BOOKS: HISTORY

Incubating Bioweapons

William A. Haseltine

Ken Alibek, formerly Colonel Kanatjan Alibekov, has written a chilling and sobering tale of his work as deputy chief of Biopreparat, the pharmaceutical agency at the hub of the Soviet Union's biological warfare program. *Biohazard* is a reminder of how deadly modern technology can become and how willing scientists can be to dedicate their knowledge and lives to evil purpose. It is a warning against complacency, a call for vigilance.

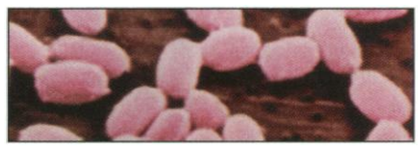
Biohazard
The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told from the Inside by the Man Who Ran It
by Ken Alibek, with Stephen Handelman
Random House, New York, 1999. 335 pp. $24.95, C$37.95. ISBN 0-375-50231-9.

The book is a straightforward, fact-filled account written in a disturbingly cheerful tone. It documents the creation and stockpiling of a vast and diverse arsenal of deadly biological weapons designed to spread disease, panic, and death in civilian populations and, secondarily, in armies. The list of infectious diseases effectively "weaponized" (Alibek's term) includes anthrax, plague, tularemia, brucellosis, smallpox, monkey pox, Q fever, Marburg virus, and Lassa virus. Alibek mentions, but does not detail, similar efforts to create bioweapons for killing livestock and for devastating crops. Biopreparat's goal was to deliver field-ready munitions to the Soviet armed forces; it succeeded. Hundreds of tons of anthrax were ready to use at any time, and a perishable 20-ton stockpile of smallpox virus was refreshed several times each year. As Alibek notes, over the 20 years following "Moscow's endorsement of the Biological Weapons Convention in 1972, the Soviet Union built the largest and most advanced biological warfare establishment in the world."

Biohazard also recounts Alibek's work at Biopreparat. He joined the agency in 1975 and his experiences included projects on *Brucella*, tularemia, and the mass production of weaponized anthrax. Gorbachev's perestroika brought increased support and generous funding for viral and bacterial weapons, which Alibek utilized as chief of weapons development from 1988 to his 1992 defection. Alibek describes research efforts to cultivate disease organisms for mass production, to stabilize them for storage, and to develop effective delivery vehicles compatible with Soviet military hardware. He triumphantly reports successful tests on monkeys using ever-more deadly agents at the open-air testing ground on Resurrection Island in the Aral Sea.

Alibek's group searched far and wide for disease strains suitable for their weapons. The KGB was their "most dependable supplier of raw material"; it delivered vials of "exotic fluids, powders, and cultures" via diplomatic pouch to Moscow. A particularly virulent smallpox strain was retrieved in the late 1960s from one of the last epidemics in India. An especially quick-acting and deadly strain of the Marburg virus was isolated in 1987 from the body of Nikolai Ustinov, one of Alibek's friends who became infected in a laboratory accident.

It is noteworthy that each advance in Western medical science was shadowed by its dark cousin in the Soviet bioweapons program. The discovery that bacterial plasmids carry resistance determinants was quickly applied to the creation of antibody-resistant strains of bacterial weapons. The global eradication of smallpox triggered a massive new weapons program. Advances in recombinant DNA technology were used in attempts to create new, more deadly hybrid viruses such as smallpox-Ebola combinations. The discovery of neuroactive peptides prompted a program to synthesize agents that could deliver toxic neuropeptides. In the 1980s, even AIDS and Legionnaires' disease were explored for military purposes. Members of several ministries and the Soviet Academy of Sciences aided Biopreparat's efforts by furnishing scientific advice.



Anthrax bacilli.

CREDIT: A. B. DOWSETT/SPL/PHOTO RESEARCHERS

After defectors exposed the biowarfare program to the West, it was officially ended by Yeltzin's 1992 decree banning offensive biological warfare research. Throughout the book Alibek hints, but does not assert, that the development and stockpiling of biological weapons continues in Russia and other countries of the former Soviet Union.

When Alibek was inducted into the weapons program, his belief (encouraged by a KGB officer) that the United States was disregarding the 1972 treaty enabled him to participate in creating biological weapons. Later, when his oath as a physician troubled him, he reasoned: "But I liked the lab work." Eventually, Alibek's desires to succeed at any cost and to retain the privileges that came with his position allowed him to calculate production schedules for arming multiple-warhead ballistic missiles with anthrax without giving "a moment's thought to the fact we had just sketched out a plan to kill millions of people."

Why did the Soviet Union develop and expand its bioweapons program throughout the 1970s and into the 1990s? If the weapons were to counter a threat from the West, why were they kept secret? Were they considered just another saber to rattle in a strategic standoff? Did the Kremlin ever calculate the long-term dangers of letting this particular genie out of the bottle? *Biohazard* does not shed much light on these strategic issues. Such thinking was probably above the author's pay grade. But Alibek notes that in the early 1980s relations between the Soviets and the West had plummeted. Conflict in Afghanistan, the U.S. arms buildup, Reagan's description of the Soviet Union as an evil empire, and the angry rhetoric of the Kremlin leaders undermined the sense of security that the détente of the 1970s had provided Alibek's generation. He offers the assessment that "along with most of my colleagues I believed that superpower conflict was inevitable."

The story *Biohazard* tells—one we may have been more comfortable not knowing and one Western scientists and military planners have done a very good job overlooking—must be reckoned with. It is extremely unlikely that the knowledge that it is possible to weaponize the worst diseases of mankind and the specific recipes for doing so disappeared with the official ending of the Soviet Union's program. At its peak the program employed more than 60,000 people, many of whom have now dispersed around the globe with their bioweapons expertise. Iraq is at least one country that has used similar methods to develop biological munitions. The capability to develop effective biological weapons is likely well within the means of many nations and even sophisticated terrorist organizations.

I believe that scientists in the military, civilian, and civil-defense communities in the United States and elsewhere must create an institutional response to this threat. Additionally, a strong international organization designed specifically for surveillance, inspection, and the enforcement of

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biological weapons treaties should be established. Issues of national sovereignty and corporate privacy pale in comparison to the very real dangers posed by bioweapons. We must also reconsider vaccination policies for diseases once thought to be eradicated, such as smallpox. These are sad conclusions, but it is my hope that Alibek's testimony to a monstrous evil will serve as a clarion call for effective action.

BOOKS: BOTANY

The Powers of Flowers

Peter K. Endress

Flowers are attractive not only because their beauty enlightens our lives but also because we depend on them for so many of our daily needs. And the many important roles flowers play in human cultures provide a myriad of enjoyable routes to follow between biology and the humanities. In *The Rose's Kiss*, botanist Peter Bernhardt weaves accounts of the forms, functions, and ecologies of flowers together with threads from history, folklore, and mythology.

Some books provide first-hand descriptions of science by thoughtful researchers who convey the essence of their fields in simple, entertaining ways. Over the past two centuries, many such books have been written on plant life. Even earlier, when Linnaeus (in *Systema naturae*, 1735) introduced his sexual system for classifying plants, he explained it with metaphors, which in his time were not only amusing but rather shocking. Although today Linnaeus's metaphorical descriptions don't upset our minds, comparisons between the sexual systems of animals and plants remain an attractive topic for researchers and non-biologists alike. And, of course, sexuality in plants is much more complicated than Linnaeus could have known; our current understanding of the phenomena has changed dramatically in the past decade alone. The once-unified natural history of flowers has long since diversified into many sophisticated disciplines, and new connections among them are constantly developing. These advances include the uncovering of exciting new floral fossils from progressively older strata, which give deeper insight into early evolution of flowering plants; the explosive rise of molecular developmental genetics, which unravels how genes regulate flower development; and much recent progress in floral ecology, which studies the behavior of flowers and their pollinators.

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In addition to technical articles on topics ranging from the irises of southern Africa to the pollination ecology of Australian bushes and Kansas prairie flowers, Bernhardt has previously written two popular books of essays about plant life. From the chapter titles, some of which ("The Pig in the Pizza," for example) are poetically enigmatic, one could get the impression that *The Rose's Kiss* is simply another collection of essays, if one more focused on flowers. Once one begins to read through the book, however, it soon becomes clear that *The Rose's Kiss* is much more: it is a comprehensive account on floral biology written for a general audience.

The Rose's Kiss
A Natural History of Flowers
by Peter Bernhardt

Island Press, Washington, DC 1999. 277 pp. $24.95. ISBN 1-55963-564-9.

Scientists have an ever-growing obligation to explain their science in a way that can be understood by the general public as well as the, frequently few, specialists in their field. Bernhardt's book is not only entertaining, it is also a good example of how to teach in a central branch of biology. It is an eye opener for non-biologists, and it may provide professionals with ideas on how to communicate the essence of flower biology.

Night diner. More than a quarter of all bat species feed on flowers. Here a small blossom bat (*Syconycteris australis*) is taking nectar from an Australian *Banksia*'s branch of massed flowers.

CREDIT: M. D. TUTTLE/BAT CONSERVATION INTERNATIONAL

The author starts with the roles flowers play in different human cultures and then moves on to biology by considering floral structure and function, generalizing from taxonomically diverse examples. When he turns to pollination biology, Bernhardt is at his best. He has many fascinating stories to tell: the many distinct means by which the ratio of male to female flowers is regulated; the variety of environmental cues that stimulate flowering; how the longevity of flowers correlates with breeding systems and life forms; the differences between "sloppy" and "neat" systems of self-incompatibility (by which plants recognize and reject their own pollen); and the wealth of attractants and rewards for pollinators. Bernhardt ends with speculations on how early flowering plants "stole" animal pollinators from the gymnosperms that were dominant in forests 200 million years ago.

Through his discussions, the author may alleviate concerns that are sometimes expressed in public debates about biotechnologies. He does a good job in emphasizing the natural and common occurrence of clones in plants, for example when he explains how almost every dandelion in a meadow is "a clone of its mother." He notes that natural genetic engineering has been performed for centuries by plant breeders, whose "tricks are based on preserving the genetic 'mistakes' that are usually rejected by natural selection." Bernhardt touches on similar topics when describing the natural plastics of pollen grain walls and the introduction of apogamy (the production of fruits without pollination) in crop plants.

The titular rose recurs throughout the book, as a symbol for flowers in general and as a metaphor for various aspects of our life. Each chapter is introduced with appropriate lines of poetry, excerpts that range from the Wisdom of Solomon, through Albertus Magnus and Shakespeare, to works of living poets. Bernhardt himself becomes poetic at times, with his funny comparisons, rhymes, and alliterations. He simplifies complicated facts and relationships, making them easy to grasp, and he uses comparisons with familiar events and structures from everyday life. Thus he succeeds in conveying a lively and colorful picture of flower biology that reveals the diversity of floral strategies. Bernhardt's instructive text is bolstered by J. Myers's informative drawings.

The Rose's Kiss is an up-to-date, popular overview that is especially perceptive because it is written by an active scientist. Bernhardt follows the theme of the rose from the ancient Greeks who cultivated roses with flowers filled by petals (as reported by Theophrastos), to the present day, and back to the Tertiary (the source of the fossil flowers of *Paleorosa*). His accounts form a well-balanced natural history, a book I recommend to all who love flowers and want to know more about their biology.