Jack Levin (left), Noel Rose, David Sachar (second right), and other awardee family members display Golden Goose Awards.

Golden Goose Awards honor scientific ingenuity and talent

Winning basic research yields surprise outcomes with lifesaving, transformative results

By **Anne Q. Hoy**

On a summer day in Dhaka, East Pakistan, the eyes of a 25-year-old U.S. Public Health Service officer were trained on the needle of an electric charge meter. He had adapted the device to test the prevailing theory of the day: Cholera was poisoning the human intestine's ability to transport sodium and water into the circulatory system of patients, exposing the untreated to severe shock, acid-laden body fluids, and death within hours.

David B. Sachar, the young Harvard-trained doctor and researcher of intestine mechanisms, and J.R. Saha, his Pakistani research associate, were treating a male Pakistani in the throes of an acute cholera attack at the Cholera Research Laboratory, which was established through a partnership between the U.S. and Pakistan–Southeast Asia Treaty Organization in what is now Dhaka, Bangladesh.

It was 1966 and Sachar was among many American-trained doctors working in Southeast Asia on the cholera pandemic and other infectious diseases in the region. "We wanted to go and save the world," said Sachar, who jumped at the opportunity to work in the laboratory on research sponsored by the National Institutes of Health (NIH), the U.S. Centers for Disease Control and Prevention, and the U.S. Agency for International Development.

The patient had volunteered to participate in the experiment while he received cholera treatment in one of the laboratory's hospital-like rooms. A thin plastic tube ran the length of his gastrointestinal tract, allowing an infusion of a sodium solution, and later a glucose-treated sodium solution, to drip into the patient.

Sachar's experiment and the clinical trials that followed were critical to the development of a lifesaving cholera treatment—oral rehydration therapy—credited with saving far more than 50 million lives from diarrheal disease, a consequence of cholera that is particularly perilous to children and a leading cause of infant mortality worldwide.

Sachar's extensive research was recognized with a 2019 Golden Goose Award for "The Frog Skin That Saved 50 Million Lives" at a 10 September ceremony at the Library of Congress hosted by the American Association for the Advancement of Science and other participating organizations. The annual award celebrates groundbreaking, federally funded basic research that has had a significant impact on human life, scientific advances, and societal needs.

The Golden Goose Award was conceived by Representative Jim Cooper (D-TN) to highlight the ingenuity and talent of the U.S. scientific research community, long supported by federal research funding. In 2012, a nine-member coalition of businesses, universities, and scientific organizations founded the award to salute scientific research's unexpected and consequential discoveries.

The award was a counterpoint to the late senator William Proxmire's (D-WI) monthly Golden Fleece Awards that often held up basic scientific research as an object of ridicule. The critique was once so sharp it devolved into a federal court battle that ended at the U.S. Supreme Court with a ruling against Proxmire.

A second Golden Goose Award went to Noel Rose and the late Ernest Witebsky, both medical doctors, for "Advancing Autoimmunity" with the discovery that the human immune system could produce antibodies that attack itself. The research gave rise to the study of autoimmunity in animals and humans, including human diseases such as lupus, multiple sclerosis, and Crohn's. NIH funded the research by Rose, who is known as "the father of autoimmunology."

Jack Levin, a hematologist, and the late Frederik Bang, also a medical doctor, were awarded a Golden Goose Award for "The Blood of the Horseshoe Crab" research that led to the development of a screening test known as the *Limulus* amebocyte lysate test, which can detect minute concentrations of bacterial endotoxin, a component of all dangerous Gram-negative bacteria.

The test is based on an extract of blood cells, known as amebocytes,

PHOTO: RACHEL COUCH

from the distinctive blue blood of the Atlantic horseshoe crab. The cells contain a blood-clotting mechanism triggered by the presence of bacterial endotoxin. The test serves as an effective detection tool that today prevents the use of intravenous fluids, injected drugs, and implantable medical devices that contain potentially dangerous concentrations of endotoxins. Levin's research was funded by the U.S. Atomic Energy Commission and the NIH National Heart, Lung, and Blood Institute and Bang's by the U.S. Public Health Service's National Microbiological Institute.

As with Sachar's cholera research, the collaborations of Rose and Witebsky, and of Levin and Bang, were built upon multiple experiments over years. Still, Sachar points to the cholera patient experiment as the watershed moment for his research.

Learning how to effectively measure the electrical charge within the patient's intestine had taken Sachar, at the request of his superiors, from Dhaka to Copenhagen, where he moved his wife and 10-month-old baby. Copenhagen was home to a laboratory run by the physiologist Hans H. Ussing, who had devised the Ussing chamber to test the functions of biological membranes using the skin of a frog. Sachar was tasked with figuring out how to adapt the tool for cholera research on humans. Upon returning to Dhaka, Sachar's patient experiment put his adapted meter to the test.

Turns out, a sodium solution trapped in a malfunctioning intestine, as the standing theory held, would alter the electrical charge within a cholera patient's intestine. A properly working intestine would register a negative charge and be able to absorb a sodium solution through the intestine's lining to hydrate a patient with cholera. Evidence of a negative charge would disprove the prevailing theory's position that cholera broke the human intestine mechanism.

The experiment verified the effectiveness of the adapted device to measure the electrical potential across a biological membrane, established that the patient's intestine was functioning normally despite cholera, and showed that when glucose was added to the sodium solution dripping into the patient, the negative charge in the intestine shot up dramatically. This proved that sodium was absorbing through the lining of the intestine, hydrating the cholera patient. Thus, the standing theory was wrong.

"The moment when the needle on a dial started to move steadily off to the end of the dial and off the scale," Sachar said, he and Saha began "whooping and clapping" and "dancing around the laboratory," making such a commotion that Norbert Hirschhorn, the senior laboratory manager, entered to find out what was going on. "The system works; we add sugar and the electric potential goes up. So, that means the cholera patient's intestine is not poisoned," Sachar told Hirschhorn. Within moments of taking in the report, Hirschhorn declared, "Well, then that's the treatment."

> ***"...a discovery that has saved 50 million to 100 million lives."***
>
> **David Sachar,**
> Mount Sinai School of Medicine

Importantly, without operating on a patient, the research validated his method of measuring transmural electric potential inside the intestine. Sachar also "showed that contrary to prevailing opinion, the absorption mechanisms of the intestine, the ability of the intestine to absorb sodium and to absorb it even better with sugar, was perfectly normal during an attack of cholera." With that, the research cleared the way for today's lifesaving oral rehydration therapy.

"It has been gratifying to know over the last 50 years that the two years I spent as an active-duty commissioned officer in the Public Health Service paid off and it continues to pay off, " said Sachar. "From a physiology laboratory looking at a frog skin in Copenhagen, to a research-oriented hospital in Dhaka, East Pakistan, to using a technique adapted for living humans and then taking it out to villages where there was nothing, no intravenous, no labs, no nothing. Within years we have a discovery that has saved 50 million to 100 million lives."

AAAS programs train new generation of science journalists

Mass Media fellows and Diverse Voices interns spend summer in newsrooms

By **Adam D. Cohen**

As a fifth-year Ph.D. student studying the courtship dances of jumping spiders, Sebastian Echeverri is not accustomed to his expertise attracting the attention of anyone beyond a handful of fellow arachnologists.

This summer, however, Echeverri found himself on staff at *The Philadelphia Inquirer*, pet tarantula on his desk, writing about the real-world biology behind Spider-Man's superpowers. The 1200-word article covered everything from spiders' sensitive body hairs to the ability of certain species to cling to walls while holding 170 times their own weight. On 16 July, two weeks after the release of Sony Pictures's *Spider-Man: Far From Home*, *The Inquirer* gave the piece a full-page spread on the cover of its Life section. Its affiliate tabloid, the *Philadelphia Daily News*, also ran the story as a lead feature.

"When I sent my friends and family the story, there were a lot of Peter Parker jokes going around, because I had the exclusive scoop on Spider-Man's powers," said Echeverri, who is working on his dissertation at the University of Pittsburgh. "Obviously, for me, that was a dream come true. I've always felt a connection to that character."

The Spider-Man story was one of nine pieces of science news that Echeverri wrote for *The Inquirer* this summer, thanks to a Mass Media Science & Engineering Fellowship from the American Association for the Advancement of Science. Each year, in a 10-week program, AAAS places advanced undergraduate, graduate, and postgraduate scientists as Mass Media fellows at news organizations across the United States.

At the same time, the organization hosts the Diverse Voices in Science Journalism Internship, placing undergraduate journalism students on the news team at the AAAS-published *Science* magazine for the summer. Together, the programs work to train the next generation of science writers and strengthen the connections between scientists and journalists, sharpening researchers' ability to communicate complex science to the public while enhancing the breadth and depth of science-related coverage in the mainstream media.

Since the Mass Media Fellowship's inaugural summer in 1975, when 10 scientists participated, the program has grown consistently. In recent years, with the total number of alumni climbing above 700, AAAS has focused on placing more fellows at outlets in the country's heartland, in addition to those on the coasts. With 26 fellows working at a diverse array of print, online-only, and broadcast outlets, this summer's group was the program's largest. Following the fellowship, some participants return to academia, while others go on to

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