalent to millions of curies. A large number of radionuclides had already accumulated, which made the blocks hot, with temperatures over 100 degrees centigrade. The isotopes of caesium, iodine, barium and many others were the main sources of gamma radiation. A. K. Kruglov, who was working at Chelyabinsk-40 at the time, noted that 'it was impossible to extract the blocks without irradiating those doing the work'.[30] Kurchatov also understood this. A choice was in prospect: 'whether to save the people, or to save the uranium load and avoid losses in the production of plutonium. . . As a result of the influence of the top levels of the PGU and of the scientific leaders, it was the second course that was chosen'.[31] This decision was taken jointly by Beria, B.L. Vannikov, head of the PGU, his deputy, A.P. Zavenyagin, and I.V. Kurchatov. Vannikov, Zavenyagin and Kurchatov, who were present almost constantly at the site, supervised all the work. Beria received regular reports, and ensured that new aluminium tubes were prepared to time through the aviation industry ministry. It took 39 days for all the work to extract 39,000 uranium blocks – containing 150 tonnes of uranium stuffing – from the reactor. Each block had to be examined visually.

Efim Pavlovich Slavsky who, in 1949, was the chief engineer of the faulty reactor, and later led the whole Soviet atomic industry for many years, recorded these events in his memoirs. These were published in part in 1997, several years after Slavsky's death in 1991. He said:

> '. . . it was decided that the task of saving the uranium load (and the production of plutonium) was of the utmost value – by means of the inevitable irradiation of the personnel. From this time, all the male personnel of the establishment, including thousands of prisoners, took part in the operation to remove the channels, and extract the damaged elements from them; 39,000 uranium elements were extracted and transferred by hand. . .'

Kurchatov personally took part in this operation. At this time, only he had some knowledge of what was necessary to sort out the defective elements. Only he had experience of the work on the experimental reactor in Laboratory No.2 in Moscow.

Slavsky wrote:

> 'At that moment, no words of any kind could alter the force of his personal example. Kurchatov was the first to step into the nuclear hell, into the central hall of the failed reactor full of gasified radionuclids. He supervised the dismantling of the damaged channels, and personally examined the damage to the unloaded uranium elements piece by piece. Nobody thought about the dangers then: we simply didn't know anything. But Igor Vasilevich knew, but he did not surrender to the terrible force of the atom. . .For him, the liquidation of the failure was fatal. He paid a cruel price for our atomic bomb. . .It was fortunate he did not take part to the finish in the sorting out of the elements; if he'd stayed in the hall till the end, we would have lost him then. . .'[32]

It remains unclear from Slavsky's evidence how long Kurchatov worked in the central hall of the reactor, sorting the uranium elements. The work went on round the clock, in six hour shifts. The dosimeter readings in various parts of the central hall, which was located over the reactor, are not available, possibly because in general they did not work, at least, not regularly. I think that Kurchatov worked no more than two or three shifts. The radioactive danger was too great. But, as Slavsky says, this work turned out to be 'fatal' for him. Kurchatov suffered radiation exposure of medium intensity. Radiation exposure does not automatically lead to the development of cancer. It damages all the organism and causes injured 'radiation ageing'. In the first weeks after such a sub-lethal dose, the basic immune system (the bone marrow) and intestinal functions are damaged. It is difficult to say how long Kurchatov was ill after his courageous, even desperate, action. The events of the beginning of 1949 are, in general, not discussed in all the biographies of Kurchatov. The failures of the industrial reactor are communicated in code: 'Everything did not always go smoothly, as often happens with something new'.[33] Undoubtedly, the irradiation, which happened several times, sharply curtailed Kurchatov's life. In the 1950s he quickly became much weaker physically. He was often ill and frail, and died in 1960 at the age of 57. MVD General Avraamy Zavenyagin, Beria's deputy, was also irradiated and suffered irreparable damage to his health after observing the prisoners' shift-work. He died in 1958 at the age of 55. Professor Boris Aleksandrovich Nikitin, the head of the radiochemical plant, who also took part in the identification of defective uranium elements, suffered most of all. The defective elements were moved to precisely that part of the establishment which he ran. He suffered a more acute form of radiation sickness, which became chronic. He died from it in 1952, at the age of 46. There are other known instances of deaths amongst scientists and engineers and those involved in dealing with this accident, which were linked with irradiation. In fact, it would be more correct to speak of 'those involved in saving the uranium load'. But how, when and where those 'thousands of prisoners' who also, in shifts, unloaded the damaged blocks and sorted the 39,000 elements to save the 150 tonnes of uranium, from the beginning to the end of this five-week, uninterrupted labour, fell ill and died, no one says. Of course, it was precisely these people who did the basic work of sorting out and recovering the uranium blocks which weighed more than 150 tonnes.

The camp for prisoners at Chelyabinsk-40, which was known as ITL Construction 859, was re-organised on the orders of the MVD on 31st January 1949. It was given a new name: 'ITL Construction 247'. M.M. Tsarevsky remained the head of the camp. The number of prisoners in the camp fell during 1949 by roughly 3,000.[35] But there would have been various reasons for such a reduction in the camp population. The basic construction work had finished.

The special contingent of 'the released' in Magadan

In my article on the hydrogen bomb (see Spokesman No.68), I already wrote about Andrey Dimitrievich Sakharov's evidence which he included in his memoirs. He told how prisoners who worked at 'establishment' KB-II (Arzamas-16), and who had completed their sentences, were not set free, but '. . . were sent into permanent exile in Magadan and other places, where they couldn't tell anyone anything'.[36] This practice also took place at other atomic establishments. It did not spread throughout the entire population of the atomic gulag. Some of the best qualified construction personnel were given an offer to stay on to work at the same establishment, but on a voluntary basis. The transfer of workers from one establishment to another was categorically forbidden – the existence of other sites was known only to the higher-up scientific and administrative personnel in the atomic industry. On 11th August 1948, Stalin signed a resolution of the Soviet Council of Ministers 'On the temporary special regime for keeping former prisoners who volunteer to continue working at plants nos. 817, 813, 550, 814'.[37] According to the MVD classification, these numbers denoted the plants at Chelyabinsk-40, Verkh-Nyevinsk (Sverdlovsk-44) and Arzamas-16. Things were simpler with respect to military construction units. The Council of Ministers resolved to postpone their demobilisation. During this period, a resolution of the Soviet Council of Ministers and a secret directive of the Presidium of the Supreme Soviet of the USSR were issued 'On the replacement of working contingents at special units established by the MVD of the USSR'.[38]

The practical realisation of these resolutions guaranteed first of all that the 'establishments' remained secret. This is obvious from I.P. Samokhvalov's evidence, which was cited earlier. Some of the military construction workers, especially former prisoners-of-war, fell into this category. Tamara L., who worked at Chelyabinsk-40 and married a soldier-builder there, said:

> 'They were soldiers, but what kind? They came to understand this only when the construction was finished. We found out then that I, my husband and three-month-old son could not go where we wanted, but only to where we were sent. In August 1949, we were sent in a goods wagon to Soviet Gavan, and then on plank beds in the hold of the steamer *Nogin* to Kolyma . . . In Magadan, they explained to the soldiers about the demobilisation, and forced them to make a contract for three years. We were sent to the mine called "Longed-for One", which earlier was served by the convicts, and lived in general barracks – mud huts – women, men and children all together'.[39]

I.P. Samokhvalov, mentioned earlier, was sent to Magadan some months later, through a different port, and by another steamer. He also turned up at the same mine, 'Longed-for One', as had Tamara L. and her husband. One strong rule governed all this: do not mix up the 'special' settlers from the various atomic establishments. The secrets had to be localised. Everything was thought through in detail. Sergei Mikhailovich Melnikov, a former teacher at the Magadan branch of the Khabarovsky State University, who researched the fate of the prisoners of *Dalstroy*, explained in an article published in 1995 that:

> '. . . The concept of the "special contingent" appeared in the official documents of the Soviet Ministry of Internal Affairs in 1949. In July 1949, MVD USSR order No.00708 on persons of the special contingent within the MVD system was issued. In September 1949, the head of *Dalstroy* issued an order to fulfil this first order.
>
> The first party of persons of the special contingent arrived at Kolyma in conditions of complete isolation in the second half of September 1949. They travelled on the steamers *Soviet Latvia* (2,370 persons) and *Nogin* (2,285 persons), and also, in October, on the steamer *Dzhurma* (604 persons). Altogether, 5,665 persons arrived in

> 1949 until the navigation was closed.
>
> Two essential conditions determined to which undertaking the persons from the special contingent were sent: the distance of the enterprises from other centres of population, and the distribution of dead-ends to prevent people from coming across them'.[40]

At this point it is again necessary to repeat that MVD orders prefixed with two noughts were issued on Stalin's personal directive or resolution. This practice applied to all the leadership of the atomic project. It is obvious from documentary archives of the MVD that the decisions of the Soviet Council of Ministers and the orders of the Supreme Soviet which 'legalised' these actions were issued on the basis of a reported list of projects compiled by 'Vannikov, Serov, Pervukhin, Zavenyagin and Komarovsky'[41] and directed by Beria. From Beria they went to Stalin. Vannikov was head of the PGU, which handled all atomic matters. Serov, Pervukhin, Zavenyagin and Komarovsky were his deputies.

S.M. Melnikov, who researched the archives of the Magadan MVD in 1989, completely confirms the evidence of Samokhvalov and Tamara L. which was given in 1989. He wrote:

> '. . . the first party of persons from the special contingent were sent to the most distant settlements – to the "October" mine (687 km. from Magadan), and to the "Longed-for One" (671 km.), under the Western mining industry directorate (nowadays the Susumansky area of the Magadan region), and to the "Victory" (1,042 km.) and "Hope" (1,175 km.) mines of the Indigirsky directorate (now the Omyakonsky area of Yakutsk), to the M. Raskova mine of the Teninsky directorate, to the Arkagalinsky building site (the building of the Arkagalinsky hydro-electric station, which took into account the professional experience of persons from the special contingent, 730 km. from Magadan).
>
> Somewhat later, in 1950, persons from the special contingent were sent to other mines as well.
>
> In accordance with order No.00708 and related instructions, former prisoners who had served their sentences in the special regime MVD camps were attached to the special contingent. The special regime camps were secret military establishments where chemical and atomic weapons were produced. Former prisoners who had worked at Chelyabinsk-40, Sverdlovsk-22 or Sverdlovsk-44 were sent to Magadan. In order to keep these establishments secret, the prisoners from these and other secret units, who had already completed their sentences, were sent to the most remote areas, and the *Dalstroy* camp network was one of these destinations'.[42]

On 1st January 1952, according to the *Dalstroy* archives, 10,348 persons of the 'special contingent' category were working according to its system of three year contracts. They were kept under guard and had no right to abandon their given working and living place. Information that workers from the atomic industry had begun to arrive at various establishments in the Magadan area somehow became known to the western intelligence services. However, this was interpreted completely wrongly. The people in the West thought that an atomic power station was planned to be built in the Magadan area.[43]

After the death of Stalin and Beria's arrest, this cruel practice of 'protecting secrecy' was no longer used. People from the 'special contingent' began to be released in 1954-55. But their freedom of residence was limited to the regions of the Urals, Siberia, the Far East and several parts of central Russia. They were not allowed to settle in frontier regions. They also came under the supervision of the local KGB departments. They also had to sign an undertaking not to divulge information about their former work. To break the undertaking meant arrest and loss of freedom. This undertaking was permanent. Even those employees and workers in the atomic establishments who retired because of illness in 1957-58 and later, came under this restriction. Fragmentary recollections of participants in the atomic construction projects began to appear in the press only in 1991. But not many of them had survived to this time.

The Siberian atomic gulag

In 1949, before the successful testing of the first Soviet atomic bomb, Stalin took a decision about the construction of the second set of atomic plants, better secreted and protected from possible nuclear attack than those which were already operating. The presence of a parallel system of building atomic bombs, including reactors, radiochemical plants and a centre for preparing the bombs themselves, sharply increased the security of the country. The strict independence from each other of the parallel systems also guaranteed competition and technical progress. The decision to build new centres was put into action by resolutions of the Soviet Council of Ministers. The first of these, taken in summer 1949, was to build an underground atomic combine in the Krasnoyarsk area after a special expedition had chosen a suitable cliff on the banks of the Yenisei, approximately 80 km. to the north of Krasnoyarsk. In the autumn of that year a camp was established for prisoners building the railway to Krasnoyarsk. The first battalion of military construction workers arrived earlier via the Yenisei on the steamer *Maria Ulyanova*. The new centre was subsequently called Krasnoyarsk-26. Here, deep underground, right in the cliffs which covered the construction zone about 400 metres from the cliff face, several reactors and a radiochemical plant to produce plutonium were planned. To begin with, even the living areas were built in the mountain tunnels. Subsequently, with the growth of the town, these were moved to the surface. Tunnels and halls were drilled for the industrial works 300 to 400 metres from the surface. More rock was extracted from here than in the construction of the Moscow Metro. Naturally, the prisoners' camp was getting bigger all the time. The number of prisoners reached its maximum by 1st January 1953 – 27,314 persons including 4,030 women.

The Krasnoyarsk camp, which was also part of the group of 'penal' camps on account of its work breaking rocks in the mountains, was called 'Granite ITL' in the MVD. A short chronicle of the history of Krasnoyarsk-26 makes clear that a complete transformation of the camp system here only got under way in 1963.[44]

The second atomic city in Siberia, the construction of which also began in 1949, was Tomsk-7. This was located only 15 km. from the regional centre on the banks of the River Tom. Here, the building of several reactors to produce plutonium, a radiochemical plant, and a plant for the separation of uranium-235 and 238 was planned. Somewhat later, a new plant for separating uranium 235 and 238 was also built in the Kransnoyarsk region, approximately 50km. east of Krasnoyarsk-26. This combine was called Krasnoyarsk-45. This time, gas diffusion was not used to separate the two isotopes, as was the case with the first Soviet uranium bomb in 1951. Instead, a gas centrifuge system was used. This method was developed first in the Soviet Union with the participation of German scientists who came to the Soviet Union in 1945. It was not necessary to set up prison camps in order to begin building Krasnoyarsk-45. They were already there. It was precisely the presence of the 'working contingent' which determined the choice of the building site. The start of construction is described very briefly in the history of Krasnoyarsk-45:

> '. . . At this time, the building site was already operating under a certain military plan. There began an urgent allocation of the necessary forces – one company of engineers – 200 men, and several camps, from the Ministry of Defence – to the new leadership of the site. The engineers and prisoners formed the basic workforce which built the town and all the industrial establishments. The contingent was mixed – domestics, common criminals, politicals . . . "the politicals" were all the same, with the maximum sentence. . .'

The camp was dismantled in 1960. The maximum sentence meant 25 years in prison – only *Vlasovtsi*, *banderovtsi* and other nationalists received such sentences after the war. Besides, as the authors of the articles remarked, to work with common criminals

> 'was the essence of torture . . . but, as the "fifty-eighth-politicals" proved, they worked well and there were many professionals among them, including drivers'.[45] (Article 58 is the political article of the Criminal Code.)

Science and the gulag

The first decisions about new centres of atomic physics combining military and fundamental research were taken in 1949. The initiative, in this instance, came from the scientists themselves. It was connected in part with the essential need to expand the institutes that already existed in Moscow. This was to be done by building various types of experimental reactors, accelerators of elementary particles, radiochemical laboratories and other units for which it was difficult to find enough space in the already overloaded scientific institutes of Moscow. But even in these cases, when the initiative for construction came from scientists, the immediate building of this or any other institute began with a camp for the prisoners. It was a simple decision which even the Soviet Academy of Sciences took calmly, to petition the MVD for a detail from the 'construction contingents'. The prisoners built the new buildings of the Physics Institute (FIAN), those of the Institute of Geochemistry, those of the Institute of Biophysics of the Soviet Ministry of Health, and those of several other institutes in Moscow and Leningrad. In 1949, a small camp of prisoners was set up to the north of the

Moscow region, on the banks of the Volga. There, with the construction of a powerful accelerator of elementary particles, and of a synchrophasotron, began the development of a small scientific town, which later became well known as Dubna. In accordance with certain theories, amongst the transuranium elements which can be obtained in particle accelerators are those from which it is possible to make atomic bombs which could be several times smaller than plutonium bombs.

In 1949, two prison camps were built in the Kaluga region on the banks of the Protva river, not far from Maloyaroslavets. Here they began to build the new physico-energy institute, including the first small atomic power station anywhere in the Soviet Union or the world. At first, this new centre was called Maloyaroslavets-10. But subsequently it became known as Obninsk after the nearby settlement of Obninskoye. The Physico-energy Institute was given over to researching small reactors using highly enriched uranium-235. Such reactors could be adapted for powering submarines. All these establishments were secret, but not highly secret. They were not categorised as top secret, which would have meant that it was impossible for state employees to retire of their own accord, and that prisoners would have been deported to distant parts after building was complete. They were able to move to other establishments.

The appetite arrived 'during the meal', so to speak and, in 1949, the number of demands from the Academy on the MVD's workforce began to exceed the capacity of the construction directorate. On 29th September 1949, the President of the Soviet Academy of Sciences, Academician Sergei I. Vavilov, sent Beria an inquiry about detailing prisoners to build a garage for the academy, and living quarters for employees of the Physics Institute. On 17th October, the deputy head of the MVD's construction directorate, Volgin, to whom Beria had sent Vavilov's request with a question about the 'possibilities', replied to Beria. He reported that to place such tasks with the MVD construction directorate was to no purpose. Let the Presidium of the Soviet Academy of Sciences handle its own programme of capital construction.[46]

Epilogue

Although the opening in recent times of the archives has allowed us to understand much more of the top secret history of building nuclear weapons in the USSR, not everything from that distant time is accessible to historians. There are still many undivulged secrets. But if again we pose the question, which has long aroused much controversy, who had the main responsibility for establishing all the branches of the Soviet atomic industry in such an extraordinarily short time – was it the secret intelligence, the scientists, or the leaders of the country, whose organisational skills should also be valued quite highly – then it is not possible to give a clear answer. But without doubt, it was the gulag which played the main role in the speed with which all these problems were solved practically in the form of reactors, plants, testing ranges and all the infrastructure. It was this unique, gigantic reserve of highly mobile and, in essence, slave labour, which was nevertheless well skilled and qualified. But was the existence of this gulag justified then? Of course not! If the Stalinist political and economic model of the State could have done without the gulag and other systems of forced labour, then the Soviet Union would not have needed the atomic and hydrogen bombs so quickly. The Stalinist terror and the Stalinist gulag themselves give birth to fear and menace throughout the rest of the world. Now, Russia's political system has changed and the United States and Russia are able to release vast forces, to liquidate tens of thousands of atomic and hydrogen devices, and to pay billions of roubles and dollars on secure burying of a colossal quantity of radioactive waste with the guarantee that it will not escape into the human environment for tens of thousands of years.

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