ing," Goldberger explains. "At first glance it just seems like a random occurrence in the overall pattern. But if you study that wobble, you may find that it's part of a large-scale pattern of its own." Such "regular irregularity" can also be mapped into images called fractals (see "Glued to the Set," January-February 1989, page 27). Fractals repeat one small pattern over and over, creating increasingly larger-scale images of the original element. Many parts of the body, including the passageways in the lungs, the blood vessels, and the nerves, are fractal in form.

Most doctors consider a steady heart rate to be healthy. Goldberger saw evidence that healthier hearts actually show fluctuation between beats.

That there is actual chaos in physiological systems, however, is a revolutionary concept, one that seems to throw the proverbial monkey wrench into theories proposing that the body works like a machine—running smoothly and predictably when healthy and showing fluctuations only when disrupted. This has been a popular perspective in modern medicine. For example, the late Walter B. Cannon of Harvard Medical School proposed that all physiological systems work to reduce variability and maintain constancy of function, and that when some stressor—such as disease or trauma—perturbs them, they try to return to a "normal" condition of homeostasis.

"The belief in homeostasis has greatly shaped the practice of modern cardiology," explains Goldberger, a cardiologist himself. "In analyzing heart rate, for instance, we are taught to look at the overall average." Most doctors consider a steady rate to be healthy, and either ignore fluctuations or see them as a problem. Goldberger and his colleagues, however, have been scrutinizing "the noise in the data"—the variation in intervals between heartbeats.

"Those dynamic changes are very complex but can be quantified," he says, and the results are intriguing. Healthier hearts actually show *more* fluctuation between beats. In studies of patients with severe heart conditions, Goldberger and his colleagues saw evidence that a switch to a more regular rhythm signaled an increased susceptibility to a lethal heart attack. Goldberger has also found evidence that cocaine overdose and space sickness may cause the heart to beat more steadily.

Chaos, Goldberger says, may allow a system to be more adaptable. Along with Lewis Lipsitz, assistant professor of medicine, he recently applied this theory to a review of data on aging. Goldberger and Lipsitz suggest that the aging body loses complexity in the dynamics of its organ functions and that this loss impairs its ability to adapt to physiologic stress. "Our theory is supported by evidence that many processes—including cardiovascular control, pulse-controlled hormone release, and electrical impulses measured in the brain—show less complex behavior as people age," says Goldberger. For instance, although two research subjects—a 22-year-old woman and a 73-year-old man—had average heart rates that were nearly identical, the woman's heart beat had more than twice as much "approximate entropy," a measure that reflects the amount of chaos in the system.

Goldberger and his colleagues have extended the chaos approach to a number of other areas, including an analysis of how the genetic code distributes its building blocks along a strand of DNA. Overall, he feels that fractals and chaos may be essential to many biological systems. "In a way, it's intuitive," he explains. "After all, the key to survival is adaptability, and chaos may signal just that."

—Malorye Allison

Six Million People Plus Two

Coming together at a four-day meeting, offspring of Nazis and Jewish survivors of the Holocaust discover the commonality of their experiences.

To inaugurate the future, they began with a remembrance of the past. Eleven children of Holocaust survivors and eleven children of Nazis—meeting in early September at the Harvard Medical School—circulated a solitary burning candle, lighting from its flame the candle each held. Then organizers Mona Weissmark, a lecturer and researcher on psychology in the department of psychiatry and the daughter of concentration camp survivors, and Ilona Kuphal, an actress and the daughter of a Waffen S.S. officer, offered

KEN WINOKUR

Mona Weissmark, left, daughter of concentration camp survivors, and Ilona Kuphal, daughter of a Nazi officer, plan a new chapter in their futures.

their story. "Ilona and I wanted our relationship and the jointness of planning this to be the symbol of what we hoped would occur," Weissmark said later. "We talked about the past—how we had inherited a past we never asked for—and how we were free to create a future together. What future did we want to create?"

They also acknowledged the difficulty of the task ahead. "When a child of a Nazi meets a child of a survivor, there's six million people between them," says Weissmark. "The relationship has to be fostered gently, with a great deal of honesty and trust."

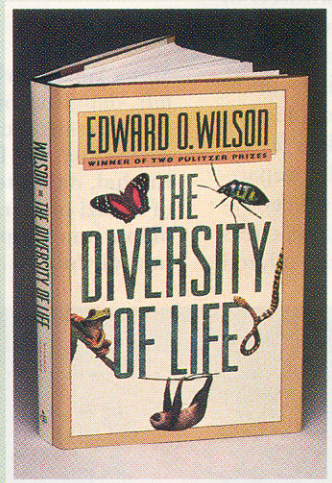
Their relationship began over a year ago when Weissmark met Kuphal and discovered Kuphal had been pursuing a quest similar to her own. "I was always searching, always talking," says Kuphal. "When I came to the States and met Jewish people, I felt free for the first time to discuss it. In Germany it was taboo."

As a result of their "shared vision," Kuphal joined Weissmark in planning the joint meeting, locating and talking with children of Nazis in Germany. The exhaustive interviews conducted by both women led to an article—"Psychosocial Themes in the Lives of Children of Survivors and Nazis" (currently under review by the *American Journal of Orthopsychiatry*)—as well as an understanding of how the two sides might begin to "see the world through the eyes of the other." "For example, to the child of a Nazi, we would ask, If you were a child of a survivor, how would you feel coming to this meeting?" explains Weissmark.

Attendees came from a wide range of professional, social, and economic backgrounds, traveling at their own expense from as far away as Australia and Israel for the emotional four-day meeting, which was sponsored by the Medical School's department of psychiatry at Cambridge Hospital. Dr. Daniel Giacomo, a psychiatrist and researcher at the Medical School who is neither Jewish nor German, facilitated group discussions, but there were also creative workshops and brainstorming sessions. The most provocative hours came on the second day, when Giacomo borrowed a technique commonly used in family therapy and asked participants to "sculpt" a concentration camp scene.

Two leaders, one a child of a Nazi and one a child of a survivor, chose others to pose in the scene, often switching "sides," so, for example, a child of a Nazi played a mother separated from her child. The exercise aroused "mixed emotions," explain Weissmark and Kuphal. Participants were suddenly, in a sense, inside their history.

"As children we got images (of concentration camps) by reading books or seeing pictures," says Weissmark, who remembers her mother weeping



KEN WINOKUR

Wilson's book is part of a series called "Questions of Science." "We felt we could assemble a group of scientists, working on the frontiers of knowledge, who could reach an international audience," said one of the editors, quietly ecstatic over this success story. "We're getting large orders from all over the country."

Life: A Bestseller?

Not many academic books published by university presses go through two printings that put 25,000 copies in circulation a month before publication. But *The Diversity of Life*, by Harvard's Edward O. Wilson, did just that, attracting enough attention to make *The Boston Globe* devote a front-page story to Wilson's work on September 15—almost a full month before the book's official publication by Harvard University Press. And it has been made a selection of the Book-of-the-Month Club. It will be published almost simultaneously in the United Kingdom, France, and Germany.

Wilson, already the winner of two Pulitzer Prizes, is Baird professor of science and curator in entomology at the Museum of Comparative Zoology. A native of Alabama, he began his scientific life studying insects—especially ants—and has expanded his interests into the larger realms of evolutionary biology, including his controversial theories on the relation of biology to the organization of human society.

He is one of a small number of renowned practicing scientists whose clear prose can be readily understood by nonspecialists. Wilson lucidly explains the evolutionary rise and fall of species, providing a detailed account of what we have learned since Darwin. Along the way he gently demolishes the arguments against evolution by believers in creationism. His biosphere—the thin realm where life exists on earth—moves by mysterious accident, genetic combination, and often silent demise. He laments the astounding rate of extinction of species now going on on earth—some 10,000 a year, the greatest rate since the disappearance of the dinosaurs.

Wilson is not without his critics. One reviewer, a botanist, has already accused him of "animal chauvinism," claiming he does not pay enough attention to plant life. Most readers will be so enthralled that they will fail to be impressed by such criticism. The book includes some of the most superb color photographs ever seen in a university press book—among them a jacket photograph of an absorbed Wilson looking for insects on a tree in the rain forest of Panama. —*Richard Marius*

when the Eichmann trials were televised in 1961. "I would often *imagine* my mother in Auschwitz. But then to *feel* it when you're in the scene, particularly if the roles are switched—that's a hard experience to have." Yet it is integral to understanding the "commonality of experience" shared by the descendent groups, she stresses.

Indeed, many psychological studies have been done on children of Holocaust survivors and children of Nazis, yet Weissmark and Kuphal were the first to explore the groups' commonalities in detail: the fragmentary information participants received as children; their obsession to make sense of this information; the anger of some toward injustice of any type (interestingly, many participants redress injustice in their professional lives, working in social or rehabilitation services); and finally, the sense of connection both sides feel to the children of the other. "When I was young, hearing all these stories, I didn't know what a Nazi was," says Weissmark. "But once in a while I'd see pictures, and sometimes in the pictures there was a child. . . . When I met Ilona, I felt I was meeting my flip side—the other child who was seeing as I was seeing."

For the Germans the sense of connection is checked by the guilt they carry for the sins of their parents. "It is always difficult for Germans to talk about their experiences," says Kuphal. "We don't want to take away from the experience of survivors, or put ourselves on the same level, because we know that the suffering of the families of victims was much, much greater than ours. . . . so we're hesitant to say, 'Oh yeah, that was my experience too,' or, 'Yes, it was also very painful for me to see the pictures.' " She cites Helga, a middle-aged housewife and mother from southern Germany who learned four years ago of her father's role as a Gestapo officer in Russia. The truth shattered Helga's life, confirming feelings and dreams of "rivers of dead" that had plagued her since childhood. The atrocities committed by her father took Helga to the brink of suicide. The joint meeting, she told a fellow participant on the closing day, "saved my life."

"If we remained enemies, then we would continue Hitler's work," says Betsy Kalau, an associate professor of rehabilitation services at the University of Maine, Farmington, whose father was a Nazi officer. For Janet Applefield, a clinical social worker from Plymouth, Massachusetts, who survived the Holocaust as a young girl in Poland by assuming the identity of a deceased Christian child, the fear was of being "disloyal to my family who perished." Yet once in the room, her doubts were replaced by an experience she calls "an exploration of my humanness."

Kuphal and Weissmark believe that, simply by bringing together the two descendent groups, they have made steps toward the future and paid an homage to the suffering of the past. They are now planning a second joint meeting with new participants in Germany for the spring. Those who attended the September conference have organized a reunion in Germany in August 1993. "What better way to remember the victims than through working on something new—on people seeing each other as human beings?" says Kuphal.

"This is not about forgiving or forgetting—that's not our purpose," echoes Weissmark. "Our purpose is building a new future together. . . . Together we are writing another chapter to our histories. There's an incredible feeling of hopefulness in what our friendship represents to us. That's why we wanted the meeting. That's our work."

—Kate Walbert

Czechs and Balance Sheets

Academics from formerly socialist states turn to five business schools to learn the unfamiliar ways of the market economy.

One ironic moment came during a field trip to a United Parcel Service (UPS) facility whose rafters displayed banners that touted accomplishments like "180 Days of Accident-Free Work" or honored an employee of the month. The touring Business School students—who were actually 63 faculty members from Central and Eastern European universities—enthusiastically photographed the banners and for some reason seemed to find them humorous. Then Gary Loveman, assistant professor of business administration, explained that in their countries, such banners and slogans are ubiquitous in workplaces. A Czechoslovakian professor elaborated: "The more banners and slogans you see, the more