DADO RUVIC/REUTERS/CORBIS

A forensics specialist from the International Commission on Missing Persons examines human remains from a mass grave in Tomašica, Bosnia and Herzegovina.

FORENSIC SCIENCE

Bringing out the dead

Alison Abbott reviews the story of how a DNA forensics team cracked a grisly puzzle.

During nine sweltering days in July 1995, Bosnian Serb soldiers slaughtered about 7,000 Muslim men and boys from Srebrenica in Bosnia. They took them to several different locations and shot them, or blew them up with hand grenades. They then scooped up the bodies with bulldozers and heavy earth-moving equipment, and dumped them into mass graves.

It was the single most inhuman massacre of the Bosnian war, which erupted after the break-up of Yugoslavia and lasted from 1992 to 1995, leaving some 100,000 dead. With the war's end in sight, the Serbian army had to worry about hiding the evidence. In the late summer, they brought out the bulldozers again, roughly dug up the decaying bodies, threw them into dumper trucks and distributed them between 30 or so more remote burial sites. After the war shuddered to a halt in the autumn, these hastily disguised sites, with their cargoes of disconnected bones, were discovered. Christian Jennings's *Bosnia's Million Bones* tells the story of how innovative DNA forensic science solved the grisly conundrum of identifying each bone so that grieving families might find some closure.

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This is an important book: it illustrates the unspeakable horrors of a complex war whose causes have always been hard for outsiders to comprehend. The author, a British journalist, has the advantage of on-the-ground knowledge of the war and of the International Commission on Missing Persons (ICMP), an organization created in Sarajevo in 1996 that has a central role in the story. In 2000, the ICMP launched the world's first systematic attempt to apply DNA-identification techniques to large numbers of people. Its labs have since been used to help to identify individuals in other large groups killed in natural disasters, accidents and wars — including the 2013 terrorist attack on Nairobi's Westgate shopping centre, in which dozens of victims were mangled beyond conventional recognition.

As Jennings shows, the organization's first job was a masterwork from hell that involved locating, storing, preparing and analysing the million or more bones. It was in large part possible because during those fateful days in July 1995, aerial reconnaissance missions by the United States and the North Atlantic Treaty Organization had picked up images of large groups of men on open ground near Srebrenica. Subsequent images showed that the men had disappeared and large areas of disturbed earth had appeared. Over the following weeks, as the bodies were relocated, images showed more stretches where the soil was newly disturbed.

Bosnia's Million Bones: Solving the World's Greatest Forensic Puzzle
CHRISTIAN JENNINGS
Palgrave Macmillan: 2013.

In 1997 and 1998, a team of archaeologists and forensic experts — put together by the Netherlands-based United Nations International Criminal Tribunal for the ▶

former Yugoslavia — began excavating the burial sites. They pieced together some evidence of when and how the mass killings had taken place from clues such as the bodies' states of decay, the times and dates on their self-winding watches, and the characteristic patterns of damage caused to skulls by bullets. Analysis of the colours and textures of soils pointed to where some of the bones had first been dumped. For example, chips of glass indicated burial near a glass factory in the area.

The task of identifying the bones was exquisitely difficult. The bulldozers had broken up the bodies, and the pieces had been mixed up in the dumper trucks transporting them to new burial sites. DNA analysis of each bone was the only possible method of conclusive identification, so the ICMP set up its lab.

At first, this remarkable operation ran on a shoestring. Members invented cheap alternatives for equipment, such as adapting a chicken rotisserie from the local market to stir DNA solutions. All of these staff (many of them "massively adaptable" graduates, Jennings writes) were locals, who could easily communicate with the traumatized relatives of the missing. This helped them to collect the blood samples for the DNA analysis needed for comparison with DNA from the bones.

Each staff member was trained in a specific aspect of this analysis, which was then carried out in modular fashion. The remains were first prepared for DNA extraction, then ground into powder in the Republic of Srpska, now an independent Serbian enclave within Bosnia. Next, the powder was transferred to Sarajevo for DNA extraction. Through that analysis, more than 80% of the remains were returned to their families for burial.

"More than 80% of the remains were returned to their families for burial."

That story needed to be told. But *Bosnia's Million Bones* is a confusing read. It weaves in other, undoubtedly important, stories — such as the manhunt for the war criminals responsible for the massacres — and diverts frequently into issues involving unrelated wars. Its structure is undisciplined, muddling timelines and sometimes even basic numbers (such as the number of victims identified by a particular date). But those who make it through will emerge shaken, and educated. ■

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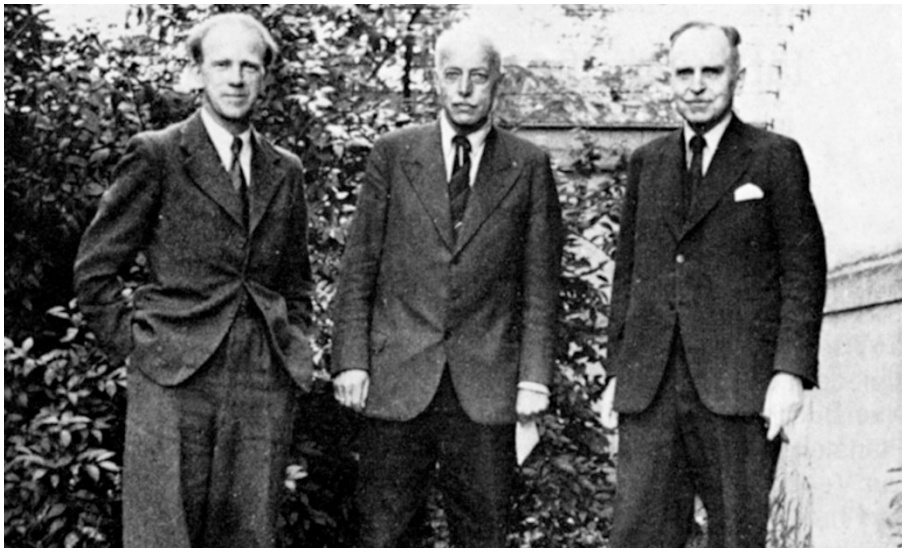

INTERFOTO/AKG-IMAGES

Left to right: Werner Heisenberg, Max von Laue and Otto Hahn in Göttingen, Germany, in 1946.

PHYSICS

Overhearing Heisenberg

Ann Finkbeiner ponders a script inspired by the 1945 internment of eminent German physicists in England.

By July 1945, the Allies and Germans had spent years racing each other to build an atomic bomb. The German physicists were certain of their technological superiority, but had not even taken the first step — building a working reactor. The Manhattan Project scientists, who had panicked that the Germans would build this evil thing first, had made four bombs. But that July, neither side knew for certain how close the other had come. So, just after the Nazi surrender, the Allies captured ten German nuclear scientists — including Werner Heisenberg, Otto Hahn, Max von Laue, Kurt Diebner and Carl Friedrich von Weizsäcker — sequestered them in Farm Hall, a country house in deepest Cambridgeshire, UK, and bugged their rooms.

Transcripts of the taped conversations were declassified and published almost 50 years later in *Operation Epsilon* (University of California Press, 1993) and annotated in physicist Jeremy Bernstein's *Hitler's Uranium Club* (AIP Press, 1995). But they begged to be a play. Now David Cassidy, historian of physics at Hofstra University in New York, has written a one-act script called *Farm Hall*. Whereas a recent produced play by Alan Brody (also called *Operation Epsilon*) focused on the scientists' morals in trying to build a bomb for Hitler, Cassidy looks at the scientists' accounts of their failure to do so.

Both playwrights had to choose, from the mess of reality, one central tension. I thought that the tension might be how close the Germans came to building the bomb. Bernstein thought the tension was the German scientists' construction of a version of reality in which they had refused to build the bomb for Hitler on principle. Cassidy, however, focuses on their realization of their technological inferiority — on how they rationalized what he calls their own "fall into failure".

Farm Hall
DAVID CASSIDY
Staged reading in Santa Fe, New Mexico: May 2014.

Cassidy quotes verbatim from the transcript, putting the stiffly translated German into American English. He narrows the cast down to five scientists, including Heisenberg, who led the German nuclear programme and won the 1932 Nobel Prize in Physics; Hahn, who co-discovered fission; and Diebner, an engineer. Their military minder at Farm Hall, Theodore Rittner, has arranged for the secret taping, translation and transcription of their conversations for British and US intelligence.

The scientists settle in and get comfortable. They talk.

They try to figure out why they're being held. To keep them out of the hands of the Russians? Because the Allies want to know what they know? They compliment themselves on being ahead of the Allies, who — they think — cannot build a reactor in which uranium can be collected into a near-critical mass and begin fission. They argue about why they never actually built the reactor: because Heisenberg insisted on using his design rather