

Paleopathological Puzzles

Researchers unearth ancient medical secrets

By KATHLEEN FACKELMANN

A view of the Atacama Desert, one of the driest places on Earth.

Photos: Aufderheide

In the mid-1980s, pathologist Marvin J. Allison conducted a series of autopsies in Chile in which he uncovered evidence of Chagas' disease, an incurable parasitic ailment that afflicts some 20 million people in Latin America today. The postmortems weren't unusual, except for one thing: The patients had died 3,000 years ago.

Allison was studying mummies found in a valley of the Atacama Desert, one of the driest places on Earth. His report, published in 1985, hinted that Chagas' disease was present in pre-Columbian Latin America. Now, other researchers have used molecular techniques to confirm his result, this time in a 4,000-year-old mummy.

It's a "pretty fantastic find," says Allison, a pathologist at the Medical College of Virginia in Richmond. Work with ancient DNA is "opening up a whole new technical aspect to the study of the history of disease," he adds.

The Latin American mummies aren't the only ancients subject to medical investigation. A British team studying a collection of Egyptian mummies has also found signs of parasitic infection. The group reports evidence that ancient Egyptians suffered from schistosomiasis, a disease that afflicts up to 300 million people around the globe.

Researchers who study mummies say their work is tied closely to the present. By studying the pattern of infectious plagues in antiquity, scientists may come up with strategies for conquering today's diseases. "A better knowledge of what drives infectious disease might open up new approaches to its control," says Arthur C. Aufderheide, a pathologist at the University of Minnesota in Duluth.

Imagine a desert so dry it's used by space scientists to simulate conditions on Mars (SN: 6/21/97, p. 382). The Atacama Desert is just such a place. This sandy region lies between the Andes Mountains and the Pacific coast of Chile. To the north, the Atacama spans the southernmost border of Peru.

Nearby residents have used the desert as a burial ground for thousands of years. Peruvian and Chilean Indians usually buried their dead in shallow pits dug into the surface of the desert. The dry heat desiccated the soft tissue and preserved the bodies, Aufderheide says. The oldest mummy found in the Atacama is about 9,000 years old, he adds.

The Atacama burial grounds have provided researchers with a medical treasure trove. Aufderheide and his colleagues reported a particularly dramatic find in 1994: traces of tuberculosis DNA in the lung of a 1,000-year-old Peruvian mummy (SN: 3/19/94, p. 181). Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis*. The finding refuted the widely held theory that European explorers had introduced this disease to the Americas at the beginning of the century, Aufderheide says. The discovery indicated that *M. tuberculosis* existed in the Americas 500 years before Columbus arrived, he adds.

Like Allison, Aufderheide saw Atacama mummies with the enlarged esophagus and colon characteristic of Chagas' disease. Early symptoms of the disorder include high fever, chills, muscle aches, and nosebleeds. Some people recover completely from this initial infection, but others develop a chronic disease that can damage internal organs and parts of

the digestive system.

Aufderheide explains that *Trypanosoma cruzi*, the parasite that causes Chagas' disease, attacks the nerves in the gastrointestinal tract. The resulting paralysis allows food to accumulate in the esophagus and colon and causes swelling there. Aufderheide also reported seeing inflammation of the heart, which can lead to heart attacks.

Pathological evidence of Chagas' disease isn't sufficient for a definitive diagnosis, Aufderheide notes, adding that other conditions can cause enlargement of the gastrointestinal tract or inflammation of the heart.

Aufderheide looked for, but didn't find, the parasite itself in tissues removed from the mummies. Neither did Allison. Both scientists point out that it is extremely difficult to identify *T. cruzi* that is thousands of years old. The parasite's remains are usually too fragmented to be identified under a microscope, although in 1992, a team led by an Italian researcher found *T. cruzi* in a Peruvian mummy.

Given the difficulty of finding the parasite itself, Aufderheide wondered if *T. cruzi* had left behind a more reliable DNA trail. His earlier study had shown the DNA of tuberculosis in a mummy. Why not look for genetic traces of Chagas' disease?

Why not indeed, agreed Felipe Guhl, a molecular biologist at the University of the Andes in Bogotá, Colombia. Aufderheide sent tissue taken from Atacama mummies to Bogotá, where Guhl and his team of DNA specialists got to work.

First, the researchers soaked the mummified tissue in saltwater to rehydrate it. Next, they used molecular probes to search for the 330-base-pair region of DNA

that defines *T. cruzi*. The researchers had samples from the skeletons and viscera, including the heart and esophagus, of 27 men, women, and children.

Guhl's team reported in the May 10 LANCET that 7 of the 27 mummies had the target DNA. "We infer that those seven were infected with Chagas' disease," Guhl told SCIENCE NEWS.

The team also tested tissue taken from an Egyptian mummy. Since Chagas' disease is restricted to Latin America, the researchers didn't expect to find *T. cruzi* DNA—and they didn't.

There had also been some question about the origin of Chagas' disease. Guhl says his work confirms that the disease plagued the people of Latin America long before Europeans arrived there.

Testing mummy tissue for DNA has had its share of technical problems, comments physical anthropologist David R. Hunt of the National Museum of Natural History in Washington, D.C. Notably, researchers risk contaminating the mummy tissue with modern DNA, he says. However, Guhl's use of 27 different mummies and multiple tests suggests a fairly definitive result, he adds.

Mummies in another part of the world may shed light on the history of schistosomiasis, a disease caused by several species of worms. These parasites are transmitted to people when they use water contaminated with infected snails. About 20 percent of the population of Egypt has this disease today.

Many researchers have found evidence of schistosomiasis in ancient peoples of Egypt, says Daniel G. Colley of the federal Centers for Disease Control and Prevention in Atlanta. As early as 1910, M. Ruffer reported finding schistosome eggs in Egyptian mummies.

Recently, A. Rosalie David of the Manchester University Museum in England and her colleagues examined Egyptian mummies with computerized tomography, an X-ray technique. They discovered calcium deposits—evidence of schistosome infection—in the bladders of two mummies. The group details its findings in the June 14 LANCET.

"This tells us that the schisto we know and love has been around for a long time," Colley says.

In schistosomiasis, an immature version of the parasite floating in the water burrows into the skin of a human victim.

The schistosome can live in various parts of the body for up to 20 years. Victims can suffer from urinary, gastrointestinal, or liver disease. Untreated, they may eventually die.

The Egyptian mummies are quite different from the Atacama ancients. In most cases, the Indians of the Atacama relied on the heat of the desert to mummify their dead. The Egyptians, on the other hand, had developed by the year 2600

B.C. a sophisticated process for preserving their dead. They first removed the major organs and then relied on natron, a type of salt, to dry out the body, Hunt says. Often, the Egyptians wrapped the body in linen.

"Egypt provides an unparalleled opportunity to study the history of disease, because there is an abundance of skeletal and mummified human material," David says in LANCET.

The Egyptian mummies present some drawbacks to researchers, however. In most cases, the internal organs aren't available for study, says Aufderheide. In addition, the harsh drying process often damaged cells of the mummies' soft tissue, Hunt says. Nonetheless, David's team has used a variety of techniques to examine them and has found a surprising lack of cancer, syphilis, and even dental caries in these ancient Egyptians.

While some scientists speculate that cancer was truly absent in antiquity, Aufderheide has a simpler explanation. He says that most ancient peoples died in their forties or early fifties. Thus, in the mummies, one

would not expect to find much cancer, a disease more prevalent in old people.

There's no doubt that mummy studies add valuable information to the annals of human disease, but do they speak to modern disease?

"They're fun science," Colley says,



A partially unearthed Atacama mummy.

"but not terribly enlightening in terms of what we ought to be doing now to protect the public health."

Aufderheide disagrees, arguing that a solid knowledge of history can sometimes illuminate the present. Chagas' disease and many other infectious diseases are driven by human behavior and the environment. Studying how Chagas' disease established itself over time may provide clues on how to beat the disease, Aufderheide says. Researchers have yet to craft an effective treatment for it, and there is no vaccine, he adds.

Allison points out that houses in the Atacama Desert today are similar to those used thousands of years ago. *T. cruzi* is passed to humans by a blood-sucking insect called a kissing bug. This inch-long creature often lives in the thatched roofs and large crevices in the walls of Atacama houses. It comes out of hiding at night and bites its victims, transmitting the parasite when it defecates into the wound.

Traditional housing has allowed the kissing bug—and Chagas' disease—to flourish in this region, Allison says.

There's no time to waste with Chagas' disease, according to Guhl. He points out that 10 to 15 percent of today's population in Chile is infected with *T. cruzi*. That is about the same as the percentage of mummies infected with the organism, according to Guhl's work. "The disease has been established strongly," Guhl says.

Allison adds that the kissing bug is on the move in Latin America, infesting areas of Peru that hadn't previously been afflicted.

All agree that it must be stopped, but how? While Colley puts his bet on the development of a vaccine or treatment, Aufderheide and others are skeptical. "If you don't understand the transmission of the disease—all the antibiotics in the world won't help," Hunt says.

If researchers ignore the past, they may increase the risk that Chagas' will inflict its deadly legacy on yet another generation of Latin Americans. □



One of the mummies tested by Felipe Guhl's team.