

Serendipity in Science

Book Preview



Research Lab hallway at opening of Niskayuna, NY GE Research Center, 1950. Left front to back: Dr. V. J. Schaefer; Dr. B. Vonnegut; Dr. J. D. Cobine; Dr. K. B. Blodgett; Mr. A. H. Young; Dr. J. R. C. Brown; Dr. P. D. Johnson. Right front to back: Dr. W. R. Whitney; Dr. C. J. Gallagher; Dr. A. W. Hull; Dr. S. Dushman; Dr. J. M. Lafferty; Dr. S. Roberts; Dr. J. S. Prener; Mr. J. Martens, Dr. L. R. Koller; Mr. E. Finley; Mr. R. W. Larson. Courtesy of Schenectady Museum.

Serendipity in Science

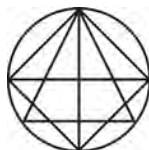
Twenty Years at Langmuir University

An Autobiography

by

Vincent J. Schaefer, ScD

Compiled and Edited by Don Rittner



Square Circle Press
Voorheesville, New York

**Serendipity In Science: Twenty Years at Langmuir University
An Autobiography by Vincent J. Schaefer, ScD**

Published by
Square Circle Press LLC
137 Ketcham Road
Voorheesville, NY 12186
www.squarecirclepress.com

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First American paperback edition, 2013.

Printed and bound in the United States of America on acid-free, durable paper.

ISBN 13: 978-0-9856926-3-6

ISBN 10: 0-9856926-3-4

Library of Congress Control Number: 2013933876

Compiled and Edited by Don Rittner.

Original transcription by Michael Sullivan.

Foreword by Michael Sullivan.

Preface by Don Rittner.

A Brief Biographical Sketch of Vincent J. Schaefer by Duncan Blanchard.

Publisher's Acknowledgments

Cover ©2013 by Square Circle Press; design by Richard Vang. Illustrations are credited within the text.

The acknowledgments of the Editor appear elsewhere in this book.

A portion of the proceeds from this book will be used for a college scholarship and grants program for students in the field of atmospheric science.

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Foreword

His formal education cut short by the need to help support his family during the Great Depression, Vincent Schaefer spent a lifetime educating himself. As part of his ‘informal’ education he spent twenty years working as a laboratory assistant, and later colleague, to Nobel Prize winner Dr. Irving Langmuir. While at “the Labs” (General Electric Laboratories) he was involved in the basic research that led to the development and refinement of color TV, sonar, cloud seeding, and many other technological advances.

As a child growing up I didn’t appreciate much of this, but I knew that my grandfather, Vincent J. Schaefer, was very special.

He was a tall and imposing figure, but his warm smile and a laugh that cascaded gently through three octaves put everyone instantly at ease. He had an infectious curiosity about practically everything and seemed to always have three or four fascinating projects going on. If an idea occurred to him, he would head down to his workshop in the basement and set about creating a prototype. He was always finding patterns, and experimenting to see what explanation might be lurking behind them.

Some of my fondest memories are of time spent with him. As we walked in the woods he would point out interesting rock formations, deformed trees, or patterns in ice, and ask me to try to figure out what had caused them. Most often he knew the answer, but when he didn’t he was quick to say, “Wouldn’t it be great to be the one who figured it out!?” When I was around ten years old he taught me how to capture snowflakes, and preserve their structure as a plastic replica on a glass slide using a process he devised. Several times he recreated for us that magical moment where he discovered the use of dry ice to seed supercooled water vapor to make it snow in a freezer in his cellar.

Working on this book brought me closer to the memory of my grandfather, and helped me to know him in a much more personal way than I had before. I hope that others who read it will be similarly touched by the account of his approach to lifelong learning.

Michael Sullivan

Book Preview

Preface

If you are lucky in life you will meet someone along the way that will have a profound effect on the way you look at the world. I was such a lucky lad when I was nineteen and a freshman at the University at Albany in New York State. Lou Ismay, who was the head of the university's Environmental Forum, decided it was time for me to meet Vince Schaefer, the man who invented cloud seeding. Lou enlisted the aid of another friend, Al Hulstrunk, who then arranged for me to go to the Schenectady Airport where Vince had set up his famous freezer for demonstrating cloud seeding.

It didn't take long to like Vince. He was an outgoing, very friendly man who wanted to share his knowledge with you. That was the beginning of a friendship and mentoring for me for the next twenty-five years. While Vince was famous for cloud seeding, he was so much more than that. He loved archeology, natural history, hiking, and everything else. I shared those interests as well and that is why Vince was such a good mentor. He loved to share and I was eager to learn.

When Vince was starting the Dutch Barn Preservation Society years ago, we had long talks about what it should do but also about the Dutch contributions to the American way of life that at the time was poorly understood. Vince of course owned one of the most classic Dutch barns—the Teller-Schermerhorn barn on his property, along with a Dutch-styled home that he built by hand with his brothers in the Town of Rotterdam off Schermerhorn Road, a location which had a historic home or two already located there.

During my early career as city archeologist for Albany I would often consult with Vince, since as a youth and throughout adulthood he had not only located and excavated many local sites, he also created the Van Epps-Hartley Chapter of the New York State Archeological Association.

When I began championing the preservation of the Albany Pine Bush, Vince was right there to help me since he studied the area in the 1950s. When I needed to learn about the geology of the region, Vince was happy to take me around and show me features and landmarks including several caves, Vroman's Nose, drumlins, Thacher Park, and of course, the Pine Bush.

As you will find from reading his autobiography, Vince was a keen observer and writer. He often told me to look for the obvious in that nature's solutions to how it functions was often very simple and logical and that we humans tend to try to make it too complex. Vince's lab director Roger Cheng proved that observation by making major discoveries in the formation of acid rain, the freezing of a water drop, and evaporation of seawater simply by studying three drops of water. Roger, a native of China, came to America with his sights

set on working specifically for Vince and spent the next twenty years running his lab. Vince encouraged his lab director to do his own experiments when he had down time, something I doubt happens very much in today's labs.

Throughout my career I have tried to emulate Vince's penchant for sharing information. As you will read in his autobiography, Vince gives much credit to his own mentor, Irving Langmuir, but it was Vince's inquisitiveness and perseverance that separated him from so many others. His relationships with others, including fellow scientists, was remarkable and devoid of the jealousies and competitiveness so prevalent today.

Toward the end of his life Vince had an offer from a publishing company to write his story. He agreed, and every morning for over a year he brought his handwritten text to his secretary at the ASRC, getting a typed manuscript back each afternoon. Once completed, he submitted the manuscript to the publisher. Weeks later Vince received a letter from the publisher explaining that the manuscript was a true "biography," but that they wanted a book with more of a broad educational twist. Vince felt too exhausted to take up the publisher's challenge and dropped the idea. However, he continued to correct the manuscript, and declared it "complete and finished" just a few months before his death.

The main text, written in his own words, often speaks to the present time in which he wrote. The pieces that comprise the "memories" section at the end of this published version were solicited from Vince's colleagues, friends, and family by his daughter Kathie after he passed away, and thus they also often speak in the present tense, or speak directly to Vince's family. These were edited for consistency and, except for "published" pieces, were given titles to distinguish them from each other.

As the editor, I tried very hard to retain the main text as Vince had written it, but some editing was required. For example, commas were sometimes inserted to elucidate some of his longer sentences, and a few spelling changes were made, mainly for consistency. One specific word that I discussed with the publisher was "archaeology." Vince, even from an early age, considered himself to be a modern, North American practitioner of this science, and therefore preferred "archeology" (without the second "a"). Out of respect for Vince, the modern spelling is used throughout the book. But despite these few changes and edits, this book remains as Vince wrote it.

It is my hope that his writings will inspire many more to open their eyes to the mysteries of the world and not be afraid to go on that path to explore and understand them. More importantly, while on that journey try to be a mentor to a young mind who shares that same curiosity. Vince would approve.

When Vince passed in 1993, his friend Everett Rau summed up what everyone knew about the man: "Vince was outstanding to many. He was like a straight tree in a forest of people. To a stranger walking the forest this tree was strong, thoughtful, sharing, a giver, a doer. What joy just to stand and listen and learn and be encouraged to think and find answers for the benefit of others."

*Don Rittner, Historian
City and County of Schenectady*

Acknowledgments

I would like to acknowledge Jim Schaefer and the entire Schaefer family for allowing me the privilege of publishing Vince's autobiography. Thanks to Mike Sullivan for taking the time to arrange and transcribe Vince's copious notes about his life and getting it into a digital format. Special thanks to Duncan Blanchard, a surviving member of Project Cirrus, for his biographical sketch of Vince, and also to Roger Chang for photos of Vince and his colleagues. Chrissie Reilly, CECOM LCMC Staff Historian from the Aberdeen Proving Ground, Maryland, supplied the photos of Project Cirrus and the H-1 Hurricane Seeding conducted in 1948. Chris Hunter, Archivist at the Schenectady Museum (now the Museum of Innovation and Science), was instrumental in supplying many of the Project Cirrus photos, as well as those of Vince and his colleagues at GE. Special thanks to Susan Holland for proofreading and to Richard Vang at Square Circle Press for bringing this project to the public.

I have included footnotes where I felt it appropriate to update or expand on something Vince mentioned.

Don Rittner, Editor

Book Preview

A Biographical Sketch of Vincent J. Schaefer

History was about to be made. On the afternoon of the 13th of November, 1946, a small, single-engine plane approached a large cloud east of Schenectady. The altitude was 14,000 feet, the air temperature -20°C . Inside the cramped quarters of the aircraft, Vincent Schaefer was giving last minute instructions to the pilot on the experiment they were about to carry out within the cloud. As they flew into the cloud, Schaefer dropped about three pounds of dry ice. Later he wrote in his notebook, "I was thrilled to see long streamers of snow falling from the base of the cloud." He shouted to the pilot to swing around, and "we passed through a mass of glistening snow crystals." They then went west of the cloud, and "we observed draperies of snow which seemed to hang for 2 to 3,000 feet below us, and saw the cloud drying up rapidly."

No wonder Schaefer was excited. What he had accomplished that day was the first successful demonstration that a natural supercooled cloud could sometimes be converted into a cloud of ice crystals.

Vincent Schaefer was not a meteorologist by training. For that matter, he had no formal training in any branch of science. But a first-class mind, unsurpassed powers of observation, and an insatiable desire to understand natural phenomena enabled him to chart a unique trail that led from one scientific adventure to another. Although he never knew in what area of natural science his next discovery might come, and he certainly had no inkling a few years before that he would discover the world's first practical technique of cloud seeding, those who knew him were not surprised at what he did on that day in November, 1946. His total communion with nature seemed almost to decree it.

At the age of sixteen, with financial hardships pressing in on the family, he dropped out of high school and went to work for the General Electric Company and completed the rigorous four-year course for apprentice toolmakers. He worked elsewhere briefly but eventually became an instrument maker at the General Electric Research Laboratory in Schenectady, NY.

At the research laboratory, the Nobel Laureate Irving Langmuir noticed that this young instrument maker had a keen mind that could pose interesting scientific questions, and an amazing talent to build simple devices with which the questions could be answered. In 1931, the year before Langmuir won the Nobel Prize in chemistry, he asked Schaefer to become his research assistant and work with him in the laboratory. Thus began a scientific adventure that during the next twenty years was to blaze a trail from one successful experiment to the next. It was a marvelous scientific symbiosis in which the older Langmuir would make theoretical predictions for the latest scientific puzzle, and the younger Schae-

fer would approach the answer with deceptively simple experiments. By letting theory and experiment both feed back into the other, they made rapid progress in research. During the 1930s they published papers on a variety of topics in surface chemistry.

Shortly before World War II they were asked by the government to design a filter for gas masks to trap toxic smokes. In working on this project they took advantage of serendipity, which in Langmuir's definition was "the art of profiting from unexpected occurrences." When they finished the toxic smoke project, they became involved in making more efficient smoke generators to screen military operations at sea. With Langmuir supplying the theory, and Schaefer the elegantly simple experiments (at one point an oil can, some oils, and a heater that can be bought in any hardware store), they quickly developed smoke generators vastly more efficient than those used by the armed forces.

From smoke generators, they turned to precipitation static on aircraft. Pilots flying through snow in the Aleutians reported that the impact of snow on the plane produced unwanted static and loss of radio contact. The government asked Langmuir and Schaefer to look into this problem.

They decided to work atop Mount Washington in the wintertime. There, in the clouds and strong winds, Schaefer exposed several metal surfaces to the clouds at temperatures of -10° to -30° Celsius; but instead of ice crystals striking them, to his surprise the surfaces rapidly became covered with ice. The clouds were composed of supercooled water droplets! Why weren't there snowflakes in the clouds? This was a question that so excited Schaefer that he began a series of experiments that culminated in his classic cold box experiment.

He devised an experiment that was beautiful in its simplicity. He took an ordinary home freezer, lined it with black velvet to provide a dark background, breathed into it to produce a supercooled cloud, and looked to see if there were any ice crystals in the beam of a microscope lamp. That's all there was to it, simple yet elegant.

Though the temperature in his cold box was far below 0° Celsius, he seldom saw any ice crystals. He spent weeks trying an endless variety of materials that he sprinkled into a supercooled cloud. Nothing worked until serendipity played a role. On a hot, humid day in July, 1946, the air in the cold box was not as cold as usual. Schaefer, in a desperate attempt to cool the air, placed a block of dry ice in the cold box. When he breathed into the cold box to produce a cloud, the water droplets disappeared and in their place were millions of tiny ice crystals that danced and sparkled in the light beam as though alive. At last, Schaefer had found the trigger by which he could convert supercooled droplets into ice crystals.

In the spring of 1947 the government-sponsored Project Cirrus was organized. During the five years the project was in operation, numerous seeding missions were carried out, countless discoveries were made, many instruments were developed, and a basis for a practical seeding technology was established. Besides Langmuir and Schaefer, Bernard Vonnegut, Raymond Falconer, and Duncan Blanchard were also members of Project Cirrus.

In 1954, Schaefer left General Electric to become Director of Research of the Munitalp Foundation (spell it backwards). During his four years with Munitalp he initiated many research programs, including one on orographic and noctilucent clouds with the International Institute of Meteorology in Stockholm.

In the early 1960s Schaefer was the prime mover behind the formation of the Atmospheric Sciences Research Center at the University at Albany. In large part because of the great admiration they held for Vincent Schaefer, both for the man and the scientist, Vonnegut, Falconer, and Blanchard (three members of the group who had been privileged to work with Schaefer during the exciting years at Project Cirrus, and who had shared with him the exhilaration of being at “Langmuir University”), joined him once again as members of his fledgling research center.

A tribute to Vincent Schaefer must include more than just an account of his research activities. He was never an ivory-tower scientist. To Schaefer the communication to others of the excitement and joy of research and discovery was as much a part of the adventure of learning as breathing is of living. He was convinced that the fun of learning is often stifled by the oppressive atmosphere of the classroom, and that the ability of young people to discover the world around them is enhanced by taking them out into the field and letting them learn by doing. To put these ideas into action, he established in 1969 what was to become the Natural Sciences Institute. Over the next ten years some 500 high-school students from all over the United States took part in these adventures of learning.

Schaefer taught that money and sophisticated scientific equipment do not guarantee the discovery of new truths, and that simple, well-designed experiments are more often the gateway to new discoveries. He put this very eloquently in an article in the 12 December 1959 issue of *Saturday Review*:

“Before we can challenge the young, we older people of America need to change many currently popular attitudes. We must accept the idea that money does not purchase new ideas. Expensive equipment and campus-like surroundings for research laboratories are no guarantee of effective spending of research dollars. The idea that the string-paperclip-sealing wax scientist is gone forever and that he has been replaced by the ‘team’ is a dangerously misleading philosophy. New ideas come from brains—generally in the singular. Our finest heritage is still freedom of opportunity for the individual.”

Over the years many honors and awards were bestowed on Vincent Schaefer. In the long list one will find three honorary degrees. In 1948 he was awarded the Doctor of Science degree from the University of Notre Dame, in 1975 the degree of Doctor of Humane Letters from Siena College, and in 1983 the degree of Doctor of Humane Letters from York University in Toronto. In 1953 he received the Robert M. Losey Award from the Institute of Aeronautical Sciences, and in 1957 the American Meteorological Society

presented him with the award for Outstanding Contributions to Applied Meteorology. In 1976 he was the first recipient of the Vincent Schaefer Award, presented by the Weather Modification Society, and was given a Special Citation by the American Meteorological Society.

Vincent Schaefer died on July 25, 1993. In the words of an old Hebrew proverb, we should: "Say not in grief he is no more, but live in thankfulness that he was."

Most of this information was taken from my article, "Vincent J. Schaefer: A Tribute," that appeared in the ASRC Report of 1975-76.

I want to end with a few words about my interaction with Vince Schaefer. He more than anyone else made it possible for me to become a scientist. In 1947, just a few months after I was hired by the General Electric Company in Schenectady, Vince welcomed me aboard Project Cirrus, where I spent a happy two years learning what it was like to become a scientist. In 1968, when I was at the Woods Hole Oceanographic Institution, he invited me to become a member of his Atmospheric Sciences Research Center. I accepted the invitation, and so did Ray Falconer and Bernard Vonnegut. The old Project Cirrus gang was together once again. I stayed at the ASRC until I retired in 1989.

Duncan Blanchard

Serendipity in Science

Book Preview



Vince cooking his meal over a campfire with a friend (date unknown). Courtesy of Jim Schaefer.



Vince, Eleanor Nichols and Ray Hagedorn find a turtle, 1932. Courtesy of Jim Schaefer.

I

The Formative Years

Book Preview

Book Preview

Chapter 1

Dreams and Action for the Future

Introduction: The Purpose for This Book

I have had a fascinating life! Its course and development could only happen in America, and I am not sure the happenings which I will tell you about could occur at the present time, though I think they could. The presence of the computer in hiring practices and decision-making has so modified the procedures, rules and regulations, that it might be a barrier to an individual's progress in areas that I traveled without hindrance.

The subtle regimentation that has been programmed into so many aspects of our freedom to act—in academia, the laboratories, big business, and in our everyday life as a citizen—with its codes, restrictions, and limitations, makes me wonder.

However, I have described the way the world has treated me during what was probably the most important twenty-year period of my life, starting when I was 28 years old, single and living at home. Under present standards it might appear that I started with “two strikes” against me. Having to leave high school at the age of 16 when only a sophomore, and then aspiring to move into a region where a doctorate nowadays is a minimum requirement, I managed to overcome obstacles to upward progress that might be insurmountable today.

Although during many of my early years I didn't recognize it, I apparently was fortunate to have discovered the serendipitous method of conducting my activities. In retrospect, I now realize that this method was brought to the attention of the world of science by an old friend of mine, Dr. Willis Whitney. He was extolling its advantages about 1917 or earlier. It has had a profound effect on my life since he discussed it frequently with me. This method, as I now understand it, is the need to develop a streak of innate wisdom, wherein the practitioner prepares the mind with a wealth of information on a wide variety of subjects, and is ready and able to “cash in” on this knowledge at appropriate times. Such action may involve meeting new people or getting a glimpse of some new area of activity of an intellectual or physical nature. These unexpected experiences and new vistas should be seized with enthusiasm, without thinking too deeply about the consequences that might develop by such action. This free-wheeling method of operation is not easily carried out! In fact, the freedom to act in this manner is not commonplace, but it is vital to the success of serendipity.

In a bestselling book, *In Search of Excellence*, Tom Peters has described highly successful organizations that emulate the old GE Research Laboratory developed by “Doc” Whitney shortly after the turn of the century. Throughout Whitney's directorship of the Laboratory,

it was a place where intellectual freedom reigned. The same management philosophy was followed by his successor, Dr. William D. Coolidge, and continued for several years after the end of World War II as Dr. Guy Suits succeeded Coolidge. However, by the early fifties, the Laboratory had grown so large that economic pressures and new thoughts on business management began to change the “free” atmosphere. To my dismay, I began to feel that the Lab was no longer an exciting place to be. Thus, in 1952, after Langmuir had retired and local managers in the Laboratory began to organize teams of researchers having assigned projects, I became greatly intrigued with a new opportunity offered to me by the Director of the Munitalp Foundation. After discussing their offer with Dr. Whitney, Langmuir, Suits, Albert Hull and with Katy Blodgett, I decided to leave the Laboratory and accept the post of Director of Research of the Foundation. The next six years were an exciting and fulfilling adventure, but that’s another story! Those years were a continuing series of serendipitous events, culminating in a highly satisfying career in academia.

If these essays give a few young people (even one) a glimpse of the way in which one can be prepared to meet the opportunities encountered in life, I will be glad.

Life is an exciting adventure and one that for each individual is only available for a limited period of time. If part of that time is wasted, that loss cannot be recovered. The way of life that I have experienced has been an exciting adventure. I hope one day you will be able to say the same!



Vincent Schaefer as a baby. Born on July 4, 1906. Courtesy of Jim Schaefer.



Vincent as a three year old on his stoop in 1909. Courtesy of Jim Schaefer.

A Brief Autobiography

1906-1912

I was born on Elm Street in Schenectady on July 4, 1906. We moved to Stanley Street and then, when I was two or three years old, to Cherry Street in Bellevue. About five years later we moved to Arthur Street. On Cherry Street, we rented a flat in a two-family house