

▶ 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.

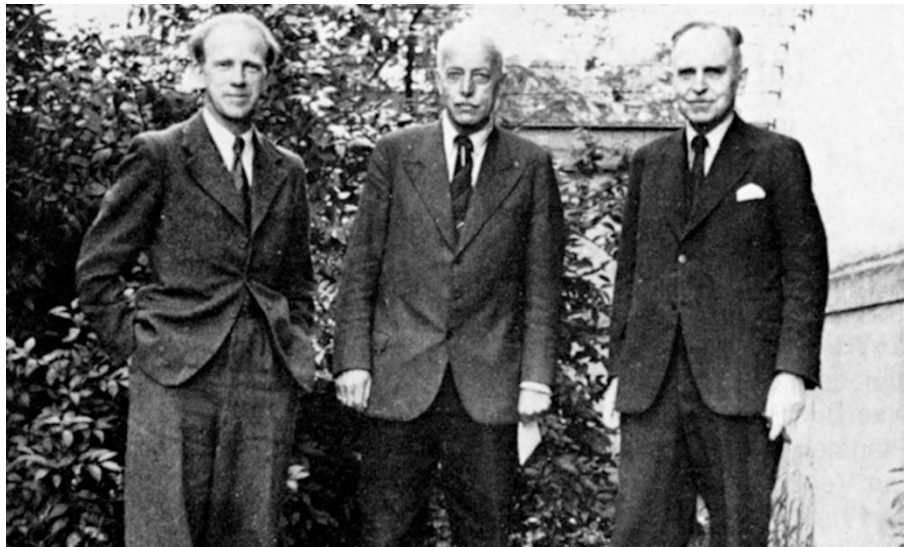
At first, this remarkable operation ran on a shoestring. Members invented cheap alternatives for equipment, such as adapting a chicken rotisserie from the local market to stir DNA solutions. All of these staff (many of them “massively adaptable” graduates, Jennings writes) were locals, who could easily 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. ■

Alison Abbott is Nature's senior European correspondent.



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

Farm Hall

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

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”.

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

than Diebner's more effectual one?

The scientists skirt around the moral issue of building an atomic bomb for the Reich. Heisenberg and the others agree that they did what was necessary to protect the future of German science. Hahn, who never worked on the bomb, says that he loves Germany but is glad that her criminal leaders lost the war. Diebner says that he joined the Nazi party because he needed work.

On the night of 6 August, they listen to the BBC's announcement that the United States has dropped the atomic bomb on Hiroshima. Stunned, they try to figure out how the Allies managed it. Heisenberg calculates that by using 100,000 mass spectrometers, one could separate out enough of the fissile but rare isotope of uranium for a bomb — about a tonne. Hahn is confused: aren't Heisenberg's calculations out by a factor of ten? (They are.)

The next day, they read the British newspapers, which brag that the Allies won the atomic race. They are outraged, having thought they were so far ahead that racing was irrelevant. They disagree about whether they were even trying to build a bomb or, as Heisenberg begins to insist, just a reactor. Everybody agrees that the German government kept them too short of funds for success. They write an official memorandum explaining that their efforts were directed towards building a power-producing reactor and that working on a bomb had not been feasible. About five months later, they go home — Heisenberg to the directorship of the Kaiser Wilhelm Institute for Physics in Berlin, and the others also to worthy and interesting jobs. As Cassidy says, they fall from the heights of their arrogance, but not far.

Cassidy's script has had two readings; others are planned, and a Spanish production in Santiago, Chile, is in preparation. Cassidy is expanding his play to two acts. "I don't think I could have picked a more difficult subject for my first play," he says. The difficulty lies in the multiplicity of historical realities that he must cram into one plot that is driven, in effect, by one tension.

The transcript itself holds many tensions: between aristocratic theorists and lower-caste engineers; between those who joined the Nazis and those who just worked for them; between arrogance and wilful blindness; between Heisenberg's great scientific stature and his failure to help a Jewish colleague's family, or indeed his own. Cassidy has Rittner, at the play's end, collapse all the tensions: people who are great in one area, Rittner says, are expected to be — and expect themselves to be — great in all. But in both art and life, they fall. ■

Ann Finkbeiner is a freelance science writer in Baltimore, Maryland, and author of *The Jasons*.
e-mail: anniekf@gmail.com

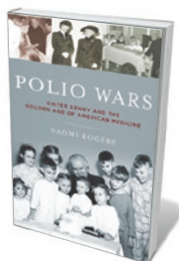
Books in brief



Shaping Humanity: How Science, Art, and Imagination Help Us Understand Our Origins

John Gurche YALE UNIVERSITY PRESS (2013)

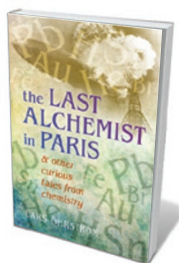
Palaeoartist John Gurche crafts hyperrealistic sculptures of extinct hominins, built up from casts or three-dimensional models of their skeletons. To bring these individuals from deep time to 'life', Gurche fuses his knowledge of comparative anatomy with forensic science and informed guesses about expressions and poses. His coffee-table gem showcases and contextualizes 15 of these finely judged creations, representing a span of 6 million years and ranging from *Sahelanthropus tchadensis* to the 'Hobbit' *Homo floresiensis*.



Polio Wars: Sister Kenny and the Golden Age of American Medicine

Naomi Rogers OXFORD UNIVERSITY PRESS (2013)

Before the Salk vaccine was licensed in 1955, polio epidemics swept the United States. Naomi Rogers traces them through the story of Australian-born 'bush nurse' Elizabeth Kenny, who eschewed splinting in favour of early muscle manipulation. Her star rose, but her methods stirred controversy and she was forgotten with the vaccine's advent. Kenny's principal legacy, Rogers speculates, might be her idea — unacknowledged in the evolution of polio science — that the disease was systemic rather than neurotropic.



The Last Alchemist in Paris: And Other Curious Tales From Chemistry

Lars Öhrström OXFORD UNIVERSITY PRESS (2013)

History offers a painless way to grasp the periodic table's 114 confirmed elements, notes chemist Lars Öhrström. So, for instance, we visit Cumbria in northern England, once an "information technology hub" that supplied the graphite used in pencils. And we follow the Swedish playwright August Strindberg as, gripped by psychosis, he set up an alchemical lab in Paris — leading Öhrström to ponder lithium carbonate (used to treat bipolar disorder), as well as gold. There is much more in this charming mishmash of a primer.



Fritz Kahn

Uta von Debschitz and Thilo von Debschitz TASCHEN (2013)

The 1926 *Man as Industrial Palace* is only the most iconic of the images unleashed by infographics pioneer Fritz Kahn. A modernist genius, Kahn's illustrations were endlessly inventive, often darkly comic and occasionally macabre. His 1924 drawing *Travel Experiences of a Wandering Cell: In the Valley of a Flesh Wound*, for example, beautifully elucidates the living landscape of blood, nerves and tissue. In this biography in English, German and French that features 350 of his works, Uta and Thilo von Debschitz pay homage to the half-forgotten artist on the 125th anniversary of his birth.



Earthart: Colours of the Earth

Bernhard Edmaier and Angelika Jung-Hüttl PHAIDON (2013)

Distance lends enchantment to Earth's particoloured, pitted surface, as revealed by this photofest by two geologists, writer Angelika Jung-Hüttl and photographer Bernhard Edmaier. Terrestrial meanders, fractals and waves echo biological forms, and vivid hues remind the reader how earthly muds and minerals yield pigments from yellow ochre to ultramarine. A chance to enter an alternative vision of our planet, from the smoked-glass icebergs of East Greenland to the stupendous lion-coloured reaches of the Chilean Andes. **Barbara Kiser**