UCLA Health | David Geffen School of Medicine

AMARA YAD:
ERASING THE STAIN OF A DARK LEGACY

A UCLA Health physician and his colleagues undertake a decade-long mission to right a historic wrong.

WINTER 2024

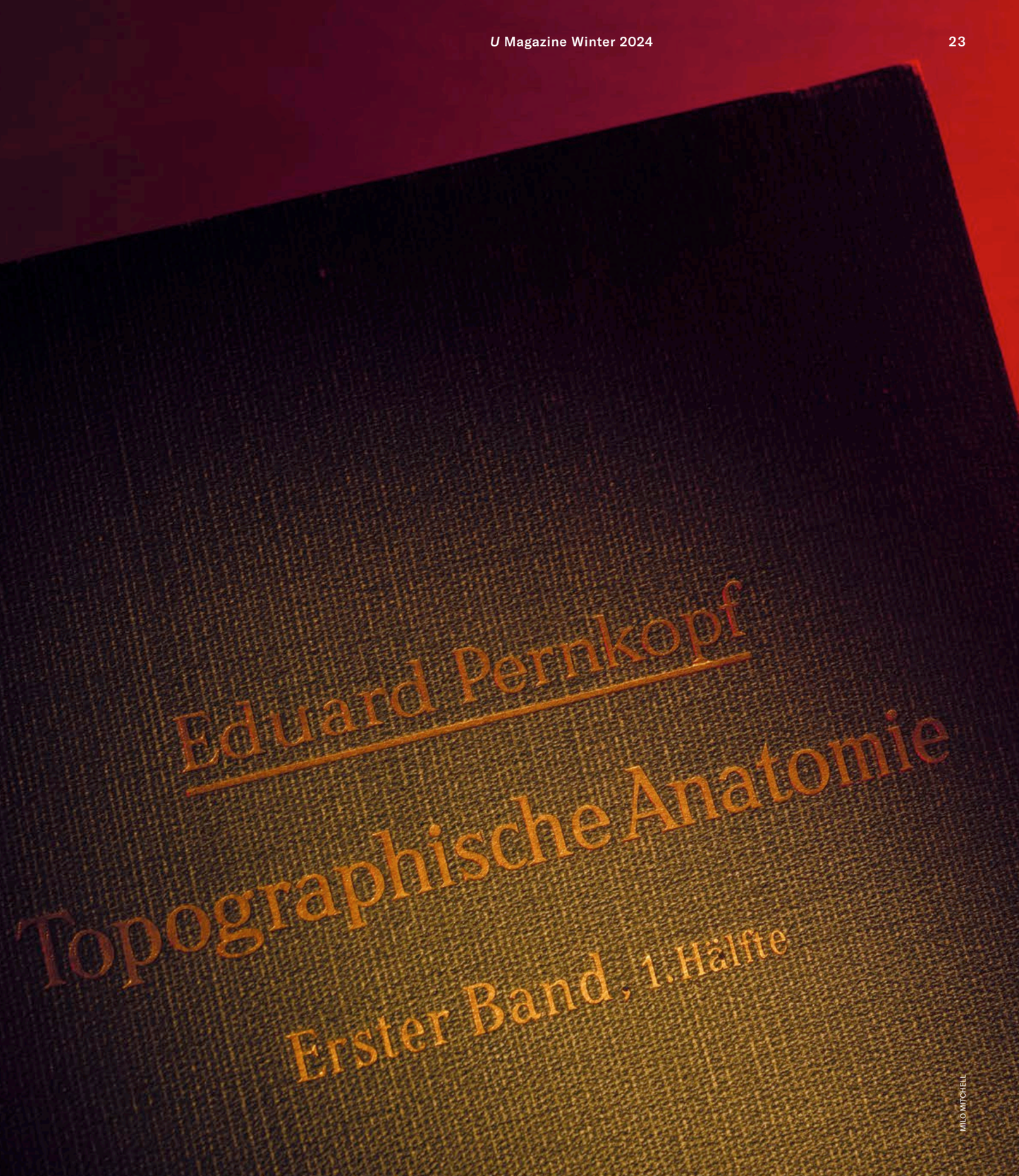
AMARA YAD:

ERASING THE STAIN OF A DARK LEGACY

A UCLA Health physician and his colleagues undertake a decade-long mission to right a historic wrong.

By Dan Gordon

This is the first of two parts. Part 2 will be published in the next issue of U *Magazine.*



MILO MITCHELL

AS THE OLDEST SCIENTIFIC DISCIPLINE IN MEDICINE, anatomy dates at least as far back as the ancient Egyptians, whose elaborate embalming methods necessitated a familiarity with organs and body parts. Hippocrates described the heart and blood vessels in establishing medicine as a scientific field in the 5th century BC. In modern times, generations of aspiring doctors have learned about anatomy in their first year of medical school, in part by dissecting human cadavers in the lab.

But this is not a story about anatomy, per se.

It is a story about an avowed Nazi physician, Dr. Eduard Pernkopf, during the time of the Holocaust, who ascended to the highest post at one of Europe's most prestigious medical schools and violated the Hippocratic Oath in the most egregious way — exploiting the bodies of executed victims of Nazi terror to create a multivolume series of atlases of the human anatomy. For decades, those atlases were held up as preeminent resources, guiding complex surgeries and teaching medical students. Even after the shameful history was revealed, many considered the information in these tainted volumes too valuable to discard.

And it is a story of a UCLA Health physician who, revolted by the origins of the atlas, has made it his mission to right what he sees as an abhorrent historical wrong. Kalyanam Shivkumar, MD (FEL '99), PhD '00 — "Shiv" to those who know him — has built an internationally renowned program as director of the UCLA Cardiac Arrhythmia Center. A leading innovator of heart procedures with a penchant for quoting Sanskrit and legendary UCLA basketball coach John Wooden, Dr. Shivkumar found himself unable to let go of his disgust upon learning of the story behind the atlases in 2012. So, he channeled his indignation into a 10-year effort, with the help of UCLA colleagues, to create a new and better resource and make it freely available to anyone.

"What Shiv has done is inspiring," says Barbara Natterson-Horowitz, MD (RES '90, '92, FEL '95), a UCLA professor in the Division of Cariology and codirector of the UCLA Evolutionary Medicine Program. "In contrast to Pernkopf's documents of death, his anatomic atlases will be powerful tools for saving lives."

"EVEN IN A PROFESSION THAT IS SWORN TO PROTECT AND HEAL, HUMAN BEHAVIOR CAN SINK INTO VERY LOW AND DIABOLICAL PLACES."

And lastly, this is the story of an undertaking much larger than that ambitious initial act. Shortly before the release of the first of six planned volumes of the *Atlas of Cardiac Anatomy*, Drs. Shivkumar and Natterson-Horowitz established Amara Yad — a combination of Sanskrit and Hebrew translating to "The Immortal Hand." The project has set out to produce as many as 40 open-access anatomic atlases, leveraging scientific and technological advances to map the entire human body as a resource for future clinicians and researchers. More than that, the Amara Yad Project will educate medical students, trainees and others on past and present moral stains on the profession while supporting corrective measures that address the damage, restore trust and educate a new generation of physicians on their sacred duty to ethically serve their patients.

"Even in a profession that is sworn to protect and heal, human behavior can sink into very low and diabolical places," says Liebe Geft, who, just before her retirement as director of the Museum of Tolerance in October, hosted an event at the Los Angeles venue in honor of the Amara Yad launch. "We can never condone abuse of the power, authority and privilege placed in the hands of the medical practitioner for the sake of some spurious notion of scientific advance."

The Amara Yad Project epitomizes a central element of the mission of the David Geffen School of Medicine at UCLA, says Steven M. Dubinett, MD (RES '84), the school's dean. "We spend a lot of time on technical education, but there is a moral imperative to our jobs as well. We must clearly articulate our values in a way that lets our community of patients, as well as our students, trainees and physicians, understand that we are in health care because we're about healing — and that the best way to demonstrate that is not only through compassionate care, but also attention to our history," he says. "It makes me proud that we have faculty who have taken this on."

FOR DECADES, ANATOMISTS AND SURGEONS regarded *Topographische Anatomie des Menschen* (*Atlas of Topographical and Applied Human Anatomy)* with awe. Published in seven volumes from 1937 to 1960, the series — best known as the "Pernkopf atlas," after Dr. Pernkopf, the Austrian anatomist who oversaw the work — used hand-drawn illustrations to display human bones, muscles, nerves, tendons and tissue in vivid color and graphic, annotated detail. As both an artistic work and a clinical resource, the Pernkopf atlas was viewed as unsurpassable — lauded as late as 1990 by a *New England Journal of Medicine* review as "in a class of its own." *The Journal of the American Medical Association* declared it a "classic among atlases," calling its illustrations "truly works of art."

Only later would the source of the endless supply of cadaver subjects featured in the atlas' pages become clear.

In 1933, the year Dr. Pernkopf was appointed chair of anatomy at the University of Vienna, he joined the Nazi party. Weeks after the Anschluss, when Nazi Germany invaded and annexed Austria into the Third Reich in 1938, Dr. Pernkopf was appointed dean of the medical school. He proceeded to dismiss nearly 80% of the school's faculty, including all Jews and other Nazi opponents, three Nobel laureates among them. The remaining professors were required to swear an oath of loyalty to Hitler. In a chilling photograph taken just days after he assumed the leadership post, Dr. Pernkopf, dressed in full Nazi regalia with a portrait of Hitler behind him, stands at the lectern for his inaugural address to faculty, who greet him with the Nazi salute.

MILO MITCHELL

Dr. Kalyanam Shivkumar (left) and Dr. Barbara Natterson-Horowitz established Amara Yad to not only produce a series of new anatomic atlases, but also to educate future generations of physicians about moral stains on the medical profession and train them to ethically serve their patients.

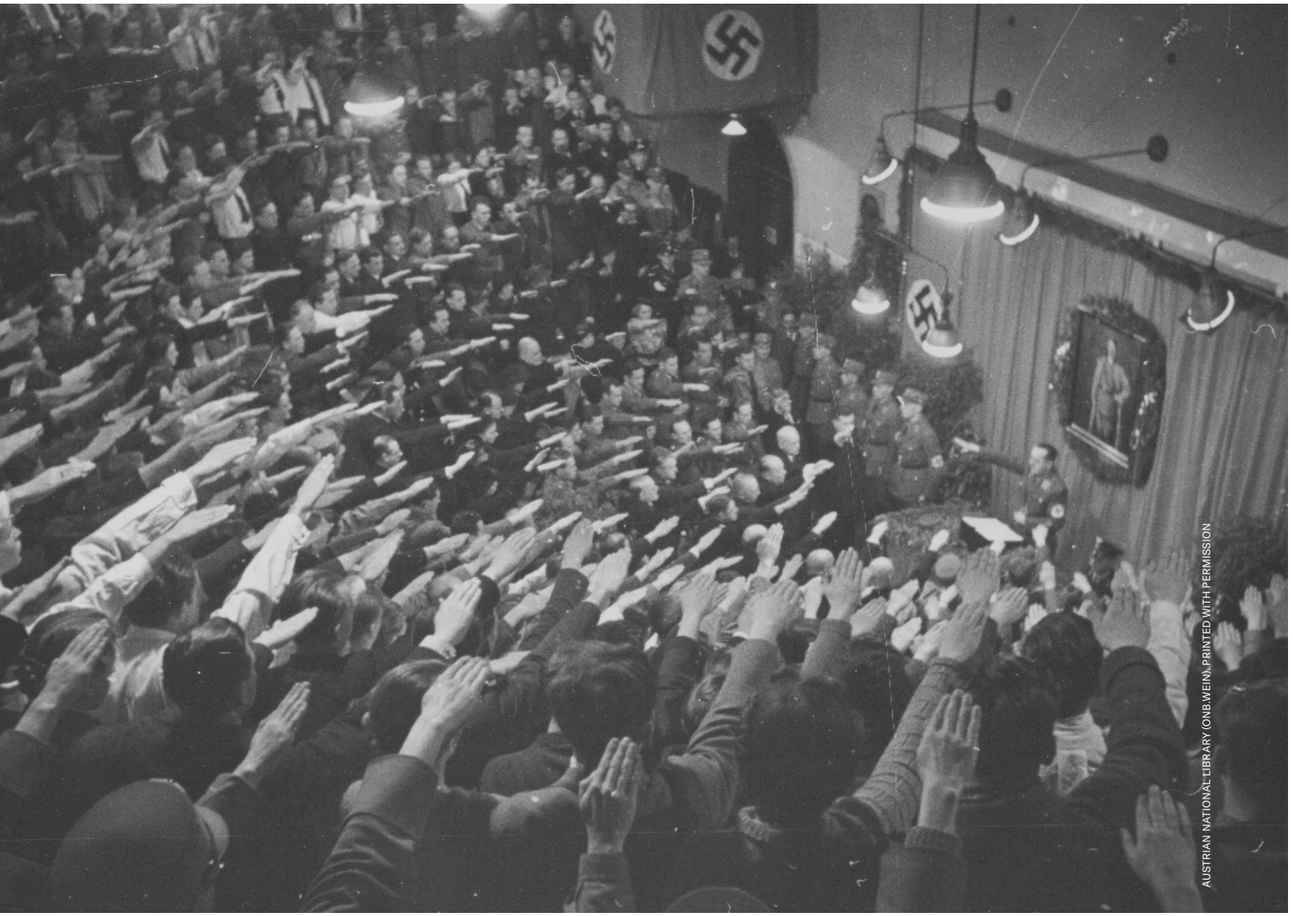
Although Dr. Pernkopf's vile past wasn't entirely a secret, decades passed during which his works remained widely used while their source was barely discussed. That began to change in the 1980s through revelations and disturbing questions raised in a series of journal articles and letters. Among other things, the four main medical artists employed by Dr. Pernkopf were themselves proud Nazis who, in the early editions of the atlas, signed their illustrations with swastikas and other Nazi symbols — crudely airbrushed out in later editions.

By the mid-1990s, new published papers questioned the source of the cadavers Dr. Pernkopf's team had used. After prodding from Yad Vashem, the World Holocaust Remembrance Center based in Jerusalem, the University of Vienna launched an investigation. The university's report confirmed the suspicions: From 1938 to 1945, the anatomy department under Dr. Pernkopf received at least 1,377 bodies of executed people, the majority of them political prisoners targeted by the Nazi regime. In all likelihood, the report concluded, images of the dissected bodies of these individuals were strewn across the atlas' pages.

"It became quite obvious that there was this extremely distressing suppressed history," Dr. Shivkumar says. "Pernkopf received the bodies of people imprisoned and murdered for trivial crimes — and these murders were timed for when it was convenient to the team that was using the bodies to make the atlases."

In the preface to the first edition, Dr. Pernkopf credits the vivid images in part to the access his group had to an endless supply of bodies. "He owns it, and not in an apologetic way," Dr. Natterson-Horowitz says. "Here is a physician, leader of a top medical school, with a total lack of awareness or shame about using these victims."

DR. SHIVKUMAR WAS UNFAMILIAR WITH THE PERNKOPF HISTORY in 2002, the year he established the UCLA Cardiac Arrhythmia Center. As an electrophysiologist, his focus is on abnormal heart rhythms. Although most arrhythmias are benign, an improperly beating heart can negatively affect blood



Dr. Eduard Pernkopf, at lectern dressed in a Nazi uniform, was greeted with a Nazi salute from faculty during his inaugural lecture as dean of the medical school of the University of Vienna.

flow to vital organs. As many as 6 million Americans have atrial fibrillation, which can produce palpitations, chronic fatigue and shortness of breath that severely impede quality of life. In the most lethal cases, untreated arrhythmias can lead to cardiac arrest or stroke.

Under Dr. Shivkumar's leadership, the UCLA Cardiac Arrhythmia Center has risen to international prominence, drawing referrals and consultations for some of the most complicated cases. Among other innovations, his group has developed new techniques for treating ventricular tachycardia, a potentially life-threatening arrhythmia in which the heart's lower chambers beat too quickly. Dr. Shivkumar is also a leader in the field of neurocardiology — the complex interplay between the nervous and cardiovascular systems and how targeting certain nerves can effectively treat ventricular arrhythmias. In September 2023, his group received an $11.5 million National Institutes of Health grant to study the use of nervous system modulation to prevent fatal arrhythmias.

It was Dr. Shivkumar's determination to venture outside the heart and into the body's nervous system that led him to Dr. Pernkopf.

In 1975, Wallace A. McAlpine, MD, a cardiac surgeon in Toledo, Ohio, published an anatomic atlas of the heart and coronary arteries, featuring highly detailed photographic images of the cardiac anatomy. "He converted the basement of his house into a studio to take pictures using Kodachrome film," Dr. Shivkumar says. "The result was a work of art."

Dr. Shivkumar came across that atlas not long after Dr. McAlpine's death in 2005, then went hunting for the original images. Ultimately, he found the collection of approximately 4,000 slides in the basement of the Cleveland Clinic Library, acquired them and digitized Dr. McAlpine's work, making it freely available.

But by 2010, Dr. Shivkumar recognized that nerve modulation was becoming a key to treating conditions involving the cardiovascular system, and as valuable as the McAlpine atlas was for mapping the heart, it was confined to that organ. So, Dr. Shivkumar began to inquire about anatomic resources that provided a detailed map of the peripheral nerves to assist his group in developing new procedures. And among those in the know, the definitive resource was clear. "All roads led to Pernkopf," Dr. Shivkumar says.

In 2012, a Canadian colleague gifted Dr. Shivkumar an entire set of the Pernkopf atlas, but in doing so shared the painful history. "Shiv was shaken by this," Dr. Natterson-Horowitz recalls of her friend and colleague. "He was offended by what happened, and by the fact that so many generations of physicians had used either Pernkopf or a newer atlas informed by the Pernkopf work, without knowledge of the history. He became fixated with getting to the bottom of this. I would come into his office to find him meeting with rabbis, trying to learn more."

More than a decade later, Dr. Shivkumar still becomes emotional when the subject is raised. "It's an insult to humanity," he says. "How can medicine have such a stain?"

KALYANAM SHIVKUMAR WAS BORN IN 1968 IN CHENNAI (then called Madras), located on the Bay of Bengal in southeastern India. His father was a mathematician, his mother a chemistry teacher. His grandfather had been a journalist who spent eight years in prison after being charged with sedition for publishing a newspaper directed by Mahatma Gandhi; he was released after India achieved independence in 1947 and went on to serve as a member of parliament.

Dr. Shivkumar still recalls his first exposure to the horrors of the Holocaust, when he was about 12. His grandfather brought in a friend, a British war photographer, to show pictures from the concentration camps. "You have to understand, in the part of the world I'm from, for millennia people from all religions, cultures and ethnic groups have coexisted," Dr. Shivkumar says. "I'll never forget seeing those photos and having my dad and grandfather tell me, quoting Primo Levi, 'This happened, it could happen again, and it could happen anywhere.'"

Dr. Shivkumar describes his own family as Hindu Brahmin, and he was raised reading Sanskrit. But, while he remains rooted in Hindu values, he dismisses the suggestion that his moral outrage at Dr. Pernkopf and other atrocities associated with the Holocaust is informed by his faith. "It's basic humanity," Dr. Shivkumar says. "Which faith would contradict this? Gandhi, when asked if he was a Hindu, said 'Yes, I am. I am also a Muslim, a Christian, a Sikh, a Buddhist and a Jew.'"

KNOWING THE SORDID ORIGIN STORY BEHIND THE PERNKOPF ATLAS RAISED A MORAL DILEMMA.

Dr. Shivkumar immigrated to the U.S. after graduating from medical school. He came to UCLA in 1995 as a cardiology and electrophysiology fellow. One of Dr. Shivkumar's first attending physicians was Dr. Natterson-Horowitz, then a first-year faculty member. She remembers him standing out for more than his technical skills. "Shiv had an unusual fund of knowledge," she says, "which included the ability to quote from wide-ranging sources — Maimonides and Osler, Ramakrishna and Shalihotra, and, after a few months at UCLA, John Wooden."

Whether he's delivering a professional talk or engaged in one-on-one conversation, Dr. Shivkumar is more likely than not to reference the legendary UCLA basketball coach. In his office at the UCLA Cardiac Arrhythmia Center, he proudly displays an autographed, framed poster of Wooden's oft-cited Pyramid of Success, the universal road map for team and individual excellence. "Wooden said it very beautifully — that he deeply cared about what is right, not who is right," Dr. Shivkumar says.

Another favorite Wooden quote spoke to Dr. Shivkumar as he began to ponder an effort to render Dr. Pernkopf's work irrelevant. The quote was about basketball but, like so many credited to the Wizard of Westwood, it applied to life: "It's not so important who starts the game, but who finishes it."

AFTER ITS CONTEMPTIBLE HISTORY WAS EXPOSED, the Pernkopf atlas remained highly influential — seen as an irreplaceable resource that could save lives, even if its authors shamefully disregarded them. It was published in five languages from 1960 to 1990. Although it went out of print after the history was revealed, secondhand copies — fetching, in some cases, thousands of dollars — can still be found, including on Amazon.

But if few copies of the originals remain in circulation, many Pernkopf images have appeared, in some form, in other publications. "For any anatomist who was creating an atlas following Pernkopf, it would be surprising if they had not consulted the Pernkopf atlas, and you can see the influences," Dr. Natterson-Horowitz says.

Knowing the sordid origin story behind the Pernkopf atlas raised a moral dilemma. If the books contained critical information that could be used for the benefit of patients, should they nonetheless be disregarded given that the information came from the exploitation of Nazi victims? On the one hand, some have argued, the knowledge derived from the Pernkopf work — and from other incidents of unethically produced science throughout history — can't simply be erased and applying the knowledge to improving lives honors the victims. Others counter that the evil doings can't be separated from the work and condoning the atlas' continued use opens the door to future moral and ethical transgressions that rely on the ends to justify the means.

In particular, the Pernkopf work was viewed as peerless when it came to its utility for peripheral-nerve surgeons. In 2015, Susan E. Mackinnon, MD, a leading nerve surgeon at Washington University in St. Louis who had long leaned on the illustrations to guide complex pain operations, approached Sabine Hildebrandt, MD, a pediatrician and lecturer in global health at Harvard Medical School and an expert in the history of anatomy during the Third Reich,

about her misgivings. They consulted leading scholars in Jewish medical ethics — including Rabbi Joseph Polak, who survived the Westerbork and Bergen-Belsen concentration camps as a child while losing his father and 30 other family members in the Holocaust.

The scholars issued a document on the case, known as the Vienna Protocol, that was formally adopted in 2017 by a group of experts at Yad Vashem. It concluded, based on Jewish law, that the Pernkopf images should be utilized if they were helping to save a life, as long as the patient was aware of the history and consented: "In this way, the dead are accorded at least some of the dignity to which they are entitled."

While Dr. Shivkumar found the conclusion "touching, and it shows how noble people can be," he had other ideas. "I was repulsed" at the thought of the Pernkopf works continuing to find circulation, he says. "It didn't sit with me very well."

AS DR. SHIVKUMAR SAW IT, ALL OF THE WRESTLING with how and whether the Pernkopf atlas should continue to serve as a resource was based on the premise that replacing Dr. Pernkopf's work was insurmountable. For decades, no serious effort had been undertaken to surpass it. Now, fueled by his moral outrage, Dr. Shivkumar was ready to summon his team to take up the challenge. "Why should we have to choose?" he says. There would be no ethical quandary if the product of Dr. Pernkopf's evil became obsolete.

Among the rabbinic scholars he consulted was Michael Berenbaum, an author and professor at American Jewish University in Los Angeles, where he is director of the Sigi Ziering Institute: Exploring the Ethical and Religious Implications of the Holocaust.

After several meetings with Dr. Shivkumar and his team, Rabbi Berenbaum says, "we were profoundly impressed by their commitment to providing an ethically normative means by which to guide surgeons and others grappling with the structure and nature of the heart."

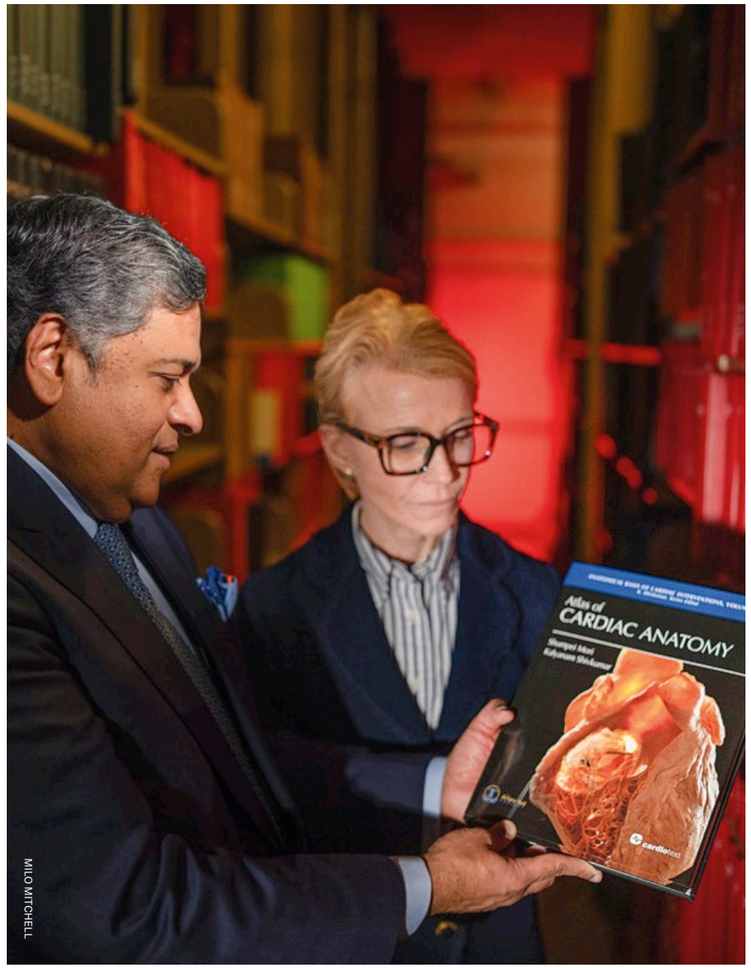
Rabbi Berenbaum likens knowledge stemming from Dr. Pernkopf's atlas to fruit from a poisonous tree. "These are ill-gotten gains," he explains. "Even though the information is essential, we would not want to be the beneficiary of those medical crimes. We want to find that knowledge in a manner that doesn't violate ethical decency, norms and propriety."

Dr. Shivkumar also reached out to Richard S. Panush, MD, a rheumatologist who had taken a public stand against the Pernkopf atlas after a 1995 *Annals of Internal Medicine* article set off the chain of events that led to the University of Vienna investigation. Dr. Panush, then at St. Barnabus Medical Center in Livingston, New Jersey, was deeply disturbed by the recollections of Edzard Ernst, MD, PhD, a former Vienna Medical School faculty member who wrote of the Nazi takeover of the university and raised the likelihood that Nazi victims were used as research subjects.

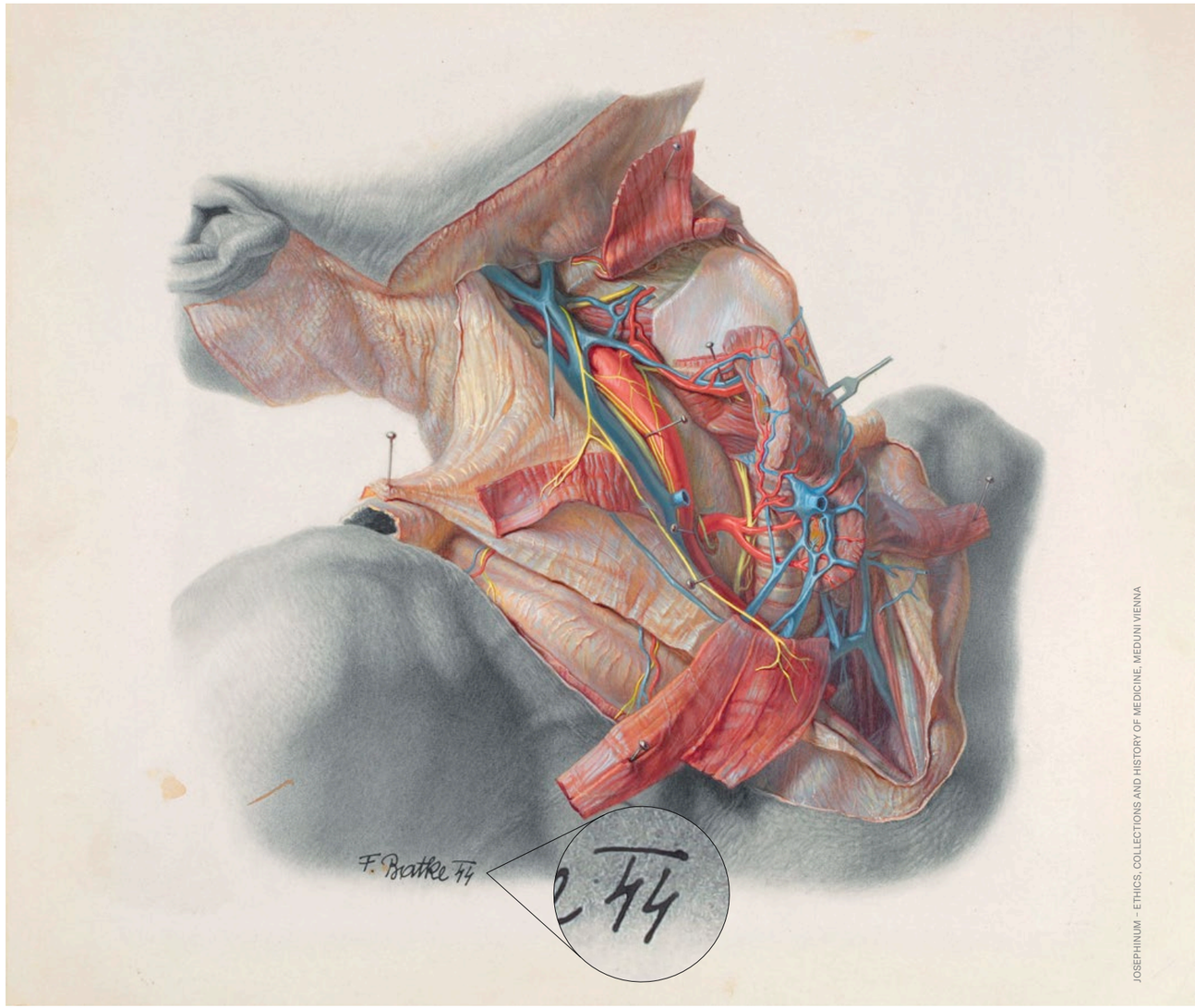
When Dr. Panush found the atlas in his hospital's library, he recoiled. He wrote a letter in response to the *Annals* article, detailing the actions he took following that discovery — including getting his institution to remove the atlas from circulation, place it in a case with a historical explanation and offer the display in a cautionary context.

Dr. Shivkumar struck up a friendship with Dr. Panush, who is now an emeritus professor at USC, and has used his sentiments as a call to action. "Dr. Panush said our obligation is to repudiate Pernkopf and all he stood for," Dr. Shivkumar says. "He said we cannot forget that Pernkopf's character and actions were so abhorrent as to irrevocably taint this work. I share that belief."

Drs. Shivkumar and Natterson-Horowitz display the first volume of the new atlas created by the Amara Yad project.



MILO MITCHELL



JOSEPHINUM – ETHICS, COLLECTIONS AND HISTORY OF MEDICINE, MEDUNI VIENNA

An original illustration for the Pernkopf atlas displays the double lightning bolt *Siegrune* of the SS in the illustrator's signature.

So, in 2012, Dr. Shivkumar set out to surpass Dr. Pernkopf. He vowed that he and his team would create an anatomic atlas of the entire body, starting with the heart. They would make it open access, so that all members of the medical and surgical community could benefit. And they would remove the need for anyone to consult the work of Dr. Pernkopf — the fruit from the poisonous tree. "When you discover that the foundation of what you thought of as a beautiful building is rotten, you don't keep building on it," Dr. Shivkumar says.

"What Shiv is doing is absolutely heroic," Dr. Panush asserts. "He has totally changed the conversation. If the atlas becomes obsolete, all of these other issues become moot."

Of course, there was a reason no one had tried to surpass the Pernkopf atlas before. "When I told the anatomists we were doing this, they said it was impossible," Dr. Shivkumar says. "But as electrophysiologists, we have not come across any arrhythmia we're not able to manage. So, I said, 'We have done harder things. This is doable.'" ●

***Dan Gordon** is a frequent contributor to U Magazine. His two-part story, "UCLA In the Time of AIDS," received the Robert G. Fenley Gold Award for Excellence in Writing and "Best of Show" from the Association of American Medical Colleges.*

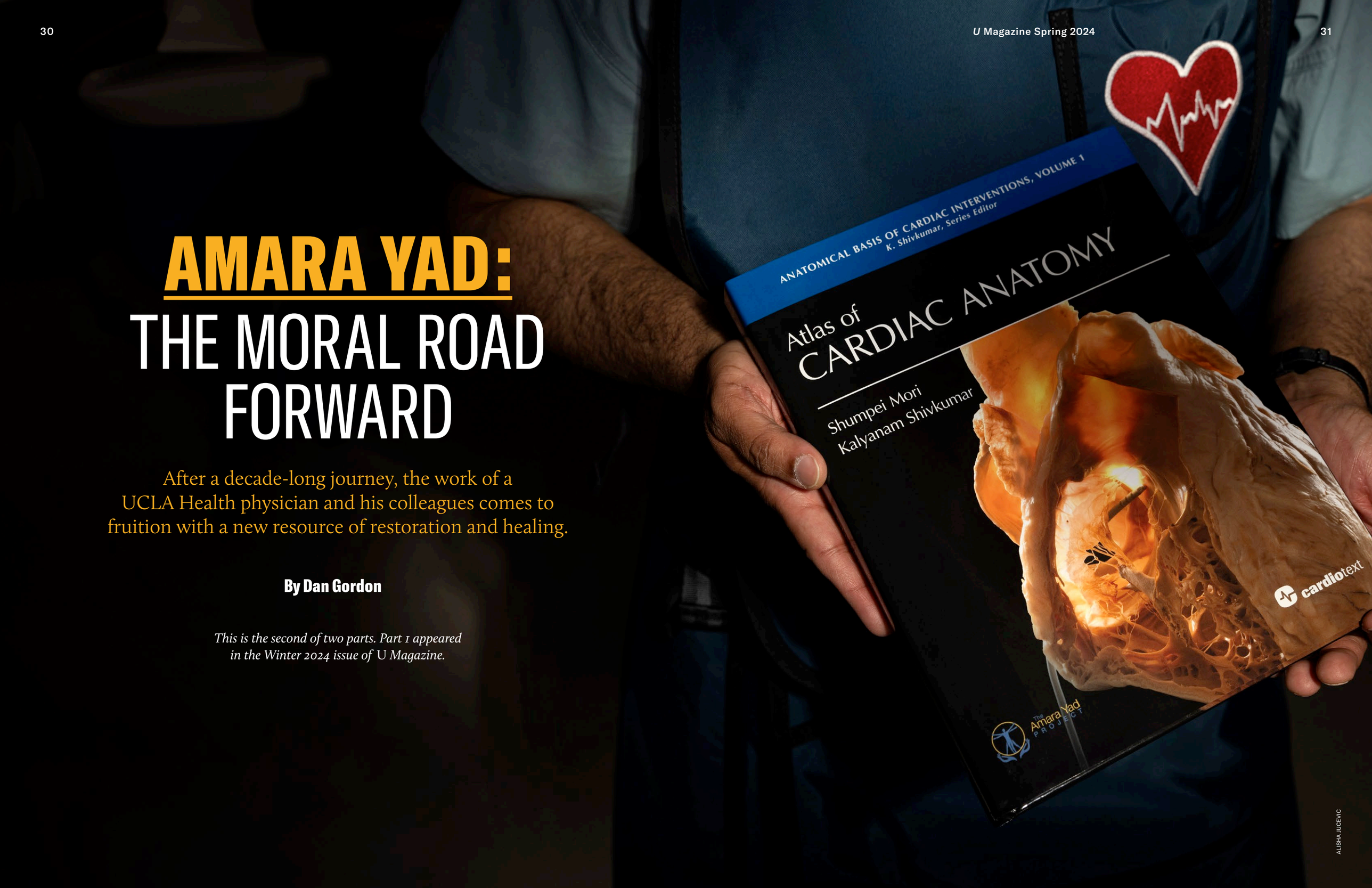
Part 2 of this article will chronicle how the UCLA team surpassed the Pernkopf atlas and the larger ambitions of the Amara Yad Project to honor the victims of medical exploitation through corrective action.

AMARA YAD: THE MORAL ROAD FORWARD

After a decade-long journey, the work of a UCLA Health physician and his colleagues comes to fruition with a new resource of restoration and healing.

By Dan Gordon

This is the second of two parts. Part 1 appeared in the Winter 2024 issue of U *Magazine.*



ALISHA JUCEVIC

When Dr. Eduard Pernkopf completed the first installment of his seven-volume *Topographische Anatomie des Menschen* (*Atlas of Topographical and Applied Human Anatomy)* in 1937, the discovery of penicillin was several years away, and Jonas Salk was a third-year medical student, 15 years from developing the vaccine that would eradicate polio. Imaging techniques that are common today — ultrasound, CT, MRI — were, if they were considered at all, merely science fiction speculation.

And yet, well into our current century, what was known simply as the "Pernkopf atlas" continued to be regarded as the preeminent resource of its kind. Mapping the human form down to the most minute detail through exquisite hand-drawn illustrations, the atlas was acknowledged as a masterpiece of both science and artistry. But the horrific nature of the authors and their methods had now become clear: Dr. Pernkopf, an Austrian anatomist who served as dean of the University of Vienna's medical school while overseeing the atlas' creation, was an avowed Nazi, as were the artists he employed. Many of the bodies portrayed on the atlas' pages were victims of Nazi terror, their executions often timed for when Dr. Pernkopf's team needed more subjects.

Even as circulation of the original volumes waned once the abhorrent details came into focus through a series of revelations in the 1980s and 1990s, their influence persisted. "For many years, Pernkopf was to anatomy what Bach was to music," says Kalyanam Shivkumar, MD (FEL '99), PhD ('00), director of the UCLA Cardiac Arrhythmia Center. "Everything after Pernkopf was a version of Pernkopf."

Part one of this story chronicled how Dr. Shivkumar ("Shiv" to those who know him), an internationally renowned electrophysiologist and leading innovator of heart interventions, became deeply disturbed upon learning that the premier anatomic atlas for the types of nerve procedures he wanted to develop carried such a vile origin story. Unable to let go of his revulsion, Dr. Shivkumar decided to embark on a decade-long effort, with his UCLA colleagues, to surpass what many had deemed unsurpassable — rendering Dr. Pernkopf's work obsolete through a series of original anatomic atlases and making them available to colleagues around the world via online, open-access publishing.

Part two of our story touches on both that journey and its evolution into something greater: Amara Yad (a combination of Sanskrit and Hebrew translating to "the immortal hand"), an initiative aiming to restore the sanctity of the doctor/patient relationship through education and actions that address historic transgressions.

"THERE'S AN OLD SAYING, 'THE EYES CANNOT SEE WHAT THE MIND DOES NOT KNOW.' WITHOUT AN ATLAS, YOU CAN'T INTERPRET. IMAGING DATA WON'T BECOME KNOWLEDGE, AND KNOWLEDGE WON'T BECOME WISDOM WITHOUT PROPER INTERPRETATION."

DR. KALYANAM SHIVKUMAR

ANATOMY IS THE OLDEST CLINIcal discipline, dating back to at least the third century B.C., and it continues to serve as the starting point in the education of first-year medical students. But as medicine advanced at breakneck speed in the latter part of the 20th century, some questioned its relevance to clinical practice.

"During medical school, I was told time and again by professors that anatomy was a dead science," recalls Jamil Aboulhosn, MD '99 (RES '02, FEL '05, '06), director of the Ahmanson/UCLA Adult Congenital Heart Disease Center. "They said if you wanted to rise in academic medicine, you had to go subcellular, to DNA and RNA — that everything about anatomy was already known. What's funny is that about a decade after that, it became clear that anatomy was still at the center of medical innovation and advancement."

As a pathologist who subspecializes in cardiovascular diseases, Michael Fishbein, MD (RES '75), has always relied on anatomy for his work. But many specialists had little use for the discipline, he notes, until advances in imaging led to the rapid growth of interventional procedures among cardiologists, radiologists and others — necessitating a detailed and nuanced grasp of anatomy for diagnosis, interpretation of images and minimally invasive treatments. "All of a sudden, everyone wants to come and see hearts," muses Dr. Fishbein, Distinguished Professor Emeritus of Pathology and Medicine. "If, rather than opening up the chest, they can go in through the vessels, they have to know where they're going and how to get there."

ALISHA JUCEVIC

"Human anatomy isn't going to change, but our understanding of it gets better," says Dr. Kalyanam Shivkumar.

An anatomic atlas, be it the ill-gotten set of volumes produced by Dr. Pernkopf or the one Dr. Shivkumar and his team set out to replace them with, provides a road map to be studied prior to heart procedures that rely on catheter-based techniques involving the coronary arteries and veins, or that target the cardiovascular nervous system. In Dr. Shivkumar's world, which involves treating patients with complex, life-threatening arrhythmias, knowing every nook and cranny makes all the difference. When performing a catheter-based treatment on a young person with an abnormal rhythm in a sensitive region of the heart, missing the target by a few millimeters can result in the patient needing a pacemaker for life.

And on that score, high-tech imaging doesn't replace the anatomic road map. "There's an old saying, 'The eyes cannot see what the mind does not know,'" Dr. Shivkumar says. "Without an atlas, you can't interpret. Imaging data won't become knowledge, and knowledge won't become wisdom without proper interpretation. Human anatomy isn't going to change, but our understanding of it gets better."

WHEN DR. SHIVKUMAR TOLD anatomists of his intention to create a map of the human heart that would render the Pernkopf atlas and its derivatives moot, he encountered heavy skepticism. With their arresting images and painstaking detail, the volumes created by Dr. Pernkopf and his group were considered unbeatable. Even Dr. Shivkumar, for all his confidence, recognized the daunting task. "It was like climbing a mountain," he says.

Dr. Shivkumar never doubted that he could assemble the expertise. As his co-author on the first of seven planned volumes of *Atlas of Cardiac Anatomy*, he recruited Shumpei Mori, MD, PhD, a physician-scientist who specializes in cardiac anatomy and advanced clinical imaging at the UCLA Cardiac Arrhythmia Center. Over the course of the next decade, more than a dozen faculty and trainees would devote significant time to climbing the mountain.

One of the major challenges to producing a comprehensive resource on cardiac anatomy is the need to acquire a sufficient supply of specimens — the donated hearts of deceased patients — to capture the organ's variations. For certain structures, understanding all of the possibilities can require dissecting a couple hundred organs. Dr. Pernkopf faced no such challenge, relying on his connections with the Nazi regime for procurement. At UCLA, specimens were ethically obtained from a variety of sources, including OneLegacy, the nation's largest organ-procurement organization, which provided donor hearts unsuitable for transplantation; the National Institutes of Health, which also helped to fund the work; and the UCLA Donated Body Program.

Foundational to the effort was Dr. Shivkumar's acquisition and digitization of approximately 4,000 slides that had been languishing in the basement of the Cleveland Clinic Library — detailed images taken by the late cardiac surgeon Wallace A. McAlpine, MD, for an anatomic atlas of the heart published in 1975. While that work had provided great utility for its time, an update was needed. "Dr. McAlpine's atlas was published when the major treatment was open-heart surgery," says Peter Hanna, MD (FEL '21, '23), PhD '21, a UCLA cardiac electrophysiologist who contributed to the new atlas. "The field of interventional cardiac electrophysiology didn't exist."

Today, the diagnosis and treatment of heart rhythm disorders typically involves the placement of catheters and the delivery of radiofrequency energy to modify the heart's architecture. "The first goal is always to do no harm," Dr. Hanna says. "And because we don't have direct visualization like a cardiac surgeon would, we have to know where we are when looking at an image."

Beyond making use of Dr. McAlpine's photography, the group headed by Drs. Shivkumar and Mori replicated his "perfusion-fixation" technique. Upon obtaining a donor heart — often in response to a call that came in the middle of the night, from a hospital two or more hours away — it was crucial to preserve its three-dimensional structure; this required inserting plastic tubes hooked to a pump to maintain pressure perfusion for 24 hours in a cold room.

Once the heart was "fixed," it was brought to a photography studio set up by Dr. Mori. With the heart mounted on a tripod atop a rotational table and illuminated by six adjustable LED light sources, Dr. Mori used a digital SLR camera with a 200-millimeter lens to systematically photograph the organ in various anatomic positions to create the undistorted versions featured in the atlas. Dissections were made depending on which chamber of the heart and which interventional procedure was to be covered.

"To show the progressive dissection with GIF clips, we needed to dissect the heart without changing its position on the tripod, and at every stage of the dissection we needed to capture the images," Dr. Mori explains. "This process of preparation, dissection and recording required patience, meticulousness, precision and time."

WHILE HE WAS OUTWARDLY CONfident in his team's ability to render the Pernkopf Atlas moot, Dr. Shivkumar admits harboring some initial concerns. "In the first year or two, it seemed very daunting," he says. But as his group approached the midway point of the 10-year undertaking, "I knew Pernkopf could be beaten."

Atlas of Cardiac Anatomy: Anatomical Basis of Cardiac Interventions, Volume 1, published in September 2022, features more than 200 full-color photographs of the human heart and its adjacent structures meant to serve as a foundational study of cardiac anatomy and a guide for those caring for patients with heart disease. In addition to the original high-resolution images and the previously unpublished, restored works from the McAlpine collection, the atlas includes 25 anaglyphs — three-dimensional images viewable with 3D glasses.

> **"OUR ATLAS IS CLINICAL CARDIAC ANATOMY BY CARDIOLOGISTS, WHICH MAKES IT DIFFERENT FROM TEXTBOOKS OF BASIC CARDIAC ANATOMY WRITTEN BY ANATOMISTS."**
>
> DR. SHUMPEI MORI

One of the recognized strengths of the Pernkopf atlas was its detailed display of the peripheral nervous system — over the years, nerve surgeons were particularly reliant on the images for their complex operations. But the first volume of the UCLA atlas provides a tour through parts of the anatomy Dr. Pernkopf's group couldn't have envisioned would bear fruit. The enhanced images establish new road maps not only for electrophysiologists like Dr. Shivkumar and his colleagues, but also for neurosurgeons, thoracic surgeons, pain-management experts and others. In the book's foreword, Francis E. Marchlinski, MD, of the University of Pennsylvania, and William G. Stevenson, MD, of Vanderbilt, describe viewing anatomic structures heretofore shown as silhouettes on fluoroscopic imaging: "It is like having the lights turned on in a dark, yet familiar room."

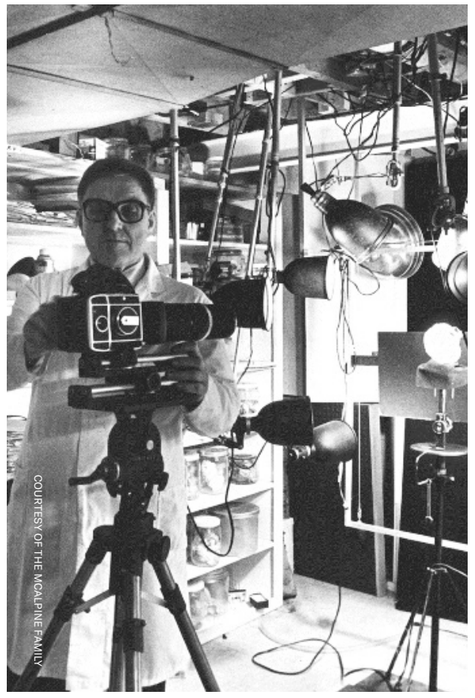
"Our atlas is clinical cardiac anatomy by cardiologists, which makes it different from textbooks of basic cardiac anatomy written by anatomists," Dr. Mori explains. "Anatomic atlases, including Pernkopf's, are often shown using illustrations or with collapsed hearts that distort the cardiac anatomy. By showing the structural anatomy in far more detail and captured from clinically relevant directions, then sharing it without paywalls, our atlas can ensure safe and effective procedures for patients around the world."

Dr. Fishbein, the UCLA cardiovascular and pulmonary pathologist who assisted in the anatomic studies, has seen his share of atlases. "None go into the detail, and have such beautiful images, as this one," he says. Dr. Fishbein's participation was personal as well as professional: His parents and sister were Holocaust survivors, and he was born after World War II in Belgium, where they had gone into hiding.

For Dr. Shivkumar, the technical superiority of *Atlas of Cardiac Anatomy* over the Pernkopf atlas tells only part of the story. "Our atlas comes from people who have seen humans suffer and have helped to make lives better," he says. "Pernkopf's came from Nazi murderers."

BY THE TIME HIS GROUP WAS SET to publish the first volume, Dr. Shivkumar was entertaining a broader vision. He began to engage in conversations with his friend and colleague Barbara Natterson-Horowitz, MD (RES '90, '92, FEL '95). A professor in the Division of Cardiology and co-director of the UCLA Evolutionary Medicine Program, she also holds a master's degree in the history of science and co-authored *The New York Times* bestseller *Zoobiquity: The Astonishing Connection Between Human and Animal Health.*

"I was moved by Shiv's sense of outrage that a physician, the head of a major medical school, was abusing trust," Dr. Natterson-Horowitz recalls. "More than almost any physician I know, Shiv is driven by purpose — here to remove this moral stain. As we had more conversations, I saw that Amara Yad could



COURTESY OF THE MCALPINE FAMILY

ALISHA JUCEVIC

Cardiac surgeon Dr. Wallace A. McAlpine (left) set up a studio in the basement of his Ohio home to photograph human hearts for his *Heart and Coronary Arteries: An Anatomical Atlas for Clinical Diagnosis, Radiological Investigation, and Surgical Treatment*, published in 1975. At UCLA, Dr. Shumpei Mori (right) established his own digital studio adjacent to his lab in the Centers for Health Sciences, where he took more than 50,000 photographic images for the new *Atlas of Cardiac Anatomy.*

ATLAS OF CARDIAC ANATOMY/DR. SHUMPEI MORI

To preserve their proper three-dimensional structure to be photographed without distortion, Dr. Shumpei Mori "fixed" donated human hearts by inserting plastic tubes hooked up to a pump to maintain pressure perfusion for 24 hours in a cold room.

extend beyond correcting just this one terrible event in the history of medicine."

In early 2022, Drs. Shivkumar and Natterson-Horowitz began building out their vision for Amara Yad as a campuswide initiative, based in the UCLA Cardiac Arrhythmia Center, that would honor the victims of medical exploitation through corrective action.

The first goal: extending the work inspired by the Pernkopf-era atrocities. Amara Yad intends to publish a series of anatomic atlases — free to all in support of medicine's life-saving mission. Volume 1 of the *Atlas of Cardiac Anatomy* lays the foundation for the cardiac atlases set to follow in rapid succession. The spring 2024 release of the series' second volume, *Atlas of Interventional Electrophysiology: Correlative Anatomy*, by Drs. Shivkumar, Mori and Roderick Tung of the University of Arizona Health Sciences, serves as an anatomic guide for the treatment of complex arrhythmias. Future volumes will bring in other authors from UCLA and beyond to cover structural heart disease, imaging, cardiac surgery, cardiac neuroanatomy and congenital heart problems.

But the heart is just the beginning. "In science we say function follows form," Dr. Shivkumar says. "We are entering an era in which many fields of medicine are going to be revolutionized by modulating nerves. Mapping the wires that connect various parts of the body — the nervous system — will have an impact on all of medicine."

To complete the volumes of what Dr. Shivkumar calls "the internet of the human body," Amara Yad is inviting collaborations with experts from multiple universities, supported by private and extramural funders. The Amara Yad Challenge, to be held in summer 2024, will bring in representatives from several medical schools to discuss the need and the task ahead. "This should be a multi-university, multinational effort to build on this portal of knowledge," Dr. Shivkumar says.

AMARA YAD'S BROADER VISION stems from the reality that the evils associated with the Pernkopf atlas are by no means isolated chapters in the annals of the medical profession.

During the Holocaust, physicians were enlisted to conduct medical experiments on unwilling victims in concentration camps and to develop race-based health policies, including mass sterilization of people viewed as "lesser" humans. Prior to the systematic murder of Jews, doctors and nurses were complicit in Aktion T4, the Nazis' "euthanasia" program, in which an estimated 250,000 individuals with psychiatric, neurological or physical disabilities were put to death to "cleanse" the Aryan race; German psychiatrists were charged with signing the papers that consigned institutionalized persons to death.

And the American medical community has committed shameful acts of its own. Perhaps the most notorious was the Tuskegee Syphilis Study. From 1932 to 1972, the U.S. Public Health Service, in a study designed to learn more about the effects of untreated syphilis, allowed 400 Black men to unknowingly go without care. "The history of medicine, both distant and recent, includes too many instances in which the absence of a moral view led to catastrophic consequences, and those violations have carry-over effects," Dr. Natterson-Horowitz says. "To optimize health, patients must believe their physician is always looking out for their best interests. When the sanctity of that relationship is breached by anyone, it affects all of us."

HONOR AND RESPECT

IT'S BEEN MORE THAN 15 YEARS SINCE JUSTIN HAYASE, MD '12 (FEL '19, '21), was a first-year medical student at UCLA. But no one who has gone through medical school forgets their first encounter with those who donated their remains in anatomy lab.

When it comes to medical education, no textbook can match the visual and tactile experience of handling a cadaver. "Shiv teaches this constantly — you have to understand how anatomical systems are formed in three dimensions," says Dr. Hayase, a UCLA Health cardiac electrophysiologist who trained under Kalyanam Shivkumar, MD (FEL '99), PhD ('00), director of the UCLA Cardiac Arrhythmia Center.

The cadavers so essential to the earliest lessons of every aspiring doctor come from individuals who choose to donate their remains, or the remains of deceased loved ones, to advance medicine and science. Whereas the Pernkopf atlas Dr. Shivkumar seeks to replace exploited non-consenting individuals murdered by the Nazi regime, today's UCLA medical students take extra time to recognize the humanity before them.

"I vividly remember sitting with my classmates before we ever set foot in the anatomy lab, talking about how these were bodies of people who wanted to help others, and that they needed to be treated with the utmost respect," Dr. Hayase recalls. "At first, we were all nervous and afraid to touch anything. But over time, you learn so much and become grateful to the person in front of you."

Dr. Hayase, who is helping to plan Amara Yad rotations for UCLA medical students, remembers that at the end of the weeks-long experience, his class held a "ceremony of thanks" in which students spoke about their gratitude for the anonymous donor they had handled, providing them with a symbolic send-off.

In its rollout of the anatomic atlases designed to advance human health while addressing past wrongs, Amara Yad reaffirms that gratitude while spelling out its mission: *We dedicate these atlases to the noble humans who have so generously willed their bodies for this use.... [W]e also honor the subjects of Pernkopf's atlases who were victims of Nazi terror by shifting the focus away from the images of their bodies and toward their enduring human dignity.*

— Dan Gordon

Numerous studies have shown that the legacy of Tuskegee and other injustices — including more recent evidence indicating, for example, that Black patients are undertreated for pain and that LGBTQ+ patients continue to report significant levels of discrimination from providers — is a high level of distrust that too often results in avoidance of needed care. Breaches in trust can also undermine advice issued by physicians and public health authorities. The anti-vaccine movement was catalyzed by a widely publicized 1998 study by the former physician and discredited British academic Andrew Wakefield and colleagues, published in the prestigious medical journal *The Lancet*, that purported to show a link between the measles, mumps and rubella vaccine and autism. Although the authors were later found to have committed a series of ethical transgressions and misrepresented their results, leading the journal to fully retract the paper in 2010, the study — whose findings were never replicated — continues to be cited by vaccine skeptics.

Amara Yad plans to use such acts of medical immorality as both educational tools and inspiration to bring about moral correctives, just as the Pernkopf atlas has provided fuel for the unprecedented endeavor to produce an open-access anatomic map of the human body for the benefit of patients around the world. While the contours of that model remain under construction, a key component will involve educating students at the David Geffen School of Medicine at UCLA. That will include a rotation in which students learn from medical ethicists and historians about the sacred nature of the physician/patient bond and cases in which it was violated, as well as participating in reparative research, education and community-outreach projects.

AT THE MEDICAL UNIVERSITY OF Vienna, where Dr. Eduard Pernkopf served as dean — dressing in full Nazi regalia and commanding his faculty to swear an oath of loyalty to Adolph Hitler — the sordid history serves as a cautionary tale for today's medical students. They learn about the Pernkopf history both in anatomy class and on a visit to the Josephinum, the medical history museum located on the university campus, which displays the original Pernkopf atlas drawings and proofs, along with accounts of the unpleasant truths behind them.

> **"MORE THAN ALMOST ANY PHYSICIAN I KNOW, SHIV IS DRIVEN BY PURPOSE — HERE TO REMOVE THIS MORAL STAIN."**
>
> DR. BARBARA NATTERSON-HOROWITZ

Juxtaposed with the Pernkopf works, the Josephinum houses a large collection of three-dimensional Italian wax anatomic models dating to the museum's origins in 1785 under Joseph II of Austria, Holy Roman Emperor. "Our students can see the anatomy drawings with swastikas on them and learn about the darkest times of medicine and humanity, then learn by walking through the most beautiful art pieces from the past," says Christiane Druml, the UNESCO Chair of Bioethics at the Medical University of Vienna, who also serves as director of the Josephinum.

The Medical University of Vienna has embraced Amara Yad, its leadership having visited UCLA and consulted with Dr. Shivkumar. "Today's doctors face so many time constraints that their ability to talk with colleagues and superiors about ethical issues is often limited," Druml says. "But it's important that they not only learn about the past, but also discuss the many new issues that come up in an era of rapid change, such as artificial intelligence and genome editing."

As technology continues to usher in possibilities that were once unthinkable, ethical questions are being raised that couldn't have been fathomed during the time of Dr. Pernkopf. "Physicians have much more power today," says Rabbi Michael Berenbaum, a professor at the American Jewish University in Los Angeles and one of many experts Dr. Shivkumar has consulted for Amara Yad. "We need to remind everyone that people who think only of science without considering the ethical consequences of the knowledge they gain bring shame to the profession."

Under Dr. Shivkumar's leadership, the UCLA Cardiac Arrhythmia Center has earned an international reputation for excellence. Its innovations in the treatment of abnormal heart rhythms have saved countless lives, drawing cardiologists from around the world to learn the techniques. But Dr. Shivkumar believes Amara Yad has the potential to be the center's most important contribution. "The foundation of medicine is ethics," he says. "Without it, nothing else matters." ●

Dan Gordon *is a frequent contributor to U Magazine. His two-part story, "UCLA In the Time of AIDS," received the Robert G. Fenley Gold Award for Excellence in Writing and "Best of Show" from the Association of American Medical Colleges.*

To read Part 1 of this story, scan the QR code or go to: ***ucla.in/amara-yad-part-1***

ALISHA JUCEVIC

"The history of medicine, both distant and recent, includes too many instances in which the absence of a moral view led to catastrophic consequences, and those violations have carry-over effects," Dr. Barbara Natterson-Horowitz says.