Nevin S. Scrimshaw

1918–2013

BIOGRAPHICAL *Memoirs*

A Biographical Memoir by
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NATIONAL ACADEMY OF SCIENCES

NEVIN STEWART **SCRIMSHAW**

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By Pamela Fraker

Nevin Scrimshaw was internationally recognized for his life-long pioneering efforts to ameliorate malnutrition and hunger around the world. He developed many special diets with available local foods to reduce deficiencies in protein, iron, trace elements, and iodine among impoverished populations. He was also among the first to show a strong relationship between nutritional deficiencies and increased incidence of infections of longer duration. For the saving of innumerable lives, especially those of children, he was awarded the World Food Prize in 1991. He also founded the Department of Nutrition and Food Science at the Massachusetts Institute of Technology, where he published over 650 papers and 20 books. In 1975 he founded the World Hunger Program of the United Nations and was a senior adviser to the program till 1998. In 1982 he created the Nevin Scrimshaw International Nutrition Foundation, which continues his efforts to focus attention on and address malnutrition throughout the world.

Scrimshaw earned his bachelor's degree from Ohio Wesleyan University, his Ph.D. from Harvard, a medical degree from the University of Rochester, and a master's in public health from Harvard. He began field research in Panama and in 1949 founded the Institute of Nutrition of Central America and Panama, which he led until 1961. That year he established the Department of Nutrition and Food Science at MIT, where he remained for the rest of his career.

Nevin Stewart Scrimshaw was born January 20, 1918, in Milwaukee, where his father, Stewart Scrimshaw, was a professor of economics at Marquette University. Nevin received a B.A. from Ohio Wesleyan University in 1938 and his Ph.D. from Harvard University in 1941. He also went on to earn an M.D. from the University of Rochester in 1945. At a much later date, 1959, he obtained an M.P.H. degree from Harvard. This extensive and diverse training served him well, enabling him to use nutrition, biochemistry, and medicine to solve many serious nutritional problems in impoverished areas of the world.

When he arrived at Rochester, Nevin found that many members of the medical faculty were focusing on nutrition. J. Murlin, a department chair, had an army contract for studying nitrogen balance and its relationship to exercise. Nevin began working with him by analyzing changes in the B vitamins, a task that initiated his lifelong interest in diets and nutritional status. His training in anatomy, biology, nutrition, and gynecology led him to begin his field research focusing on nutrition and pregnancy outcomes in Panama in 1948. It was here that he first developed specialized local diets to improve health outcomes in underdeveloped countries. He went on to found and organize an Institute of Nutrition of Central America and Panama (INCAP), an amazing accomplishment so very early in his career. He led the development of this institution from 1949 to 1961.

In 1941, as he progressed through school, he had met and married Mary W. Goodrich, a biologist and nutritional anthropologist. She would work closely with him throughout his career. The Scrimshaw family eventually included five children: Susan C. Scrimshaw (Allan Stern), Norman S. Scrimshaw (Cynthia), Nevin B. Scrimshaw, Steven W. Scrimshaw**,** and Nathaniel L. Scrimshaw. The family lived for many years in Guatemala as INCAP was developed. Of special note is Nevin's daughter, Susan, who is currently president of Sage College. Following in her father's footsteps, she spent considerable time improving pregnancy outcomes and providing better health care for the poor.

A seven-decade career

In Nevin's own words we learn of his findings as he began his career in the field.

> *The most frustrating aspect of field visits at this time,was our inability to help women with severely malnourished children who approached us in the villages we visited. They could not afford the protein sources we could suggest. Milk was too expensive and their diets had almost no meat. An egg could be exchanged for corn to provide a meal for the entire family. We set about to develop a culturally acceptable plant-based complementary food for older infants and young children at the lowest possible cost.*

This approach, developing inexpensive solutions to problems stemming from malnutrition, became the dominant work of his career and the means by which he saved countless thousands of young lives. A few of these examples are described below.

In the 1950s, in association with INCAP, Nevin developed solutions for kwashiorkor, a deadly disease that strikes young children. Recognizing from studies at INCAP and

elsewhere that the problem was one of protein deficiency, Scrimshaw searched for an affordable, indigenous protein source. Using mainly a mixture of cottonseed flour and maize, to which was added vitamins and minerals, he was responsible for the development of Incaparina, which is today given to 80 percent of Guatemalan children in their first year to combat protein deficiency.

While working at INCAP, he also focused his attention on endemic goiter. He developed a method of iodizing the moist local salt with non-soluble potassium iodate. Data show that in 1955, three years after the use of iodate began, the prevalence of goiter in Guatemala dropped from 38 percent to 3 percent. These results prompted Nevin to work with governments to require iodation of all salt used for human consumption, alleviating endemic goiters in many countries throughout the world—clearly a remarkable and inexpensive solution to a serious problem. These examples demonstrate how his highly educated, imaginative mind worked, constantly solving serious nutritional problems with simple, elegant, and practical solutions.

During the 1967 famine in India Nevin guided the development of another balanced, low-cost food. India had been dependent on wheat imported from the United States that was costly and not distributed as widely as needed.

> *My first day in India was spent in New Delhi with Venkatachalam, deputy director of the Indian Council of Medical Research, working out an agreement on the nutritional composition of the new food based on United Nations (U.N.) Protein Advisory Group (PAG) recommendations. The second day was spent in Hyderabad, looking at potential sources of oil seed meals. Suitable cottonseed flour was not available, but peanut meal was abundant. The problem was aflatoxin produced by a ubiquitous soil mold under conditions of high humidity.*

Chemical processing to remove the toxin was too costly, but Nevin developed a solution using conveyor belts with workers on each side picking out moldy peanuts. With strict supervision and sampling of each batch before use, meal could be produced that met PAG standards for cottonseed flour in complementary food mixtures for child feeding. The result was Balahar, based on peanut flour and wheat. The name "Balahar" was chosen for the new food source because it meant "child food" in most of the Indian languages. Balahar proved valuable in the emergency and continued to be available as a relief food for many decades. An instant form by the same name is commercially available. Some years later Nevin led a team to assist Thailand with similar complementary food devel-

opment. The concept provided by Incaparina and Balahar became the basis for the development of low-cost nutritious diets in many other developing countries.

As chairman of the Malnutrition Panel of the U.S.-Japan Medical Science Program from 1964 to 1974, Nevin was instrumental in the development of a broad program of U.S. support for research on nutrition problems in Southeast Asia. He helped initiate a feeding program called "Operation Beta" for reducing the high prevalence of severely malnourished children in Bangladeshi refugee camps in 1971, where he traveled with Senator Ted Kennedy for the U.S. Senate Subcommittee on Refugees.

In 1971 Nevin was elected to the National Academy of Sciences. This was an early and prestigious recognition of his growing body of research. Because his work substantially improved the lives of millions of people, especially children, in dozens of countries around the globe, he was recognized with the 1991 World Food Prize. The prize committee cited him "for his revolutionary accomplishments over six decades, in fighting protein, iodide, and iron deficiencies, developing nutritional supplements, educating generations of experts, and building support for continued advances in food quality around the world."

Nutrition and infection

As Nevin noted in the 1950s, no textbook mentioned a relationship between nutrition and infection. Oddly, the significant increase in infections of longer duration along with a higher mortality rate that is now widely recognized to be a prevalent problem for malnourished children was not even being recognized, much less documented. Ever vigilant, Nevin and colleagues began to document the greater severity of infections in malnourished subjects and concluded that nearly all cases of kwashiorkor were precipitated by earlier infections. Measles, chicken pox, whooping cough, rubella, diarrheal disease, and even staphylococcal skin infections were capable of setting off kwashiorkor in malnourished children. It was common for Central American villages to have a composite child growth curve at the third percentile of normal. Growth of a breastfed village child during the first six months of life was usually satisfactory, but when breast milk was no longer sufficient as the sole source of food, infants were exposed to pathogens, and their growth faltered in response to multiple infections. Unclean sources of water were and remain a problem there and around the world. As an example of the impact of infections, the time required for poorly nourished children to regain their pre-disease weight after a siege of whooping cough was 13–24 weeks in 25 percent of

children and 25 weeks or more in another 25 percent—compared with **3 to 6** weeks for well-nourished children after the same illness.

The malnutrition/prolonged-infection effect creates a vicious circle of adverse effects of infections on nutritional status. Decreased food intake due to anorexia plays a role, as do metabolic losses in the urine, internal diversion of protein for synthesis of immune proteins (for example, antibodies, globulins, and cytokines), decreased absorption (if infection affects the gastrointestinal tract), increased metabolic rate (related to altered cytokine profile), and direct nutrient losses in the stool if diarrhea is present.

That improved nutritional status could reduce the frequency and severity of infections was based on a previous investigation into the causes of death in children in four Guatemalan Highland villages. Kwashiorkor, respiratory infections, and diarrhea were each associated with approximately one-third of the postneonatal deaths. However, kwashiorkor deaths would not have occurred without precipitating infections, and few of the diarrheal and respiratory deaths would have occurred in well-nourished children. Nevin and his team concluded that nearly all of the post-neonatal young child deaths were due to the synergistic interaction of malnutrition and infection and not to either alone. At this point he and others began to gather evidence for the concept of synergism between nutrition and infection in the scientific literature. With added material, it became an important 1968 World Health Organization monograph "Interactions of Nutrition and Infection." Thanks to Nevin's work, the role of infection in worsening nutritional status was beginning to be documented. Important concepts such as "weanling diarrhea" and "second-year death rate" were introduced and became widely accepted. A great deal of information has accumulated since 1968 in support of these relationships, and the subsequent knowledge and the explosive increase in discoveries of cell- and antibody-mediated immune mechanisms has led to an understanding of how malnutrition lowers resistance. Today, recognition of the synergistic relationship between nutrition and infection is a driving force in public health interventions to reduce the burden of infections and malnutrition.

Providing the foundation for nutritional immunology

One suspects that Nevin would be very pleased with the growth and activity in nutritional immunology today. Indeed most major nutritional journals have a section devoted to this topic each month. As a young immunologist, I was among the many who read his papers with keen interest. I initiated a series of studies regarding the impact of zinc deficiency (ZD), a common human deficiency, as well as protein calorie malnutrition (PCM)

on the major immune defense systems. These studies demonstrated that both ZD and PCM caused rapid depletion of lymphocytes in the peripheral immune system, which in turn significantly reduced responses to pathogens, vaccines, antigens, etc. My work was confirmed and extended upon by G. Fernandes, R. Good, R. Cousins, and others. Further research found that these two deficiencies also caused heightened apoptosis among developing precursor B cells in the bone marrow and the immature thymocytes in the thymus. This was the underlying cause of lymphopenia and thymic atrophy. It affirms some of Nevin's early suppositions.

Another finding that is of great interest was made in Melinda Beck's lab, University of North Carolina Medical School, 2003, which demonstrated that deficiencies in selenium can greatly increase the mutation rate of coxsackie disease viruses in the host. This is one of several affirmations of the idea that there are unique interrelationships between pathogens and the malnourished host not necessarily observed in well-feed people.

A substantial home base at MIT

In July 1961 Nevin arrived at the Massachusetts Institute of Technology to establish a new graduate-level Department of Nutrition and Food Science. This major event afforded him the resources to select and hire an outstanding faculty and the freedom to determine the department's research mission and graduate training programs. As the first department in the United States to combine nutrition, food science, and food toxicology, it became a successful model for other institutions. It soon provided in-depth multidisciplinary graduate degree training in nutritional biochemistry and metabolism, clinical nutrition, food toxicology, food science and technology, industrial and food microbiology, and biochemical engineering. Amazingly, within his first year Nevin was able to establish an outpatient unit for metabolic balance studies. Within three years he won an NIH grant to establish the only clinical research center (CRC) outside a teaching hospital. This grant and other support attracted a long series of exceptionally well-qualified and motivated M.D.s working to obtain Ph.D.s in nutritional biochemistry and metabolism. The CRC facilities provided 24-hour nursing and medical coverage for clinical research, and the physicians in the program had major medical responsibility for the center and the quality of its research and patient care.

With the combination of faculty of the Nutrition and Food Science Department plus clinicians from Harvard and Boston Universities, as well as physicians in the Ph.D. program, the center became extremely productive. The M.D.s in the program pioneered the concept of nutrition support services for hospital patients. Everyone in the clinical

nutrition training program spent time on nutrition support services established in area teaching hospitals. Graduates of the MD-PhD program are now leaders in nutrition investigation and research administration in the United States and many foreign countries.

The department made many successful hires, among them another future National Academy of Sciences member, Arnold Demain, whom Nevin brought on in 1968. Demain focused on fermentation pathways, especially those that led to production of penicillin and other antibiotics, providing valuable biotechnology for the bio-production of these important molecules. Nevin and Mary became good friends with the Demains. In addition he hired Vernon Young, who successfully pioneered the assessment of human amino acid requirements with a powerful new approach employing stable isotopes. Young demonstrated that essential amino acid requirements were about double the previous estimates, adding extremely valuable methodology and information to the department's work. Young was a mentor to Nancy Krebs and Janet King, who have used this methodology to enhance our understanding of zinc absorption and distribution in the body. In 1980 Nevin himself initiated a series of studies on the functional consequences of iron deficiency, a field of study that occupied him until his death.

Mentoring, education, and service to others

Beyond creating an outstanding department for the study of modern nutrition, Nevin was also an important mentor to young scientists around the world, including leaders like Her Royal Highness, Princess Maha Chakri Sirindhorn of Thailand. Nevin also created extensive educational and training programs in food and nutrition that have benefited over 500 scientists from developing countries. This process has strengthened research capabilities in developing countries and helped them become nutritionally more self-sufficient. His dozens of awards and honors included the designation Hero of Public Health by President Vicente Fox of Mexico, a knighthood from King Bhumibol Adulyadej of Thailand, naming to the Order of Rodolfo Robles by the government of Guatemala, and the Bolton L. Corson Medal from the Franklin Institute.

From 1982 to 2002 Nevin was the editor-in-chief of the *United Nations University Food and Nutrition Bulletin*, a peer-reviewed publication that he started and is disseminated free to developing-country professionals in nutrition throughout the world. He was the founder and honorary president of the Nevin Scrimshaw International Nutrition Foundation, housed at Tufts University in Boston, and founder of the World Hunger Program of the United Nations University, where he was a senior advisor from 1975 to 1998.

From 1981 to 1997 he directed the Food, Nutrition, Human and Social Development Programme at the United Nations University.

After his retirement from MIT in 1988, Nevin was given the prestigious title of Institute Professor Emeritus. For hobbies he grew lilies, fruit, and vegetables on his New Hampshire farm and continued to love travel. Not surprisingly he used his knowledge of nutrition to create a personal regime of diet and exercise that he credited with helping

sustain his own good health. He also maintained a longstanding love of hiking and downhill skiing well into his 90s. Even while he was enjoying skiing, nutrition was always on his mind. Around the Waterville Valley ski area not far from where he lived it was said that those riding the ski lift with Nevin stood a good chance of learning more than they wished to know about their nutritional status and appropriate eating habits. Nevin Scrimshaw died of congestive heart failure in Plymouth, New Hampshire, on Friday, February 8, 2013, at the age of 95. He is survived by his wife of 71 years, Mary, and his five children.

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