to the cabinet that held the Iowa State collection.

Here the story of the Ames strain leaves the realm of speculation, because what happened next is precisely known.

The National Veterinary Services Laboratory in Ames serves as the diagnostic center for the entire nation; it is a repository for all manner of germs and diseases that afflict American livestock. That is why the U.S. Army wrote to the N.V.S.L. in late 1980 requesting a sample of an anthrax culture. The Ames lab made a subculture of the anthrax and sent it to the Army's Medical Research Institute of Infectious Diseases—USAMRIID—at Fort Detrick, near Frederick, Maryland, along with the information that the isolate had come from a dead cow. The Army named it the Ames strain.

USAMRIID has long been familiar with anthrax, as far back as the days when it was the Army Medical Unit and was associated with the Biological Warfare Laboratories at Fort Detrick. The mighty lethality of anthrax has been appreciated by mankind since classical times, and its potential as a weapon has been intuited by warriors since 1876, when the bacteriologist Robert Koch discovered that the disease had a bacterial cause. During the First World War, German agents were injecting anthrax into American livestock. In the nineteen-thirties, Japan tested anthrax as a weapon in Manchuria. In the forties, the United States, Britain, and the Soviet Union also took up the challenge of weaponizing anthrax.

But if anthrax is the perfect killer, silent and invisible, it is not, as it exists in nature, a perfect weapon. It is a livestock disease, and when humans contract it under normal conditions it is through contact with diseased animals or their hides. The commonest form of human infection (ninety-five per cent) is through skin contact—cutaneous anthrax. Lesions form, followed by a black scab, but, while potentially deadly, cutaneous anthrax is highly treatable by antibiotics. For people, by far the deadliest form of anthrax is that which is contracted by breathing spores into the lungs—inhalation anthrax. But, as the spores are not airborne under natural conditions, inhalation anthrax has been a rarity. According to the Center for Nonproliferation Studies, between 1900 and 1978 only eighteen cases of inhalation anthrax were reported in the United States, and two of those were contracted in a laboratory.

What happens to a human being who does develop inhalation anthrax, however, is what inspired bioweaponeers. Once someone has breathed anthrax spores deep into the lungs, symptoms soon appear that seem very much like those of the common flu. There is a fever, cough, and aches, at which point aggressive antibiotic treatment can still offer patients a fighting chance. Otherwise, the fever suddenly elevates, breathing becomes labored, and shock seizes the body. After the onset of this severe stage, it is almost always too late for a cure.

Broadly posed, the trick of weaponizing anthrax is to make it breathable. A clump of infected soil might contain billions of anthrax spores, but a clump of soil is unlikely to be inhaled. So the first task in weaponizing anthrax is to purify it, producing a concentration of spores. This is done by creating a suspension, in which the anthrax spores are separated from the material surrounding them in the sample—water, material from the growth medium, and so on. No particle of anything much bigger than five microns is likely to get past the mucous membranes and reach deep into the lungs, and each anthrax spore is itself less than two microns in size. Purifying and concentrating the spores requires real laboratory skill.

Purification and concentration, however, is not enough. In even the purest concentrate, anthrax spores, like most small particles, will clump together, owing to natural electrostatic force. "If you just grow up spores in a test tube and then you remove the liquid, you'll have a kind of a clump," says Philip S. Brachman, a legendary epidemiologist

and an old anthrax hand. "Now, that clump won't go anywhere—it'll fall to the ground." The next grand step in weaponizing anthrax is to cause those purified spores to separate, like individual sprinkles of a fine powder, so they can linger in the air and be inhaled.

Such anthrax becomes a weapon of unfathomable potency, but for years bioweapons scientists searched vainly for an efficient means by which to turn clumpy anthrax spores into airy, inhalable anthrax. Finally, in the early nineteen-sixties, a man named William C. (Bill) Patrick III, chief of product development for the American biowarfare program, found the answer. Patrick discovered that a certain combination of ingredients formed a handy anti-caking material, which, when combined with anthrax spores, allowed the spores to separate into a fine dry mist of unagglomerated poisons. "You want a free-flowing powder containing the agent that is electrostatic-free, so that it flows very nicely," Patrick explains calmly, as if he had developed a product to keep laundry static-free in a clothes dryer. "And when energy is applied to the powder, it breaks up into small particles."

A single gram of powdered anthrax can contain as many as a hundred billion anthrax spores. Conventional medical wisdom holds that inhalation of just eight to ten thousand spores is needed to trigger infection. The letter sent to Senate Majority Leader Tom Daschle's office last month contained two grams of purified, powdery anthrax spores—potentially enough to kill twenty-five million people if it were efficiently distributed.

A letter sent through the mail is not a maximally efficient means of distribution, although, as government officials were surprised to discover, the automatic sorting machines at postal centers can, in jostling a tainted letter, cause a lot of human damage. Two postal workers at a mail-distribution center near Washington have died of inhalation anthrax. "When a person opens a letter, that represents the munition," Patrick says. "When letters go through that high-speed sorting-out process in the post office, you are talking about a huge amount of energy. And you really have a munition."

Patrick's process for making static-free anthrax spores was secretly patented by the government, but he switched over to defensive work when Richard Nixon announced, in 1969, that the nation would unilaterally end its biological-warfare programs. Two and a half years later, the United States—and ultimately some hundred and fifty other nations—became a signatory to the international Biological and Toxin Weapons Convention. By most accounts, the United States actually did stop making these weapons, although the Soviet Union continued with a huge program of germ- and chemical-weapon development until at least 1992. Iraq, another signatory to the convention, admitted in 1995 to having produced two thousand gallons of liquid anthrax, and is believed to have an ongoing biowarfare program. Israel never signed the accord. Patrick says, "I think that the Israelis, if truth be known, have an extremely advanced program in biological warfare, because it's too good a weapons system to give up."

After the American program ended, the research on biological and chemical weaponry was taken up by the Army's Medical Research Institute of Infectious Diseases. The unit's chief purpose turned from making biological weapons to devising defenses against them, through such means as developing and testing vaccines.

It was an Army scientist, George Wright, who developed the human anthrax vaccine, which was field-tested in the nineteen-fifties by Philip Brachman. To test the vaccine, Brachman went to the one place in the country where human anthrax infection, including the inhalation form, was most likely to occur—the animal-hide-processing industry in New England. (Anthrax was once called woolsorter's disease.) Brachman recruited volunteers from four mills whose workers regularly contracted anthrax at a rate much higher than the average population—an annual rate of 1.2 infections for every hundred workers. He divided the volunteers into two groups, vaccinated one group, and administered a placebo to the other. The results proved the efficacy of the vaccine. That same formula is, in its essence, the vaccine now administered to the American armed forces and other peo-