



Jerome Gross



Jerome Gross, scientist and physician, passed away on January 27, 2014, one month shy of his 97th birthday. During his 60-plus years on the faculty of Harvard Medical School, and in the research labs of the Massachusetts General Hospital (MGH), he focused his energy, intelligence and creativity on fundamental puzzles of biology. Why do some wounds fail to harness the body's power to heal? What mechanisms allow salamanders to regrow lost limbs? Over his long career, Dr. Gross contributed substantial insight into these questions.

Few individuals have had such an impact on modern biology or have influenced the scientific lives of so many others.

Jerome Gross was born on February 25, 1917 in the Bronx borough of New York City. His father, Benjamin, was an electrical engineer and his mother, Rose (born Shvitz), was a homemaker. Both were first generation offspring of Jewish immigrants from eastern Europe. Jerry grew up in New York City as the eldest of three children, with a brother Robert and a sister Lois. Jerry inherited his father's aptitude for science and developed early interests in biology and astronomy. He built his first telescope at the age of 14.

Jerry attended Manhattan's Stuyvesant High School, a college preparatory school that offered accelerated academics. He was accepted to the Massachusetts Institute of Technology (MIT) for undergraduate studies, and completed his bachelor's degree in 1939. He then chose to concentrate further in medicine and completed an MD degree at the New York University College of Medicine. After an internship at Long Island College Hospital, he served 2 years in the Army Medical Corps.

Looking back over his career in an invited essay published in 2004 ¹, Jerry reminisced about "the twisted pathway whereby one finally arrives at a research project that bears more fruit than expected." He traced his trajectory back to his medical school days when he developed an interest in rheumatic fever, at that time thought to be a 'collagen disease'. "Nothing ever came of my effort to find significant pathologic

¹ How tadpoles lose their tails: path to discovery of the first matrix metalloproteinase. *Matrix Biology* 23: 3-13; 2004

collagen in rheumatic fever lesions” Jerry observes. “However, exciting revelations on the normal fibrillar organization and self-assembled supramolecular structures from solutions of collagen molecules dotted the route. I was hooked again on science. ‘Molecular self-assembly’ seemed to me, to hold a major secret of life.”

Jerry’s recommitment to science began after World War II in 1946. Fresh from military service in Japan, he attempted to land a residency in cardiology at MGH. This being unsuccessful, he crossed the Charles River into Cambridge to visit the biology department of his undergraduate alma mater. There at MIT, Jerry found collagen research ongoing in the lab of Professor Frances O. Schmitt. He quickly put together a project to study the role of collagen in the pathology of rheumatic fever using electron microscopy and biophysical approaches. This won him a two-year fellowship from the Life Insurance Medical Research Fund.

As his fellowship at MIT was concluding, Jerry was recruited to a second training position by Walter Bauer in the Department of Medicine at MGH. Bauer thought that many of the secrets of rheumatoid arthritis and rheumatic fever could be uncovered by some of the same methods that Jerry employed at MIT. Although he tried to get Jerry to put in clinical time, he did not insist, and ultimately Jerry’s research efforts won out. In 1950, he was appointed as a full-time Research Associate, and encouraged to set up the Developmental Biology Laboratory.

Despite his junior status, Jerry’s work on collagen structure received much attention from the scientific community for its innovation. This earned him positions on several elite committees at this very early point in his career. In 1952, he was invited to deliver the prestigious Ludwig Kast Lecture by the New York Academy of Medicine.

Coincident with his increasing attraction towards scientific investigation, Jerry found himself at the same time drawn towards another type of love when he met the young Betty Bloch, whose father was head of Bloch Publishing Company in New York. Jerry and Betty were wed in 1947, and quickly started a family. Their first child Jill, was born in 1949, followed by Neil in 1951 and Adam in 1956. Shortly after Adam was born, the couple purchased a home in Waban, a village within the city of Newton, west of Boston. This remained the family home until Betty passed away in 2019.

Every summer, beginning in the 1950s, Jerry and Betty Gross would pack their kids and ever-suffering cats into a station wagon and relocate to a rented cottage in Chilmark, Menemsha or Gay Head (Aquinnah). After more than a decade of this ritual, a friend offered to sell Jerry some land near the Gay Head cliffs. The house he and Betty built, low against a hill and ringed by scrub oak, briars and blossoms, gave Jerry the happiest memories of his long life. It remains in the family to this day.

Balancing Jerry’s love for science was Betty’s passion for art. She maintained winter and summer studios at the family homes in Waban and Aquinnah. In describing her work, she observes that “visual

memories and emotions are taken over by the act of painting itself to create a final image. Playing one color against another, one shape against another becomes more important than the original idea.” The family would come together, sometimes at the expense of homework, to watch *Star Trek* episodes. The children inherited their parents’ creativity, expressed in pursuit of careers in music, science writing, and the film industry.

In 1956, Jerry became an established investigator of the American Heart Association and shortly thereafter, was appointed to the Harvard Medical School faculty. Scientists from around the world traveled to Jerry’s Developmental Biology Laboratory to work on collagen structure, wound healing, and limb regeneration. The lab produced a continual stream of ground-breaking papers and Jerry received increasingly more prestigious invitations to national committees. This reached a peak in 1966, when he was elected to fellowship in the American Academy of Arts and Sciences. In 1969, Jerry was promoted to the rank of full Professor at Harvard. This was followed in 1974 by election to membership in the National Academy of Sciences, and in 1986 by elected membership to the Institute of Medicine.

Jerry’s lifelong work on collagen structure and self-assembly was balanced in a satisfying symmetry by his work on the dismantling of collagen structures. His discoveries in both areas received equal attention from the scientific community. However, it was his work on collagenolysis that persistently inspired others over a long period. The first demonstration that tissues can produce a neutral collagenolytic activity, published in 1962, is now recognized as the seminal paper that launched the Matrix Metalloproteinase (MMP) field. As discussed in his 2004¹ memoir, Jerry reasoned that “the lytic factor must be synthesized upon demand, closely controlled by the cell producing the enzyme, and that it must be limited to the local extracellular environment”. This suggested to him that collagenolytic activity might be demonstrated by culturing tissue fragments, presumed to be secreting collagenase, on the surface of an opaque collagen gel. If the enzyme was present and active, it would induce collagen lysis, which could be detected as a clearing of the substrate around the explant. The first successful experiment used growing limb buds from an early metamorphosing bullfrog tadpole.

Jerry’s demonstration of collagenolysis had an immediate impact. The collagenolytic explant assay, then considered quite technologically innovative, was seized upon by labs around the world studying collagenolysis in many different organ systems and diseases. Many papers were published citing Jerry’s accomplishment. But this was not the end of the story. Over the next 25 years, a small group of labs using biochemical approaches, identified a handful of other neutral metalloproteinases expressed along with collagenase in tissue undergoing remodeling. Once genetic engineering and recombinant DNA technologies were introduced, it was possible to determine that these enzymes were all related. The MMP field had grown sufficiently by 1969 to merit an international conference in Destin, Florida and the first Gordon Research Conference on MMPs was held in 1993. Jerry was honored as the founding father of the MMP field at both meetings. The field subsequently burgeoned. A search on the National Library of Medicine’s PubMed using the search string “matrix metalloproteinase” at the time this Memorial Minute was written brought up more than 72,000 articles.

In 1987, Jerry became Professor Emeritus of Medicine at Harvard Medical School, but continued his work in the lab. Several years later, the opportunity to reinvent himself was presented when he was recruited by John Parrish to lead development of the Harvard/MGH/Shiseido Cutaneous Biology Research Center (CBRC), a new collaborative research model for academics and industry. In 1992, he was appointed as the Acting Associate Director for Research and in 1993 as Senior Associate for Academic Affairs. The colleagues that Jerry invited to join him in the CBRC remember with fondness, his various pet projects on how wounds close, why people (as opposed to mice) have “tight skin”, and the then newly discovered strains of “flesh-eating” bacteria. As the 21st century began, Jerry could still be found culturing tissue explants in the CBRC labs and reaching out to old friends to initiate collaborations. He also maintained key consulting relationships, notably, with the regenerative medicine company Organogenesis.

Jerry’s scientific opinions and prognostications worked their way into various public forums. He authored several published science fiction stories and *The New York Times* published some of his Letters to the Editor. At the turn of the century, his riffs infused many articles by his son Neil, then a senior editor at *Businessweek Magazine*. One article speculated, in 1999, that global electronics would soon become life-emulating tissue that would enfold our planet. The article, titled ‘The earth will don an electric skin’, influenced the evolution of the Internet of Things² (IoT). It predicted that our planet would soon have “the Internet as a scaffold to support and transmit its sensations” with trillions of embedded sensors, pressure gauges, radio and camera chips and still-unknown devices that would “probe and monitor cities and endangered species, the atmosphere, our ships, highways and fleets of trucks, our conversations, our bodies – even our dreams.”

An engaging conversationalist, Jerry loved to debate with friends and colleagues. “I was a member of the fencing team at Stuyvesant High School and at MIT,” Jerry wrote in an autobiographical sketch released at his 80th birthday celebration. “I’ve always felt the spirit that goes with dueling pervades my professional actions.” In an obituary that he wrote for the *Martha’s Vineyard Gazette*, son Neil described Jerry as having “fenced his way through half a century of hot, heavily lubricated summer evenings on Martha’s Vineyard. If neighbors and friends were sometimes nicked by his foil, they also got generous doses of his warmth, camaraderie and compassion. He would do anything in his power to help people who were sick. He loved to share what he knew of medicine, along with anything he’d deduced about the workings of the universe. In the darkness, Jerry liked to drape an arm over your shoulder and point out lesser-known constellations in the shimmering sky, accompanied by the sound of waves pounding or lapping the shore. On a fine night, he might pull you upstairs to a telescope mounted on the roof above his wife’s painting studio.... If the next morning was fair, he would pull you along on a run to the beach. You’d plunge into the cold surf, but the conversation and passions stirred the evening before would never be doused so simply. Jerry also spent peaceful mornings and nights on his front deck, smoking his pipe and listening to his family play music around him. When he died, he was wrapped close in warm Vineyard memories.”

Jerry's flashes of insight, the intensity of his attention, the depth of his affections and the complex spectrum of his emotions are sorely missed by his family, and by his many friends and colleagues. His legacy continues in his academic descendants. "It was due to Jerry's mentorship that I went on to pursue an MD/PhD program" says one grateful pathologist, now back at MGH and on the faculty at Harvard. "His inquisitive nature and love for science were infectious." A website erected in Jerry's honor by his children, including a career timeline and numerous historic photos, can be found at <https://jeromegrossmd.weebly.com>.

Respectfully submitted,

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