RESEARCH ETHICS

Germany to probe Nazi-era medical science

Overlooked brain tissue slides prompt another look at "euthanasia" victims

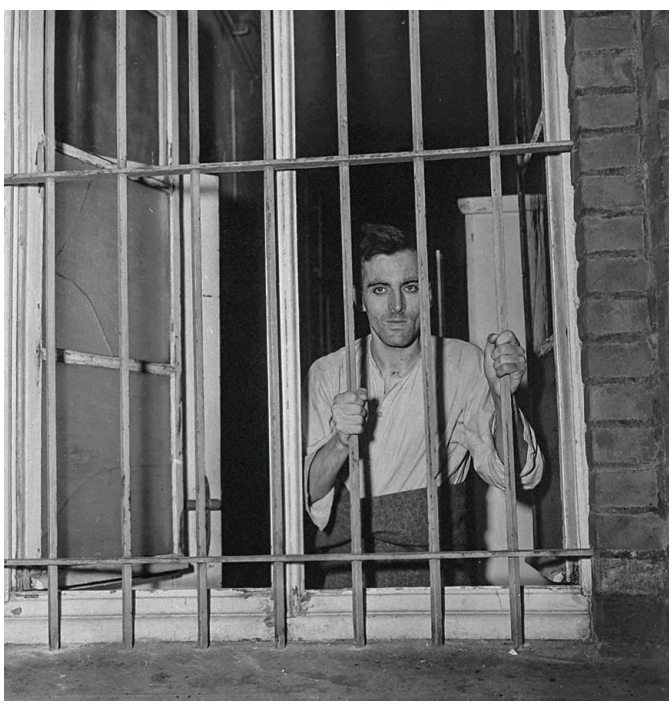
By **Megan Gannon**, *in Berlin*

Soon after Hans-Joachim was born, it was clear that something was terribly wrong. The infant boy suffered from partial paralysis and spastic diplegia, a form of cerebral palsy. In 1934, when he was 5 years old, his parents admitted him to an asylum in Potsdam, Germany, where clinical records described Hans-Joachim as a "strikingly friendly and cheerful" child. But his condition did not improve. He spent a few years at a clinic in Brandenburg-Görden, Germany, and then, on an early spring day in 1941, he was "transfered to another asylum at the instigation of the commissar for defense of the Reich"—code words meaning that Hans-Joachim, then 12, was gassed at a Nazi "euthanasia" center. His brain was sent to a leading neuropathologist.

During World War II, as part of its racial hygiene program, the Nazi regime systematically killed at least 200,000 people it classified as mentally ill or disabled, historians say. Stories like Hans-Joachim's have largely been lost to history. Now, a new initiative is seeking to reconstruct the biographies of victims used in brain research. Starting this month, the Max Planck Society (MPG), Germany's top basic research organization, will open its doors to four independent researchers who will scour its archives and tissue sample collections for material related to the euthanasia program.

The project's impetus is MPG's desire to take moral responsibility for unethical research that its forerunner, the Kaiser Wilhelm Society (KWG), conducted on euthanasia victims and their remains. "We want to find out who the victims were, uncover their biographies and their fates, and as such give them part of their human dignity back and find an appropriate way of remembrance," says Heinz Wässle, an emeritus director of the neuroanatomy department at the Max Planck Institute for Brain Research in Frankfurt, Germany, and head of an MPG committee overseeing the new investigation.

Despite numerous accounts of ghastly experiments and high-profile prosecutions of doctors during the Nuremberg trials after World War II, historians involved in MPG's new investigation say they still don't understand the full extent of research that top institutes conducted in cooperation with killing programs. "Historians of euthanasia generally took their research to the point of death of the victims," says Paul Weindling of Oxford Brookes University in the United Kingdom. "What was not reconstructed was that a proportion of victims"—he estimates 5%—"had their brains withheld for research."



A survivor at the Hadamar Institute in Germany in 1945. In 1941, more than 10,000 disabled adults were gassed and cremated at the killing center.

PHOTO: UNITED STATES HOLOCAUST MEMORIAL MUSEUM, COURTESY OF ROSANNE BASS FULTON

In the 1980s, journalist Götz Aly correlated brain tissue slides collected by Julius Hallervorden, the World War II–era director of the neuropathology department at KWG's Institute for Brain Research here, with a group of 38 children who were murdered by the euthanasia program one day in October 1940. In response, MPG's Institute for Brain Research decided that out of respect for the victims, it would destroy all the brain sections it could find—about 100,000 slides—that dated to the Nazi era, from 1933 to 1945. Germany's other major neuropathology center, the Max Planck Institute of Psychiatry in Munich, also purged its World War II brain slides. Many, including those from Hans-Joachim's brain, were ceremonially buried in 1990 at the Munich Waldfriedhof cemetery.

In the years that followed, historians dug up evidence that KWG scientists had strong ties to the Nazi agenda. Still, MPG did not initiate a more comprehensive accounting of its wartime history until the late 1990s. The results of that examination prompted MPG in 2001 to issue a historic apology to victims of Nazi experiments. That investigation "was a very important project, but it was not complete," says Volker Roelcke, a historian and psychiatrist at the University of Giessen in Germany and one of the four experts on the euthanasia program tapped for the independent review. (The others are Weindling, Patricia Heberer-Rice of the U.S. Holocaust Memorial Museum in Washington, D.C., and Gerrit Hohendorf of the Technical University of Munich.) They hope to reconstruct in greater detail the networks that allowed KWG scientists to exploit the Nazi euthanasia program. They will also strive to identify individual victims whose brains were used for research—in some cases, long after the war ended—and track what happened to tissue slides and other specimens.

Hallervorden remains a focus. He accepted hundreds of brains of euthanasia victims, a U.S. intelligence officer testified at the so-called Nazi doctors' trial in Nuremberg, but was never prosecuted. Instead, he retained his KWG post after the war and continued to study the "wonderful material" from the killing centers, as he described it when debriefed by the intelligence officer. In 1953, Hallervorden published a chapter in a neurology book featuring two micrographs of Hans-Joachim's brain used to illus-

trate ulegyria, a cortical scarring that may have resulted from circulation problems in the womb.

A grim discovery prompted the new investigation. In early 2015, Wässle set out to identify victims whose remains ended up in Hallervorden's "Series H" collection, which included slices of Hans-Joachim's brain. In the process, he came upon a cardboard box containing about 100 brain sections. He confirmed that at least some were from euthanasia victims: Not all the Nazi-era slides were interred at Waldfriedhof after all. A search at the psychiatry institute also turned up more slides.

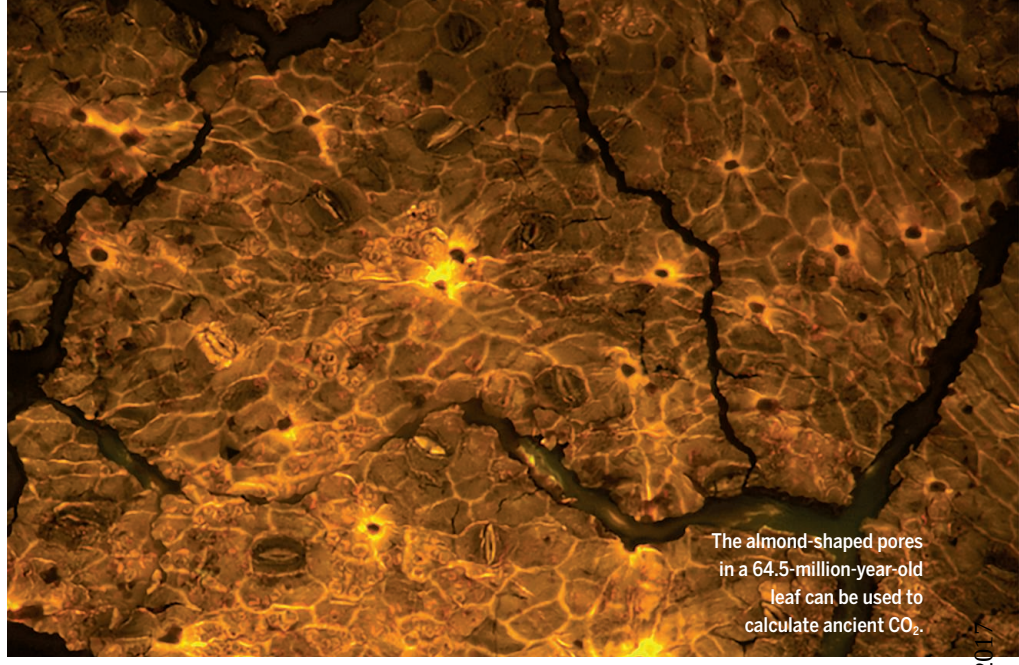
Over the next 3 years, the investigators will attempt to uncover any remaining specimens and link them to clinical records at hospitals and asylums, university archives, and KWG scientists' files, now scattered across a couple dozen institutions. Weindling says he and his colleagues hope to identify as many as 5000 victims. "Everybody knows that Nazi scientists were conducting unethical research," he says. "But what has never been done is a full-scale reconstruction of the extent to which it had taken place."

The historians also hope to gain a better understanding of how unethical science was allowed to flourish in Nazi Germany. The scientists involved "were not bizarre and perverse psychopaths," Roelcke says. "In the postwar period, they were very well integrated in German society. They were very good researchers of international standing. So what are the conditions under which these kinds of biomedical scientists are prepared to initiate or commit atrocities to further their research interests?"

Because Hallervorden and many other complicit scientists kept their positions after the war, Roelcke adds, probing MPG's role during the Nazi era was long taboo, and the reluctance persisted long after the first investigations. Roelcke encountered resistance several years ago, when he attempted to document that Ernst Rüdin, the Nazi-era director of KWG's Institute for Psychiatry in Munich, and the University of Heidelberg in Germany were involved in research on child euthanasia victims.

"This is not only about 'forgotten' specimens, but the apparent whitewashing of the [MPG's] darkest history and the failure to adequately respond to and to commemorate the tragic past," says Martin Keck, clinic director at the Max Planck Institute of Psychiatry. Roelcke sees the new investigation, and particularly Wässle's involvement, as an encouraging sign that MPG is ready to fully confront its past. ■

Megan Gannon is a journalist in Berlin.



The almond-shaped pores in a 64.5-million-year-old leaf can be used to calculate ancient CO_2.

PHOTO: JENNIFER KOWALCZYK (BROWN UNIVERSITY). DANA ROYER (WESLEYAN UNIVERSITY). AND IAN MILLER (DENVER MUSEUM OF NATURE & SCIENCE)

PALEOCLIMATE

Fossil leaves bear witness to ancient carbon dioxide levels

Relics warn that climate may be more sensitive to atmospheric CO_2 than models predict

By **Eric Hand**

When it comes to carbon dioxide (CO_2) and climate, the past is prologue. Barring radical change to humanity's voracious consumption of fossil fuels, atmospheric CO_2 is bound to go up and up, driving global warming. But it won't be the first time that CO_2 has surged. In Earth's ancient atmosphere, scientists see the faint outlines of a CO_2 roller coaster, climbing and dipping across deep time in repeated bouts of climate change. "Each little slice in Earth's past is a replicated experiment," says Dana Royer, a paleoclimatologist at Wesleyan University in Middletown, Connecticut. "It helps us think about where we may be headed in the near future."

If only the past could be seen more clearly. Models of ancient atmospheres and tools for teasing out past CO_2 levels from fossils and rocks all have limitations. Now, scientists have developed a new method for wringing CO_2 estimates from fossilized leaves—one that can go deeper into the past, and with more certainty. "At the moment, it's very promising and it's probably the best tool that we've got," says David Beerling, a biochemist at the University of Sheffield in the United Kingdom who helped develop the so-called fossil leaf gas exchange technique. Already, it is solving ancient climate puzzles and delivering some unsettling news about the future.

Last month, at a meeting of the American Geophysical Union in San Francisco, California, another pioneer of the technique, plant physiologist Peter Franks of the University of Sydney in Australia, trained it on one of those puzzles: the time shortly after an asteroid impact killed off the dinosaurs 66 million years ago. Tropical forests were growing at temperate latitudes, yet earlier studies suggested CO_2 levels of about 350 parts per million (ppm)—less than levels today and seemingly too low to create a global hothouse. Based on a gas exchange analysis of fossil leaves in what was once a tropical forest at Castle Rock, near Denver, Franks and his colleagues now conclude that the atmosphere 1.5 million years after the impact contained CO_2 at about 650 ppm—a far more plausible level.

But in applications of the method to times between 100 million and 400 million years ago, Franks finds hints of a foreboding message. During documented episodes of global warmth, he says, the method reveals relatively low CO_2 values, nothing like the levels of 2000 ppm or more suggested by other proxies. If these downward revisions hold, Earth may be even more sensitive to injections of CO_2 than current models predict. "Temperatures are going to climb further for less carbon and we bet-