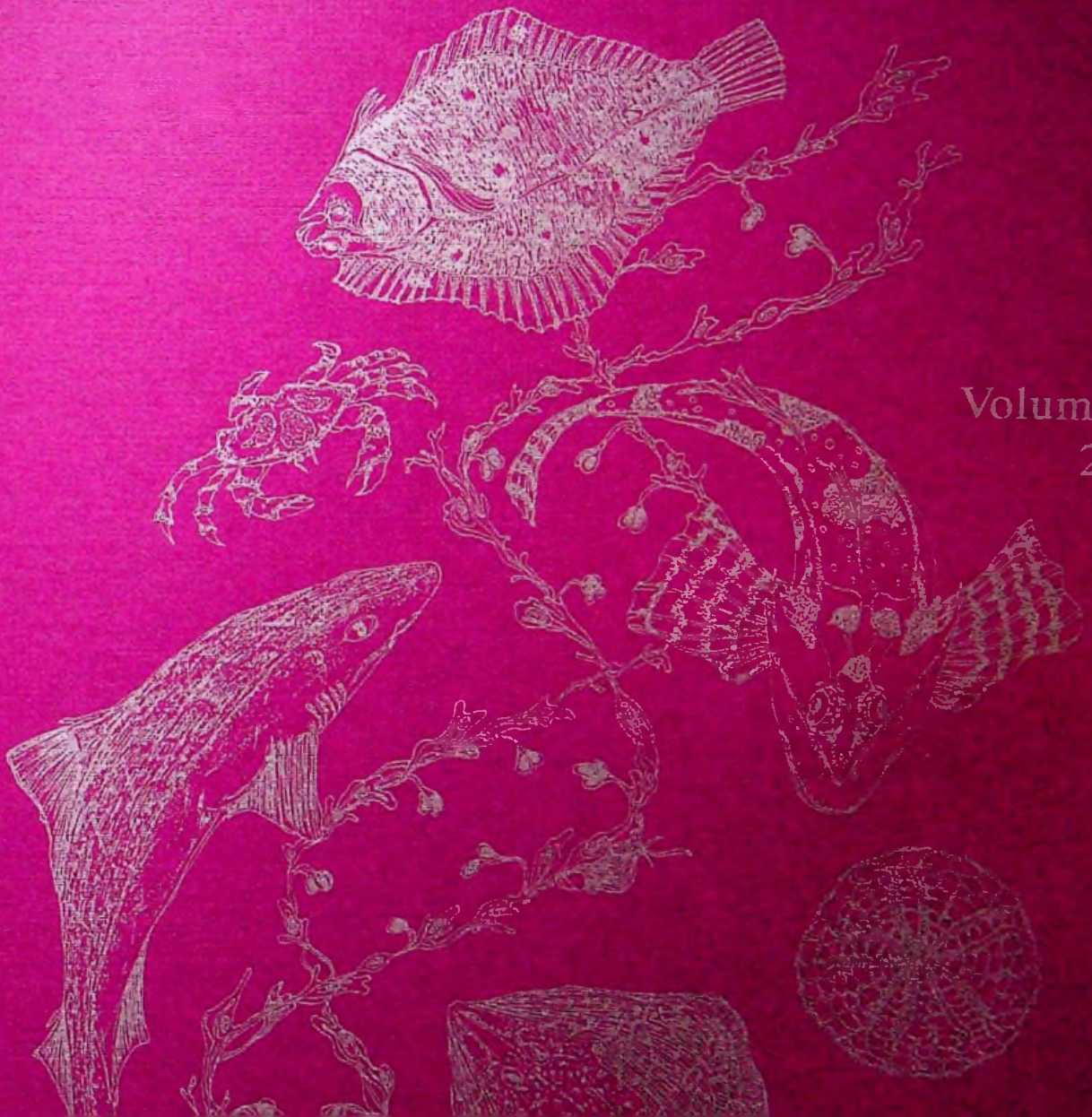
THE BULLETIN

Mount Desert Island Biological Laboratory



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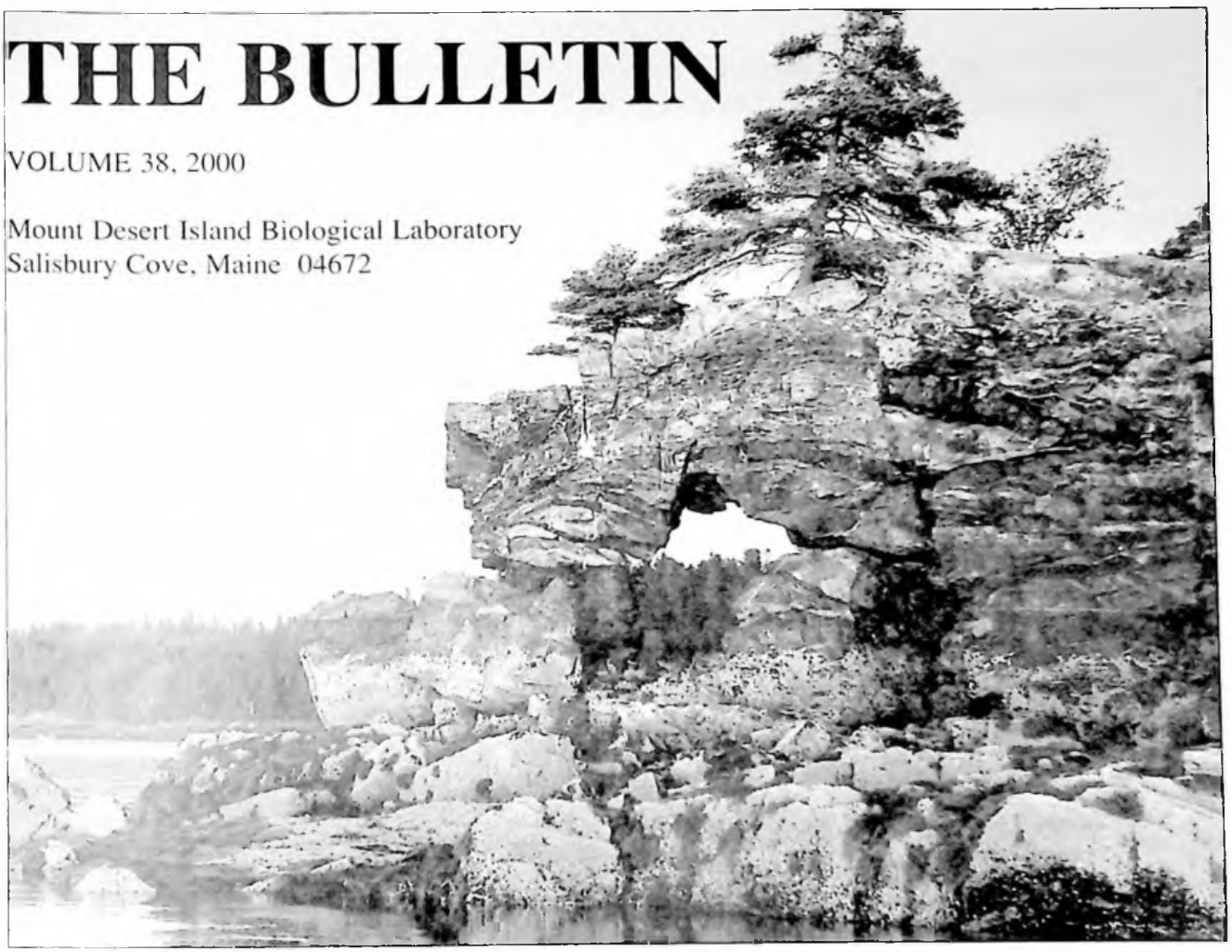

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THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY
RESEARCH AND EDUCATION IN THE BIOLOGY OF MARINE ANIMALS

INTRODUCTION

The Mount Desert Island Biological Laboratory (MDIBL) is an independent non-profit biological station located on the north shore of Mount Desert Island, overlooking the gulf of Maine about 120 miles northeast of the Portland near the mouth of the Bay of Fundy. The island, well known for Acadia National Park, provides a variety of habitats including shallow and deep saltwater, a broad intertidal zone, saltwater and freshwater marshes, freshwater lakes and streams, forests and meadows.

The Laboratory is the largest cold water research facility in the Eastern United States, and its unique site provides an outstanding environment for studying the physiology of marine and freshwater flora and fauna. During 1999, the scientific personnel included 55 principal investigators and 120 associates, representing 70 institutions in 24 states and five European countries.

HISTORY AND ORGANIZATION

MDIBL was founded in 1898 at South Harpswell, Maine by J.S. Kingsley of Tufts University. Its present site at Salisbury Cove was donated by the Wild Gardens of Acadia, and relocation was completed in 1921. The Wild Gardens of Acadia, a land-holding group headed by George B. Dorr and John D. Rockefeller, Jr., who was instrumental in the founding of Acadia National Park.

In 1914, the Laboratory was incorporated under the laws of the State of Maine as a non-profit sci- and educational institution. Founded as a teaching laboratory, MDIBL is now a center for marine research and education that attracts investigators and students from across the U.S. and around the world. Since the pioneering work of H.W. Smith, E.K. Marshall and Roy P. Forster on various aspects of renal and osmoregulatory physiology of local fauna, the Laboratory has become known worldwide as a center for investigations in electrolyte and transport physiology, developmental biology, electrophysiology and marine molecular biology.

The Mount Desert Island Biological Laboratory is owned and operated by the Board of Trustees and Members of the Corporation; at present, there are 430 members. Officers of the Corporation - Chair, Vice-Chair, Director, Secretary, Treasurer, Clerk - and an Executive Committee are elected from among the Trustees. The Chair and Executive Committee oversee and promote long range goals of the Laboratory. The Director, with the aid of a full-time Administrative Director, staff and a Scientific Advisory Committee is responsible for implementing the scientific, educational and public service activities of the Laboratory.

NIEHS TOXICOLOGY CENTER

Introduction: The Center for Membrane Toxicity Studies (CMTS), an NIEHS Marine and Freshwater Biomedical Sciences Center was established at the Mount Desert Island Biological Laboratory (MDIBL) in 1985. The purpose of this Center has been to involve a group of internationally recognized investigators, who are primarily experts in mechanisms of epithelial transport, to study the biological effects of environmental pollutants on cell and membrane transport

functions. The primary emphasis of this research effort has been to elucidate the mechanisms of toxicity of environmental pollutants at the cellular and molecular level, using novel aquatic models developed at this laboratory.

The focus of the research progrms of the Center has broadened in the last several years from the more narrow objective of identifying the molecular targets for the effects of heavy metals (or metal compounds) on cell functions, to include the effects of a broader range of environmental toxicants (including marine toxins) and the mechanisms by which the organism takes up and eliminates a wide range of xenobiotics and environmental pollutants. However, the concept that a ìmembrane lesionî accounts for the cellular toxicity of many environmental toxins still remains as a paradigm.

Research Cores: The Center consists of 3 highly integrated research cores or themes consisting of: 1) Signal Transduction, 2) Ion and Cell Volume Regulation, and 3) Xenobiotic Transport and Excretion. Investigators in the Signal Transduction Core are examining the basic mechanisms concerning the cell's signaling response to changes in its external environment, particularly as related to environmental stress, heavy metal exposure, marine toxins and environmental estrogens. Investigators in the Ion and Cell Volume Regulation Core are interested in determining the fundamental mechanisms by which cells regulate their cell volume, internal pH and secretory functions and how these processes are disturbed by environmental influences. Work in this Core has considerable overlap with the Signal Transduction Core. Investigators in the Xenobiotic Transport and Excretion Core are examining the processes that are used by various epithelial tissues such as the liver and kidney to take up and excrete drugs and xenobiotics and other toxic compounds that enter from the environment and to study the effects of toxicants on this process. Investigators in this Core also interact with investigators working in the other two Cores.

Facilities Cores: The Center provides for 5 facility cores for Center investigators. These include: 1) an Animal Core that is responsible for the acquisition, and maintenance of the many marine species available to investigators at this Center; 2) an Instrumentation Core that maintains the basic laboratory equipment that investigators would not otherwise be able to easily bring to the laboratory (a fully equipped cell culture and molecular biology facility is also part of this core); 3) a Cell Isolation, Culture and Organ Perfusion Core that provides isolated cells and tissues from marine species to Center investigators; 4) an Electrophysiology Core that maintains equipment for basic electrophysiologic measurements as well as an oocyte injection facility; and 5) an Imaging Core that maintains and operates a confocal fluorescent microscope as well as providing other imaging technology including epifluorescence and video-enhanced microscopy.

Community Outreach and Education Program: The Center's outreach program involves community education on water monitoring programs. This is directed primarily at high school and college students in the immediate area of the laboratory. However, an extensive summer research educational program includes high school students from both regional and national sites, the latter emphasizing minority student education as well as college and postdoctoral fellowship training.

Pilot Projects: The Pilot project program provides support for investigators who are interested in pursuing a new projected related to environmental toxicology in one or more of the Center's Research Cores. The purpose of these Pilot grants is to obtain preliminary data to facilitate new

grant submissions. Grants are awarded competitively and successful applicants receive up to $10,000/season.

APPLICATIONS AND FELLOWSHIPS

Research space is available for the entire summer season (June 1 - September 30) or a half-season (June 1 - July 31 or August 1 - September 30). Applications for the coming summer must be submitted by February 1st each year. Investigators are invited to use the year-round facilities at other times of the year, but such plans should include prior consultation with the *MDIBL* office concerning available facilities and specimen supply.

A number of fellowships and scholarships are available to research scientists, undergraduate faculty and students, and high school students. These funds may be used to cover the cost of laboratory rent, housing and supplies. Stipends are granted with many of the student awards. Applicants for fellowships for the coming summer research period are generally due in January.

For further information on applications and fellowships/scholarships, please contact:

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The Mount Desert Island Biological Laboratory is indebted to the National Science Foundation and National Institutes of Health for substantial support. Funds for building renovations and new construction continue to permit the Laboratory to expand and upgrade its research and teaching facilities. Individual research projects served by the Laboratory are funded by private and government agencies, and all of these projects have benefited from the NSF and NIH grants to the Laboratory. For supporting our educational initiative, *MDIBL* acknowledges the Cserr/Grass Foundation, Milbury Fellowship Fund, American Heart Association – ME, NH, VT Affiliate, Blum/Halsey Fellowship, Bodil Schmidt-Nielsen Fellowship Fund, Maine Community Foundation, NSF - Research Experience for Undergraduates and Hearst/Hancock County Young Scholar Program for High School students and many local businesses and individuals.

A TRIBUTE TO THOMAS H. MAREN

On August 15, 1999, the laboratory lost a remarkable and giant soul. Thomas H. Maren died at the age of 81 at his home overlooking Frenchman Bay after a long courageous struggle with heart failure. This was his 46th consecutive summer of residence and research, "at the Cove," a place he spoke of as his "window on the world, in science and spirit."

Born in 1918 and raised in Mt. Vernon, New York, Tom Maren graduated from Princeton University in 1938. Torn between a love of the humanities and science, which foreshadowed and enriched much of his career, he decided upon a chemistry degree to support himself in the depression era. Upon graduation, he took a job with a small pharmaceutical firm. Although he enjoyed this work, his love of literature called him back to Princeton in 1940 to pursue a PhD in English literature. However, World War II intervened and before finishing a few minor requirements for his MA, he was recruited for war-related work. Based upon his initial pharmaceutical work with heavy metals, many of which are potent antiparasitic agents, he joined the efforts to combat the significant problem of tropical parasitic diseases in the South Pacific. He was posted in 1943 to the Johns Hopkins School of Hygiene and Public Health beginning a relationship and close connection with that institution which was to last his entire life. It was there that he was persuaded by the EK Marshall, chairman of pharmacology and a legendary MDIBL figure to train as a pharmacologist, while simultaneously pursuing his medical degree. He was appointed an instructor in the department in 1947, and received his MD in 1950. Thereafter, he joined the Chemotherapy Division of the American Cyanamid Company and was assigned to study an enzyme, carbonic anhydrase (and its inhibitors), that would

occupy the remainder of his scientific life. His early work was fundamental to the release of acetazolamide (Diamox), the first effective oral diuretic. Although more powerful diuretics soon supplanted it, Diamox also lowered intraocular pressure in the eye and became the standard in glaucoma treatment for four decades, saving the sight of countless lives.

Following this brief but productive tenure in industry, the new medical school of the University of Florida recruited Dr. Maren in 1953 as its first chairman of Pharmacology and Therapeutics. He continued as chairman until 1978 and thereafter as a graduate research professor. Throughout his long tenure he led an active laboratory group that explored all aspects of carbonic anhydrase chemistry and biology, published over 300 papers, built a first class department, and served on national and international review boards. He was devoted to education at all levels. He initiated an innovative curriculum in medical pharmacology, that had a standard pre-clinical course, but also a very popular clinical therapeutics course for all senior medical students that brought them back into the classroom after gaining direct clinical experience. What he enjoyed most of teaching and research was the intimate discussions that took place in small groups and at the lab bench. His pharmacology lectures might often be spiced with literary allusions, such the influence of opiates on Samuel Coleridge and his writing of the famous poem, *Kubla Kahn*. In order to teach a popular elective course on literature and humanities in medicine, he was asked to document his formal training in humanities. Thus in an unprecedented decision, Princeton belatedly awarded him his Master's degree in English literature in 1990 for his studies fifty years earlier.

Nineteen fifty three was also the year that he first came to Salsbury Cove to answer a question posed by Homer Smith (another luminous MDIBL figure): why was there no renal bicarbonate loss or diuretic effect of Diamox in the kidneys of sea-going fish? The answer following his brief sojourn that summer was that there was no carbonic anhydrase, and that other mechanisms of acid secretion and bicarbonate reabsorption independent of the enzyme had evolved in these fish (reviewed in Can J Physiol Pharmacol 52:1041,1974). A life-long attachment to MDIBL and the value of studying marine life with this work was born. He returned to the question of the lack of CA involvement in renal acid-base transport many times during his sojourn at the laboratory, and I had the pleasure of collaborating with him to further define these mechanisms (Am J Physiol 250:F1986, 1987, and Am J Physiol 267:F639,1994). As is often the case in science, initial findings are ultimately overturned. In collaboration with Larry Renfro, he found that carbonic anhydrase is present in small amounts in marine fish kidneys, but it subserves a unique purpose, that of sulfate excretion (Am J Physiol 276:F288, 1999). These and many such interesting biological questions and studies of the enzyme's function in marine organisms often provided him with crucial insights into the roles of carbonic anhydrase in mammals and humans, a notable example being the mechanism of cerebrospinal fluid secretion (Am J Physiol 222:885, 1972). He was a powerful advocate of comparative physiology and its ultimate value to clinical medicine.

As alluded to above, it is no surprise that Tom Maren is the single individual most closely linked with carbonic anhydrase. His contributions include many seminal studies into the physical chemistry, biochemistry, physiology and pharmacology of the enzyme and its inhibitors. Hardly a facet of this remarkable and ubiquitous enzyme escaped his curiosity or failed to yield to his theoretical and experimental skills. His work has led to

a better understanding of the roles of carbonic anhydrase in respiration and fluid secretion, and to the safe and effective use of carbonic anhydrase inhibitors. The pioneering work on Diamox kept him always in the forefront of basic research in ophthalmology. In the mid 1970s, he returned headlong into glaucoma research with a new idea opposed by all leaders in the field. He was certain that carbonic anhydrase inhibitors could be applied directly to the eye via the cornea, and so avoid the debilitating side effects of oral inhibitors, that limited the sight-saving use of Diamox. Much of his thinking in this area was stimulated by his work at MDIBL and critical collaborations with other MDIBL investigators. Thus, it is entirely fitting and not surprising that his most notable contribution to clinical medicine and pharmacology, the design and successful synthesis of topically applied carbonic anhydrase inhibitors for glaucoma closed a full circle. Diamox, the drug he so successfully launched at the start of his career, has now faded into relative obscurity by the advent of Trusopt (dorzolamide); following his patented concepts of an effective topically applied drug with virtually no side effects.

Beyond Dr. Maren's far-reaching scientific work was his enduring commitment to the people, scholarship and traditions of those institutions he loved. At the laboratory he served for many years as a member of the Board of Trustees and on its scientific advisory committees. He was often a voice urging remembrance and continuance of the laboratory's heritage and "verities," particularly in unsettled times of change. Many others and I were drawn to the lab by his infectious enthusiasm not only for the place, but also for the science. He was equally liberal in praise and criticism, always intended to promote the best. In the last several years, Dr. Maren and his wife, Emily donated generously to the new sea water system and the Co-op. On the occasion of the laboratory's centennial celebration they provided the enabling funds for the beautiful restoration of Dahlgren Hall and its expansion as a first class conference facility, whose auditorium now bears his name. Although understanding the value of bricks and mortar, his deepest concern for the future was always the quality and commitment of individuals working on basic questions. In order to further this best strength of MDIBL, four years ago he established the Salsbury Cove Research Fund. This endowment has and will continue to provide the laboratory with funds to recruit and support new and established investigators willing to "throw their lot in with the lab," as he did so magnificently and unstintingly. In a memoir (Ann Rev Pharmacol Toxicol 22:1-18: 1982) entitled Great Expectations, he wrote of how he had always been blessed by the great expectations held out for him. Possibly his great expectations of the laboratory will be his finest gift to us.

Erik R. Swenson, MD
Associate Professor of Medicine
University of Washington

REMEMBERING ROY P. FORSTER (1911-1998)

The following are talks (or excerpts) delivered at the Roy P. Forster Memorial held at the Mount Desert Island Biological Laboratory on August 7, 1999.

My father was a born teacher. He taught me most of the useful things I know. Certainly he tried to teach me how to think, with mixed results. Generations of his students describe how Daddy's joy in learning ignited sparks in their minds. So it was with me.

My experience of science (through Daddy) instilled a sense of awe about the natural world that worked compatibly with the general messiness of biology. To understand kidney function, I learned, would be to comprehend the ways of the universe. To contemplate the ocean is to experience intimations of man's origin: "I say it touches a man that his tears are salt, that the seed of his loins is scarcely different from the same cells in a seaweed, and that of stuff like his bones is coral made". Daddy posted these words wherever he worked and I absorbed them as essential wisdom.

Wisdom, I learned, we derive from great thinkers (among them Shannon, Smith and Marshall), from cartoons, from poets, from the Bible ("Ask the fish of the sea, and they will declare unto you."), and from the mouths of babes. Probably because his mind was alsways at play, he sought kindred spirits among the young. He once surprised a game of "cowboys and indians" by appearing with a toy arrow through his head- scaring the daylights out of the boys. He traded marbles. He read Mad Magazine. He dressed up on Halloween and insisted that trick-or-treaters perform tricks to earn their treats. Lucky is the child whose parent is full of mischief!

And fortunate is the daughter whose father knows how to dance. From Daddy I learned the waltz, fox-trot, rhumba, polka, and how to fake any rhythm with a samba. We once won a dance contest on a transatlantic ship by dancing the samba step to every number! (There are many lessons in this story.)

Our family never made it through a meal without consulting a reference book. Daddy was fastidious about grammar, which accounted for some of this research, but there just always seemed to be more questions than answers- a phenomenon that supports my chosen career as a librarian. One of the most important lessons my father taught me was that questioning is intrinsic to a happy life. Not only did this principle eventually provide my livelihood, it absolutely precludes the possibility of ever becoming bored.

In short, my parents taught me how to live. Although only my father's legacy is written in textbooks, as his lifelong partner, my mother completed the team. They lived simply, but well. They counted their many blessings, and made sure that I did too. Among their happiest hours were evenings spent in Salisbury Cover (Daddy spelled it Salsbury) on the deck of the old Procter shack, enjoying the breathtaking view. My mother often said that nobody had a better life than theirs. Could be true.

Peggy Forster Hyde
Etna, New Hampshire

Roy Forster earned his Ph.D. at the University of Wisconsin in 1938. Later that year he came to Dartmouth. Colin Holman and I were then junior premedical students. Our zoology courses had been chiefly oriented to anatomical studies. We were delighted by Roy as Dartmouth's first Physiologist. We taught him how to bend beer cans and wax skis. In return, he very shortly had us doing the newly developed renal clearance measurements on the fresh water turtle *Pseudomys elegans*. He was interested in comparative physiology.

Characteristically, Roy's voice always transmitted enthusiasm, particularly if he were speaking of new scientific advances. Colin and I became as close as family with Roy and Dorothy. When Peggy arrived we sent an elegant blanket for her crib.

Roy took me with him to visit Homer Smith the world leader in renal physiology at New York University.

In 1939 Roy invited me to spend the summer here at Mt. Desert Island Biological Laboratory. Among other things, we learned his secret of making the best martinis known to the scientific world – and he made quite a few. Jim Shannon was also here – a major intellectual power, a leader and later to become head of this country's National Institutes of Health.

Roy's scientific guidance was both deep and inspiring. He set me on the track of a fungus disease of herring, which was costing the state of Maine millions of dollars a year in condemned catches. It proved impossible to grow this fungus on any known culture medium until the obvious idea of making herring agar let us see its life cycle.

That summer Roy also discovered a terrific Jazz group broadcasting at the unlikely hour of 2:30 wednesday afternoons. It's name "the Chamber Music Society of Lower Basin Street" was appealing as was its vocalist, an unknown 22 year-old school girl named Dinah Shore!

Roy's superb teaching ability and his scientific stature led to the Presidency of the Laboratory and also to national leadership. Dorothy, his wife, sadly died in 1991. His daughter, Peggy Hyde is well, living in Etna, N.H.

As with us all, in recent years Roy had some confusion when first awakened. When I called him last year and introduced myself, he asked "Why are you calling me?". My answer was, "Because you have been the most important man in my life".

Allan L. Friedlich, M.D.
Harvard Medical School

Back in 1952 I had the good fortune of being invited by Homer Smith to come to MDIBL to collaborate with Roy on urea secretion by the frog.

Roy Forster was a happy man full of humor, full of fun and kindness, and intensely interested in his work. Roy was a family man. He and Dorothy hiked the mountains together. They gave delightful parties, and saw to it that none of the young people were left out. In the early morning you could see him walking from his house to his laboratory along the narrow path that follows the edge of Laboratory Cove. I was introduced to Peggy when she was about 11 years old and found her a spirited young gal.

Whenever I think about Roy I see in my mind a series of very vivid pictures. No, that is wrong. They are not static pictures, they are more like videos because Roy was always doing something. Three months of the year Roy did his research in Maine at MDIBL. He worked all the time he was in Maine from early June through August. It was in Maine that he did all of his research, because back at Dartmouth he had a heavy teaching schedule. That he was an inspiring teacher I heard from one of his former students just a week ago at a dinner party given by Joyce Lewis. Her brother Bill Cochran is about 65 years old. He suddenly began speaking about Roy Forster saying that Forster's lectures were so fascinating that the auditorium was absolutely quiet so you could hear a pin drop while they listened to him. I heard Roy speak many times at MDIBL, but because I enjoyed Roy's humor, to me his most memorable performance was an introduction he gave for E.K. Marshall Jr.'s talk. He mentioned how he would go to Marshall discussing some scientific problem, seemingly the conversation was going along amiably, but as Roy was leaving, he would discover a knife firmly implanted between his ribs.

There are photographs of Homer Smith supervising research here at MDIBL. Homer Smith stands on the dock with his hands behind his back. This was not how Roy did things. Roy was forever in the middle of the action. There is a series of photographs of Roy and Leon Goldstein when they got hold of the first Latimeria. It had been believed to be extinct and now they got their first chance to look at it. In the first picture Roy is standing back letting Leon, his young colleague cut into the fish, but a moment later Roy eagerly has grabbed the scalpel and is leaning over the fish, while Leon looks as if he is overcome by the smell of the fish.

Now let me give you some of my many fond memories:

It was Homer Smith who suggested that I work with Roy because I was working on urea secretion by kangaroo rat tubules and Roy was interested in urea secretion in the frog kidney tubules, a continuation of E.K. Marshall's work. Together we went to work. Both of us steeped in Homer Smith's techniques for studying kidney function, we found an ideal partnership. I had a lab in the Halsey building right across from Roy's lab in Lewis. We soon found out that we could easily divide the work between us combining the analytical methods we each had.

During that memorable summer in 1952 my whole career opened up thanks to Roy and thanks to MDIBL, as I saw the endless possibilities in comparative physiology, and Roy was the personification of it all. Everything we did was an adventure and full of fun. When our frogs, shipped to us from a dealer, were found to be diseased we needed fresh caught frogs, so Roy

took us on a frog hunting expedition and enlisted Ray Rappaport to help catch them in Witch Hold pond (with permission from the park service, of course). It was a quaking bog, as Roy warned us, and every once in a while one of us sank through the matted of vegetation along the shoreline and deep into the water. Ray performed admirably and caught most of the frogs and Roy said he had web feet.

Not long after this expedition a note appeared announcing a trip for the entire Laboratory community. The note said: Expedition into the great heath and on to Lakewood led by Web-foot Rappaport, Push-up Schmidt-Nielsen and the Crying Crooner. Roy was the crying crooner, he used to croon in the lab like Bing Crosby. I got the nick name Push-up S-N because of the push-ups I did on the dock daily before my swim. Roy played innocent, he had nothing to do with the notice, but the truth came out!

In great spirit, we all set out into the stream that leads into Hamilton Pond with Homer Smith in the lead. Homer stepped right into the creek saying, "If Bodil can do this I can too". Roy led us through the heath and through the burned out Forest at Lakewood, climbing over charred and burned fallen trees (it was only five years after the great fire of 1947), while the laboratory families waited for us with food at Lakewood.

Another picture of Roy that I have is from the trips with the fishermen to collect goosefish for Roy's research on the aglomerular fish. We had to meet on the pier in South West Harbor at 3:00 am. The fishing vessel was dragging for fish. As the hauls came in we searched for the fish we were interested in, and Roy's goosefish were properly taken care of. When the trip was finished I saw Roy walking down the gangplank dragging in huge wolffish by the gills singing, "walking my baby home". And what did he use the wolffish for? Roy cooked fish chowder for everybody in the laboratory. The best chowder I have ever tasted.

The goosefish were put to good use by Roy who was studying the function of the kidney tubules and secretion of dye. The fish were catheterized and placed in small round galvanized washing tubs while Roy was doing his experiment and collecting samples. I can still see him stripped to the waist walking from tub to tub as he collected urine and blood samples.

Now, one of the great things about Roy's research was that he knew that only fresh healthy animals can be used if you want good physiological data. One time, however, Roy wanted to follow through with an experiment to see what happened in a fish that was in pretty bad shape. At that time Roy was working with the Swede Fred Berglund. Fred had told Roy a story about two Swedes sitting in a bar drinking heavily. One of them pointed to a man across the bar saying, "Isn't that Anderson sitting over there?". The other Swede said, "No, don't you remember he died and we went to his funeral last week?". The first guy kept staring and pointing with a shaking hand, and then he said "yes, but he moves". Now as Roy worked on the dying goosefish, Fred told him- "Give up Roy, the fish is dead". "but it moves", said Roy.

Roy pioneered the work on isolated fish tubules where he could study the dye (phenol red) secretion through the cells and into the tubules directly under the microscope. For this he needed very fresh fish. I recall an early morning looking out over the Cove, seeing Roy and his crew sitting comfortably in a rowboat fishing instead of working in the lab. That looked very

pleasant but how could they take the time off. They were not taking time off, they were fishing for flounders. As soon as a flounder was caught it was brought into the lab where the kidney tubules were teased out and placed in Ringer solutions for the experiments.

I have another story that illustrates Roy's ingenuity, generosity, and marvelous spirit. I came to collaborate with Roy again a few years later. This time, it was Roy's idea that Leon, Roy and I should work together to study when in the course of development the frog gets the capacity to actively secrete urea. The urea cycle enzymes had been shown to appear at the time the tadpole loses its gills and goes on land. Again we caught our own animals, this time in Lakewood. The tadpoles become frogs when they have grown hind legs and the tail has been partly reabsorbed. That is, the tail gets shorter and the hind legs get longer and at one point in time, tail and hind legs have the same length. That happens to coincide with the time the tadpole becomes a frog. We collected blood and urine samples from tadpoles before and after this happened. There were lots of analysis to do and Peggy Forster, who was working with us, was doing glucose analysis. All the bench space left for Peggy was the top of a stool, where she managed to have her test tubes and reagents neatly arranged. With all of us coming and going and messing up Roy's small laboratory, Roy did not complain, but one morning we saw that he had marked off his desk space by nailing wooden strips around it. A sign in the middle of the space read: **"Renal Roy's private sea of tranquillity"**.

Now Roy has reached his private sea of tranquillity and we shall all miss this unique and wonderful man. I am glad he lived so long that we had time and opportunity to tell him how much he influenced each of our lives and scientific careers. I know that my life has been infinitely enriched by Roy's teaching and example and the pleasure and fun of knowing this delightful man.

It has been proven that laughter and fun are good for our health but Roy knew that laughter was also good for scientific research. To a rare degree Roy knew how to combine work and having a whale of a good time.

Bodil-Schmidt-Nielsen, Ph.D.
University of Florida

I am here because Roy infected me with the research virus. Also, by example, he showed me the joys of teaching.

After taking his course in Physiology, my buddy and I asked Roy if we could do "some research". He set us up with a piddling project. By "piddling", I mean the effects of water diuresis on renal functions in the rabbit. He showed us the techniques, approved our protocol and left us alone. I mean he really left us alone for this was the summer of 1945 when Roy was here trying to save this Laboratory. Under these conditions we learned several things the hard way. Such as, when you put a stomach tube into a rabbit, you had better listen to it. For if you hear air moving, you are in the wrong place.

Later I went to graduate school. And of course, I went to the University of Wisconsin where Roy had earned his doctorate. Eventually I returned to Dartmouth on the faculty where we worked together on transport processes in thin kidney slices.

I also had the pleasure of working with and learning from Roy as a teacher. He brought an enthusiasm to the class that infected his students. Out of a faculty of 350, Dartmouth students once elected Roy Teacher of the Year.

John H. Copenhaver, Ph.D.
Dartmouth College

I came to work with Roy at Mount Desert Island Biological Laboratory in August 1957. As a lowly graduate student I was apprehensive about working with Roy whom I had heard so much about but hardly knew. One day, soon after I arrived, Roy handed me a box of tea and asked me to brew a pot. Not having much experience making tea with tea leaves, I put the leaves in a pot, added water, and proceeded to boil the mixture for about ten minutes. After swallowing the first gulp Roy said, "That ought to loosen a few fillings." After that I knew we would get along well.

I worked with Roy for the next 25 years, first as a graduate student, then as a junior collaborator, and finally as a partner in research. He was a wonderful scientific role model. The most important lesson I learned from him was asking the right research questions and that the answers you got could be no better than the questions you asked. From the beginning, Roy encouraged me to do my own thing. He was never directive nor did he ever stop me from starting a new line of investigation. He was always supportive, even when he had his doubts about the outcome.

As a person, Roy was a real "mensch": he was respected and admired by all for his intelligence, charm, wit and warmth. He could charm the local patricians (when he called upon them for donations to the Lab) as well as the local fisherman whom he depended upon for a steady supply of goosefish.

Personally, Roy was like a big brother to me, and our families became quite close. Roy loved kids and took a special interest in mine. He liked entertaining them when we visited his cottage. One of his forms of entertainment involved Roy disguising himself as a pirate (Captain Bloodshot) and coming out of a shed next to his cottage accompanied by the squeals of the startled children.

In 1972, Roy drove from Hanover to Providence on a snowy day to attend my son Jon's Bar Mitzvah. During the reception following the ceremony Roy engaged our Rabbi, a well-known Biblical scholar, in a philosophical discussion about the attitude of Judaism towards animal experimentation. Roy and the Rabbi continued their discussion by mail after that.

As mentioned above, our families remained close over the years, even after Roy stopped coming to MDIBL. Roy and I would speak on the phone often and catch each other up on family affairs. Last year, Roy told me that he kept on his desk a picture of my granddaughter, Kyra, that I had sent him.

Leon Goldstein, Ph.D.
Brown University

Today the entire MDIBL Community joins with the Forster family in celebration and remembrance of Roy Forster. We are grateful to Leon Goldstein and Roy's daughter Peggy Forster for organizing this special occasion.

My charge is to describe Roy's unique contributions and service to the Laboratory throughout his many years at MDIBL. Roy Forster literally saved this special place. Let us set the scene. Roy came here in the summer of 1937, as a graduate student, at the invitation of James Shannon, founder of the National Institutes of Health. In 1938, after considering several other institutions, he accepted a position at Dartmouth College, for he knew that he wanted to teach and do research at an undergraduate institution. Just two years later, in 1940, he became the youngest scientific director of MDIBL. The crunch for the Lab came soon, in 1945, when World War II was winding down. In Roy's own words, "The Lab was dead broke". It had been closed almost completely during the War. The dock had been totally demolished and the few buildings were in disrepair. Smith and Marshall, the two scientific leaders of the Laboratory were pessimistic about the Lab's survival.

Roy Forster decided to seek support outside of the lab, with "hat in hand", as he put it. He went first to Providence, Rhode Island to visit Henry Sharp, Sr., and then to Sorrento to visit Avery Thorndyke and he managed to raise $3,000, a princely sum in those days, before the advent of NIH and NSF. It was enough to rebuild the dock, paint the buildings, and get the Lab back on its feet.

His second period of service was as President of the Laboratory from 1964 to 1970. In these heydays of NIH's expansion and support, the role of the Lab President was largely honorific. Roy was the gentle patriarch of the Lab. As President, he coined a phrase that has been passed down quietly from Director to Director. It originated from a different era of governance and the phrase certainly sounds like Roy. "The role of the President," he said "is to stay out of the way of the Director"!

Roy's scientific leadership had two components. First, he was a developer of important techniques. In a single author paper in *Science* dated July 16, 1948, he reported on the first use of thin kidney slices and isolated renal tubules for direct study of cellular transport kinetics. This seminal technique for isolating renal tubules is used worldwide to this day. The second and equal component, is that he was a gifted and imaginative teacher. He drew students to him by his innovative ideas, his originality, his engaging humor and wit and his technical expertise, particularly in obtaining urine and tissue samples from many fish species.

I close with a few personal reflections on this extraordinary man, whom I can see still talking with a colleague by the mail shed or offering up his special goosefish chowder. Roy was a personal hero who loved words, quoted Latin and studied fish. He was charming, sophisticated, attentive, patient, a little mischievous, and modestly gracious. He reminded us of the best sides of others. Words were jewels to Roy, and he used them to teach in subtle ways. I first came to MDIBL in the summer of 1970, in the full blush of that confidence that comes from serving as a Chief Resident in Medicine at

Yale. He subtlety pointed out the limitations of the institutional reputations. Referring to the cardiac glycoside "ouabain", he quipped, with a twinkle in his eye "Everyone from "*Yayhle*" mispronounces that word." Years later, on the lawn of the Eden Baptist Church at the August band concert, my wife Catherine introduced our youngest child, one month old Suzanne, to him as her "last hurrah". Reminding Catherine of the seasons of life yet ahead, Roy quipped "She's just your frost blossom!"

To his daughter Peggy, to his sister-in-law Verna, and other members of his family, the Laboratory thanks you for generously establishing the Roy Forster Fellowship Fund, which will grow with the help of his friends and former colleagues. MDIBL looks forward to awarding the Roy Forster Fellowship as a lasting memorial to this fine and special person.

John N. Forrest, Jr.
Yale University

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