generally introduced themselves, but after the fourth or fifth introduction I would lose track of who they were and which agency they came from.

At first I felt detached, but gradually I began to look forward to the debriefings. I felt a certain relief in speaking for the first time about the things I had kept secret for so long.

Lena remarked on the change in my demeanor. The tense government official she had lived with in Moscow was gone, replaced by a more relaxed stranger. I would try to tell her about the day's session after the children went to bed, but she seemed uninterested. She wanted to forget the past.

I had expected the debriefings to be surrounded by an atmosphere of espionage and intrigue, but they were more like academic seminars. They were sometimes frustrating, especially when it came to strategic questions, which seemed to interest my interrogators not at all.

"We're only interested in what you know," one U.S. defense analyst told me, "not what you think could happen."

I understood their logic—I was an administrator and a scientist, not a military or political strategist—but their attitude seemed to reveal a profound misunderstanding of biological weapons. My interrogators wanted to know how much of our stockpiles and production capacity had been shut down and which of our labs and facilities had been destroyed. They expressed little curiosity about the potential of the weapons we had made. Few asked me about the specific capabilities of our anthrax, tularemia, and plague weapons or paid more than cursory attention to our genetic work. The emphasis on our shrinking arsenal made it clear to me that Americans believed Russia's biological weaponry no longer constituted a significant threat.

Slowly and reluctantly, I came to believe they were wrong.

In early 1994 I came across an article published the previous year by Sergei Netyosov, deputy scientific director of the Vector complex. He reported that a team of scientists had successfully inserted foreign genetic material into vaccinia, a nonpathogenic virus related to smallpox. My heart sank. This experiment was part of a

secret plan I'd authorized five years earlier to create a powerful new smallpox weapon.

I first met Netyosov in February 1989. A promising virologist in his early thirties, he was introduced to me by Lev Sandakchiev during one of my inspection trips to Siberia.

"Netyosov is one of our best people," Sandakchiev had boasted as I shook the young scientist's hand. "I'm recommending him for a promotion."

Netyosov, who held a Ph.D. in virology, belonged to an impressive new generation of civilian scientists recruited by Biopreparat in the 1980s. Sandakchiev told me he was on the verge of a breakthrough that would have as large an impact on our weapons program as the genetic experiments performed with bacteria and toxins at Obolensk.

"We believe we can create a chimera virus," he said, elliptically.

A chimera is an imaginary monster with the head of a lion, the body of a goat, and a serpent's tail. Biologists use the word to describe an organ composed of tissues of diverse genetic material. I'd never heard it applied to viral organisms before.

Netyosov's work was inspired by Western research. He had read accounts in foreign journals of a successful experiment in which scientists had inserted the gene of Venezuelan equine encephalitis (VEE), a virus that attacks the brain, into vaccinia. The experiment was part of continuing research into the viral genome, the collection of genes that code the peculiarities of every living organism, and it had significant medical implications. Understanding the genetic differences between closely related strains of viruses could help explain why some strains caused disease and others didn't. Researchers also believed that vaccines capable of immunizing people against several diseases at once could be produced by introducing the genes of one virus into another. An altered vaccinia virus, for example, could reproduce VEE cells as well as its own. The research required months, sometimes years, of painstaking work. A host virus will reject alien genes until lab technicians find a compatible place in the genome to introduce the new material.

Vaccinia's genetic structure was almost identical to the smallpox virus. If VEE could be combined with vaccinia, Netyosov ob-

served, perhaps it could also be joined to *Variola major,* creating a "double agent," a superweapon capable of triggering both diseases at once.

Persuaded by Sandakchiev of the project's importance, I granted him permission to promote Netyosov from lab chief to deputy scientific director of the facility. Back in Moscow, I authorized a special grant of one hundred thousand rubles for the Chimera project.

The techniques used to manipulate viral genes are more complicated than those for bacteria. Some viruses, like Venezuelan equine encephalitis, are made of RNA, or ribonucleic acid, an inverted version of ordinary DNA. The gene sequences of RNA viruses must be transposed before genetic experiments can be performed. Once this has been done, the viral genome is sliced with special enzymes called restrictases and knit together with the foreign genes to create what is called recombinant DNA.

Within six months, in the spring of 1990, Netyosov reported that he had successfully inserted a DNA copy of VEE into vaccinia. Space had been found for the transplanted material in a gene of vaccinia called thymidine kinase, and it multiplied along with its new host. Netyosov's team immediately began similar genetic manipulations with *Variola major.*

At the time, I was not confident of their success. Western geneticists had discovered that when VEE and vaccinia were combined, the vaccinia appeared to lose its virulence. This was a problem for us: we did not want to weaken our smallpox weapon.

By 1990, as my attention was drawn to preparations for the foreign inspectors, I lost track of Netyosov's work. But the research continued.

Two years later, in 1996, the same team published an article in *Molecular Biology,* a journal published by the Russian Academy of Sciences. The scientists reported that they had found a space in the vaccinia genome where foreign genetic material could be inserted without affecting virulence. They claimed the purpose of this research was entirely peaceful—to explore different properties of the

vaccinia virus. But what medical reason could there be for experiments aimed at preserving its virulence?

The Vector scientists had used a gene for beta-endorphin, a regulatory peptide, in their experiments. Beta-endorphin, capable in large amounts of producing psychological and neurological disorders and of suppressing certain immunological reactions, was one of the ingredients of the Bonfire program. It was synthesized by the Soviet Academy of Sciences.

In 1997, the same team reported in the Russian publication *Questions of Virology* that they had successfully inserted a gene for Ebola into the genome of vaccinia. Once again, a benign scientific explanation was put forward: they said it was an important step toward creating an Ebola vaccine. But we had always intended vaccinia to be our surrogate for further smallpox weapons research. There was no doubt in my mind that Vector was following our original plan.

One of our goals had been to study the feasibility of a smallpox-Ebola weapon.

Vector has been the official repository for Russia's smallpox stocks since they were moved from the Ivanovsky Institute in Moscow in 1994. Sandakchiev and I first tried to transfer the strains from Ivanovsky to Vector in 1990, hoping that these "legal stocks" would serve to cover up Vector's smallpox work. The Ministry of Health turned us down at the time, but four years later the Russian parliament approved the same plan with no public explanation. The transfer aroused little international attention.

The research at Vector was by no means an isolated case. In 1997 scientists at Obolensk reported in the British scientific journal *Vaccine* that they had developed a genetically altered strain of *Bacillus anthracis* capable of resisting anthrax vaccines. In earlier articles, they claimed to have developed a multi-drug-resistant strain of glanders. Both projects were initiated in the 1980s.

My American interlocutors were skeptical of my concerns. Some doubted a combined weapon was possible. Scientists whom I respect wondered why anyone would want to make such a weapon.

Smallpox and Ebola, they pointed out, were each sufficiently lethal on their own. Dr. Peter Jahrling of USAMRIID, who was present at some of my early debriefing sessions, has called the concept "sheer fantasy."

I have no way of knowing whether a combined Ebola-smallpox agent has been created, but it is clear that the technology to produce such a weapon now exists. To argue that these weapons won't be developed simply because existing armaments will do a satisfactory job contradicts the history and the logic of weapons development, from the invention of machine guns to the hydrogen bomb.

I told my debriefers that Russia's biological labs should be as carefully monitored as its nuclear arsenal. I was told in turn that it is wrong to conclude intentions from the nature of scientific research, and that the work being conducted in Russia should be accepted as peaceful until there is a compelling reason to think otherwise.

Throughout my career, I had worried that American scientists would surpass us. Now I found myself struggling to persuade them how far the science of germ warfare had come. It wasn't until Bill Patrick walked through the door two months after my first debriefing that I felt someone understood what I was trying to say.

Patrick handed me his business card as soon as we were introduced. I couldn't read a word, but when I saw the skull and crossbones over his name, I started to laugh. The card, I later found out, identified his occupation with a single word: "bioweaponeer."

Patrick, then in his late sixties, had retired from Fort Detrick, where he had made a smooth transition from supervising the U.S. Army's biological warfare "product development" division to formulating methods for the protection of soldiers from the weapons he and his associates had made. He had become a consultant on biodefense, participating in the first United Nations team of arms monitors sent to Iraq in 1992. The difference in our ages and backgrounds evaporated as we shared the secrets of our former profession. We had tackled many of the same scientific problems. When I gave him details of the recipes for our weapons, he buried his head in his hands.

Patrick knew as well as I did that improvements in the cultiva-