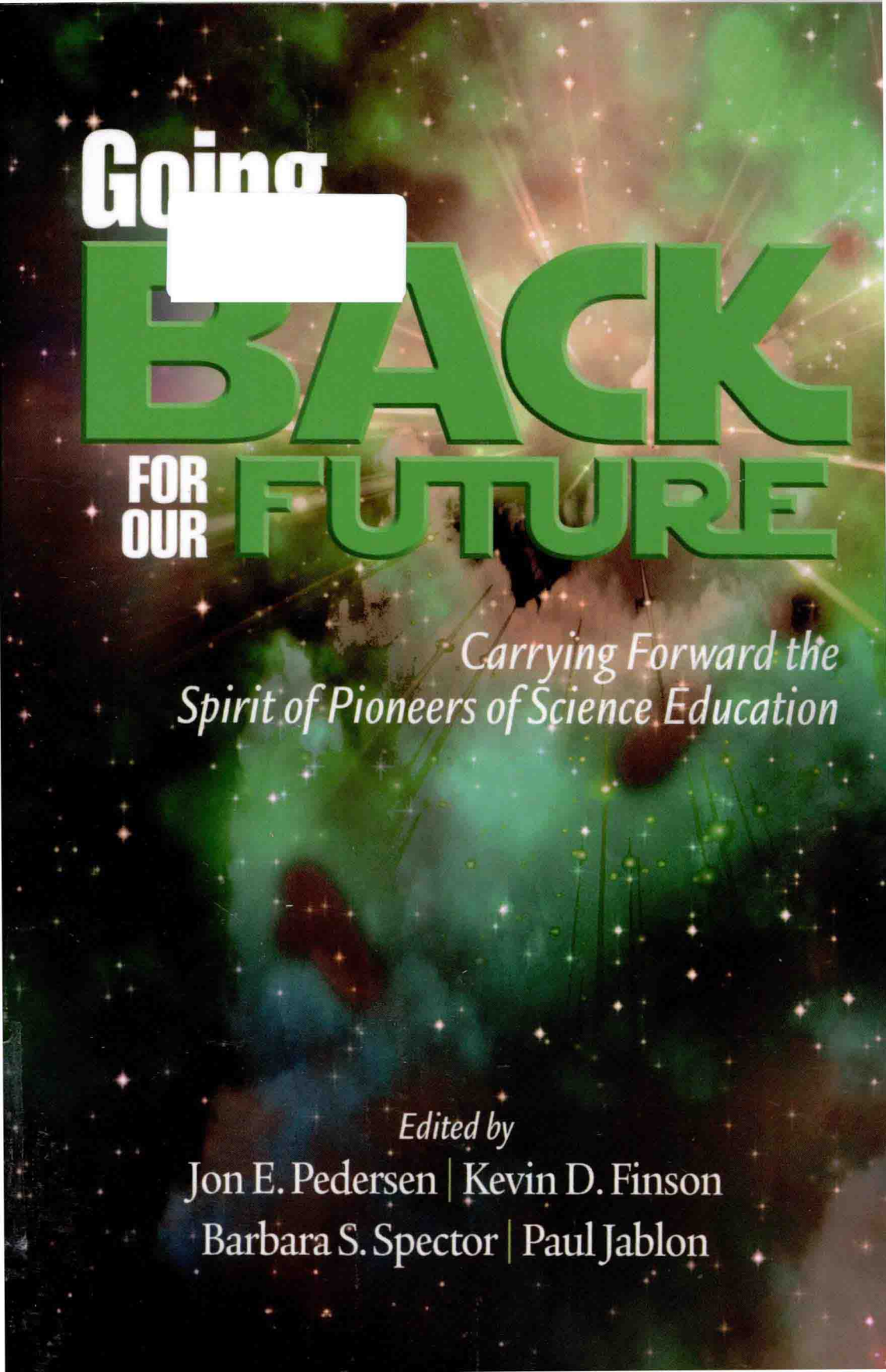
Going
BACK
FOR OUR FUTURE
Carrying Forward the Spirit of Pioneers of Science Education
Edited by
Jon E. Pedersen | Kevin D. Finson
Barbara S. Spector | Paul Jablon

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edited by

Jon E. Pedersen
University of Nebraska–Lincoln

Kevin D. Finson
Bradley University

Barbara S. Spector
University of South Florida

Paul Jablon
Lesley University

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Going Back for Our Future

Carrying Forward the Spirit of Pioneers of Science Education

A volume in
Pioneers in Science Education
Jon E. Pedersen, *Series Editor*

INTRODUCTION

Imagine you are in a time hundreds of years ago, standing at the edge of a great expanse of prairie or forest, or on the shores of an ocean, or at the crest of a mountain. You gaze at the sight before you, simultaneously feeling waves of anticipation and anxiety wash over you. You begin to wonder: What lies beyond the horizon? How would I even get there? What perils lie in wait for me? What treasures might I gain by getting there? The thoughts are almost overwhelming as you realize few people, if any, have ever stood in that place, seeing what you are seeing, knowing the limits you know, yet willing—almost driven—to step forward into the unknown to discover what is there and what rewards can be had, to blaze trails that others will surely follow—perhaps later rather than sooner, but nonetheless, knowing (hoping) in your core that they will come. So you set out, on your own, separating yourself from the safe confines of civilization. You are a *pioneer*, or maybe even a *trailblazer*!

Think about the trailblazers and pioneers. Who were they? Perhaps more importantly, who *are* they? Certainly, pioneers are not just the mountain men of 1700s North America, or the rugged individuals piloting their Conestoga wagons westward along what would later become the Oregon Trail, or the great seafarers of centuries ago, or those who rocket into outer space. Trailblazers and pioneers are individuals who invent new paradigms, are among the first to venture into new territory, to explore new ways of doing things, to rethink old ideas and fashion new ones—to shift paradigms that redefine and redirect life and living. The life of a pioneer cannot be an easy one. Although there is potentially great reward to be gained, there will indeed be sacrifice and angst and struggles—some certainly life-changing.

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What would possess someone to be a trailblazer or pioneer? What could possibly motivate someone to take on a pioneering persona and subject themselves to the unknown—to step into the vast prairie, or set sail into the uncharted sea, or trek to the next mountain? Do they do it for themselves, for others, or for some higher reason? What do pioneers actually accomplish, and how enduring are those accomplishments? Do they leave descendants, and do those people carry on the work envisioned by their pioneer forebears? In what ways, if any, does all this change the landscape (or seascape or spacescape) that the rest of us will eventually inhabit?

This book is about trailblazers and pioneers who had an impact on science education in the United States. Some began their pioneering ventures before "science education" was even a discipline. Phil Schlechty, in his 1993 seminal article about school reform, uses this same analogy. He notes that educational trailblazers take "paradigm-breaking journeys that are not for the timid . . . without maps to places where no one has gone before them. Closely following are the pioneers. Like the trailblazers, pioneers are an adventurous and hardy lot and are willing to take considerable risks" (Schlechty, 1993, pp. 47–48). Who these pioneers and trailblazers were in science education is not only determined by how early in the 20th century they did their work, but more by the unique, unexplored, and sometimes-dangerous paths to their careers that they were willing to endure. Although the trailblazers took the lonely and completely uncharted journey, they did not always stay and found institutions where many could live and work together. The pioneers stayed the course. They made the journey and then institutionalized practice so that the rest of the "settlers" could follow. They created new systems and approaches. Schlechty (1993) elegantly states that pioneering effective reform required, "faith, logic, wisdom, and intuition." We can do web searches and derive lists of publications and presentations made by many of these pioneers and trailblazers. What is more difficult to do, however, is to find out what was the driving force that motivated them to do what they did in the ways they did it. How did they feel about it? What were their joys and fears along the journey?

This book is the first volume of an attempt to capture and record some of the answers to these questions—either from the pioneers themselves or from those persons who worked most closely with them. We know there are many pioneers and early trailblazers who are not included in this volume, but there are other volumes to follow. We had intended to include a number of individuals in this first volume, but their chapters were not completed in time for publication. As we have posed questions, rummaged through files and oft-neglected books, and probed the memories of many individuals, we have come to realize our list of true pioneers is ever growing. There are names on the list that most of us readily recognize, and there

are names of whom few of us have heard—yet who were significant in their roles as mentors or idea development and teaching. We quickly discovered that the "family tree" showing connections between these people is not a neat, clean simple branching tree, but is more like spaghetti. The connections are many, are intertwined, and all have their significance. The stories in this volume demonstrate how vital this network was in supporting the individual pioneers during their journey in difficult times and continues to be for those of us today in our own enterprise.

One of our major goals at the outset of the project leading to this book was to recover and preserve (and share!) the personal histories of the pioneers in science education before the information became lost in time, disintegrating into dust as the pioneers themselves left us—and, as it turns out, before their first-generation descendants (such as their graduate students) also left us. Like someone doing genealogical work on a family member, the documents that are available and accessible become more difficult to obtain the further time moves forward. And few of those documents can really convey to us the true flavor of the personality of ancestors. That is something best done with first-hand contact and dialogue. We, as colleagues in a profession and discipline, are now standing at the critical juncture where we can decide whether to make the attempt to record those personal pioneering histories or lose them forever.

Just as when science as a discipline matured, certain universities created specialties in the *History of Science*, we believe it is now time for certain science education doctoral programs, in conjunction with history programs at their institutions, to create a specialty in the *History of Science Education*. As editors we have come to realize this historical work needs to be a full-time endeavor for some individuals and their institutions if we are to preserve an accurate and rich history along with the physical documents that can be utilized by scholars in the future. Try to imagine a Biology major who was not familiar with the work and life of Charles Darwin. Unfortunately, as we address in the *Epilogue*, the parallel is often all too true in our own science education profession where little is known of the work and lives of our own pioneers. How can we create an effective future if not by looking back and building it upon the shoulders of those pioneers?

As editors and contributors to this book, we have obviously chosen to do what we can to not lose this heritage. We have chosen to honor our pioneers for their efforts and life contributions, and to come to know them with a more personal and familiar touch. Some of what we've found in our endeavors is surprising. Some brings joy, some sadness. All is enlightening. It is like finding our family legacy once again.

ABOUT THE DIAGRAMS IN THE BOOK

At the end of this Introduction and each chapter in this book, you will find a diagram. We thought a little explanation about them would help readers understand why we have included them. Rather than showing exact chronologies, the diagrams at the end of each chapter are intended to primarily show the connectivities or interconnections between the person who is the focus of the chapter and other individuals who influenced him/her in some way. Pieces included in a diagram are largely drawn from and limited to information provided within the chapter narrative. We acknowledge there are likely many other connections not noted in the chapters, and consequently don't appear in the diagrams. However, what we have included were those the authors evidently felt were most important to mention. Across the chapters as a group, we noted some names recurred more than others. To that end, we generated the diagram at the end of the Introduction. The more often the collective authors mentioned an individual's name, the closer it was positioned toward the diagram's center. Again, we acknowledge there are likely many connections between these individuals that were not counted in this analysis, yet we chose to limit the analysis to just that information provided by the authors because that was the most manageable and least cumbersome route to take. Rather than being a hierarchy of importance, the general purpose of the diagram is to show how the people who are the focus of chapters are networked and connected to others. And that gets us back to the purpose of the book: to show how we are all connected in some way to the pioneers who went before us.

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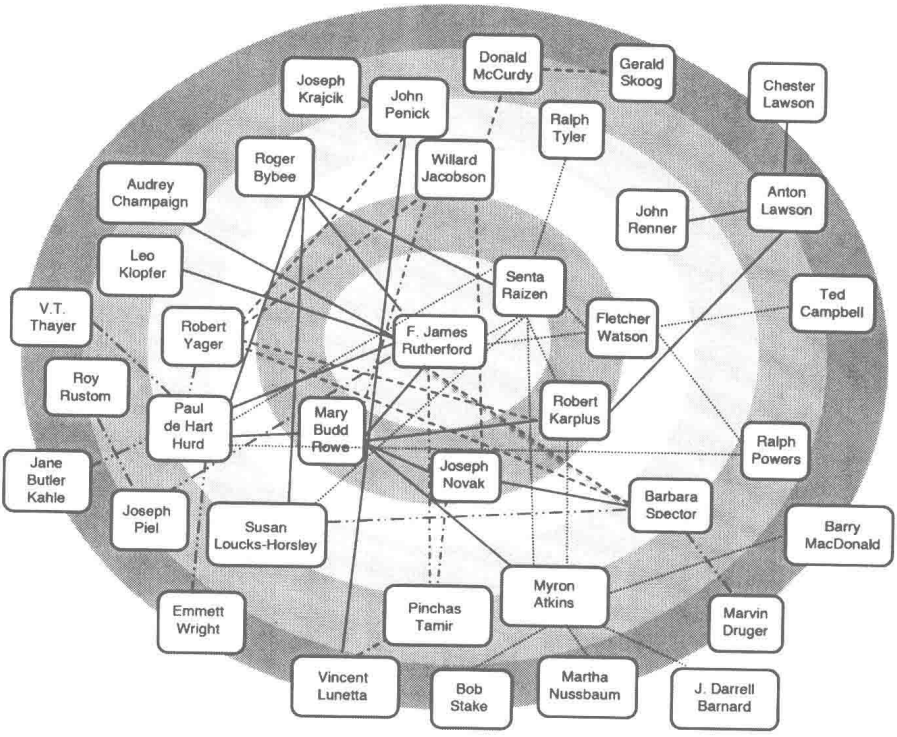
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FLETCHER GUARD WATSON

Setting an Agenda for Science Education

Paul Jablon
Lesley University

PROLOGUE

It was terrific working at the Harvard College Observatory for four years despite an interruption of service in the armed forces during the war, but in 1946 it was a bit disconcerting being summoned to President James Bryant Conant's office. Not only was Conant president of Harvard University, but he was also the man who had taken on the task of transforming Harvard into an increasingly diverse and world-class research university (Conant, 1945). For Fletcher Watson, it had been a long, but interesting road to get to this point in a career. It seemed like such a long time ago deciding on astronomy as a career. Then getting into Pomona College, graduating in 1933 with a degree in astronomy and then a PhD in astronomy at Harvard. But why did Conant want to see Harlow Shapley's research assistant at the College Observatory and not Shapley himself?

The meeting turned out to be inspiring, frightening, and life changing. Here was one of the most powerful educators in the country asking

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a research astronomer to leave his astronomy research career and to take on the rather daunting task of leading the university, and because it was Harvard, likely the country, in creating an effective training and research program in pre-college science education. Fletcher Guard Watson took on the challenge and successfully led the enterprise for the next 31 years in the Graduate School of Education and as a national and international consultant. Never on that day could he have imagined that he would be chairing national study groups, leading of one of the most historically significant pre-college physics curriculum projects, pioneering science education research techniques that are still emulated in the profession, and mentoring countless numbers of science education leaders who have had profound effects upon the nature of K–12 science education in our country for the past half a century.

THE EARLY YEARS BECOMING AN ASTRONOMER

Born in Baltimore in 1912, Fletcher Watson attended elementary school in Los Angeles under the shadow of Mount Wilson with its great observatory.

> I remember when President Harding died, there was an eclipse that went over Catalina Island somewhere along the line and it was right under Mount Wilson. Somehow in a moment of enthusiasm I had decided that I wanted to be an astronomer. [It] was fourth or fifth grade; a ten year old kid. I didn't know what it was about. It was a glamorous thing. My music teacher—I was taking piano lessons—and the other people around were—they gasped and applauded, and sent me stuff to read, so I started reading about astronomy in a very remote, distant, summarized fashion. (American Institute of Physics, 1990, p. 3)

At the time, astronomy was a seemingly exciting kind of thing because there was a lot of news in the local paper about Mount Wilson. Watson was a sickly teenager and his parents didn't want him far from home. So after a year at Pasadena Junior College in 1929—the year that Pluto was discovered and the beginning of the Great Depression—he followed his sister-in-law to nearby Pomona College. They had a small department of astronomy, so he became the one astronomy major for the years he was there. Watson spoke about wasting a lot of his early college years and all his high school years because he didn't make or borrow a telescope. He made no observations; he was an armchair astronomer. This all changed when his college advisor, Professor Walter Whitney, arranged for him to attend the Journal Club at the Observatory where he heard Edwin Hubble with his descriptions of the galaxies and their expansions. Each week he was the only "kid in the room" with the likes of Walter Baade, Edwin Hubble, Adriaan Van Maanan,

George Ellery Hale, and Walter Adams (director). As a senior, he had an opportunity to use the observatory to attempt to take spectral readings of meteors, a rather daunting and unsuccessful task (Eisenkraft, 1981).

Through these meetings he formed a relationship with Seth Nicholson, who was doing research on the sun. He was a kindly man who not only helped Fletcher with his senior honor's thesis, but also wrote a letter of recommendation for him to Harlow Shapley at the Harvard Observatory. It was during the Depression, and he was fortunate to receive a teaching fellowship while he was doing his doctorate in astronomy at Harvard. When he was finished, he stayed on as a research assistant to Harlow Shapley, one of the leaders in astrometry in the first half of the twentieth century. In 1938, he joined the Harvard College Observatory staff.

> Under the wing of Fisher . . . after Peter Millman had just finished his thesis on spectra meteors . . . [I began] a fair amount of observing, which was naked eye observing or running cameras in the middle of the night, usually when it got cold. And, it got colder and colder and colder. [His first time observing it was –18F.] So I had an introduction to meteor observing—naked eye observing. No one had any machinery other than cameras to do anything and I wanted some other kinds of information. (AIP, 1990, p. 7)

He had intended to work with Ernst Opik, who was doing research at the observatory on meteors, but Opik had returned to Estonia before Fletcher arrived. So he became Bart Bok's teaching assistant for three years. Bok's work was not on meteors, so Shapley let Watson work mostly on his own. He did interact with Willard Fisher, Dorrit Hoffleit, and Samuel Boothroyd and others gathering a reputation in the field. His astronomy career was going strong. In addition, during this time he met and married his wife Alice, then a Radcliff student who was working for Shapley, and they started a family.

In 1941 he published *Between the Planets*. Written for a general audience, the book summarized the current knowledge of comets, meteors, asteroids, and meteorites, was well illustrated, and was translated into several languages. In a June 2008 article in *Nature*, Chandler cited this book as "one of the first and most important books written about near-Earth asteroids. And though only a handful of near Earth asteroids had been discovered Watson, along with Opik and Baldwin, came up with the order of magnitude correct understandings about how often a bad thing [collisions with earth] would happen" (Chandler, 2008, p. 262). In addition to this Fletcher had also published over a dozen scientific research articles. His career was well under way.

WORLD WAR II AND BACK TO THE OBSERVATORY

Shortly after, during World War II, Watson served in the Navy where he assisted in the development of the Long Range Navigation (LORAN) system and achieved the rank of lieutenant commander. He returned after the war to work at the observatory where, unbeknownst to him, Shapley put his name in for a new position to be the "science educator" in the School of Education at Harvard. Simultaneously, he had been co-teaching a course for liberal arts students called "Understanding Science" created by Conant (himself a scientist) and also co-taught by Thomas Kuhn and Leonard Nash. Conant, Watson, and the other instructors of this general education physical science course,

> aimed it at bright people whom we knew were going to be important but we're [sic] not going to be scientists. They would end up as possibly the president of the United States or end up in Congress; or as major lawyers, judges, bankers, and businessmen. The people who control the country, which the scientists do not. (Eisenkraft, 1981, p. 370)

They met weekly in Conant's living room, and this started Watson thinking deeply about teaching science to general students and gave him some feeling of confidence about teaching when Conant approached him about the "science education" position. In a 1981 interview Fletcher stated that he was candid with the education faculty who later interviewed him when he said that he "knew *nothing* about education."

THE BEGINNING OF SCIENCE EDUCATION AT HARVARD

He realized the incredible significance of the president of Harvard asking him to move from science to education, nevertheless he felt "I had cut off my right arm." He still had astronomy research papers that were unpublished when he went off to war. After only three years he had been elected to the prestigious International Astronomical Union, and many of his distinguished astronomy colleagues, including Bart Bok, thought making this move would be a grave error. In retrospect, he says he was not dissatisfied with this decision to transition into education, not knowing whether his success would have continued in astronomy research. He soon had an astronomy job offer in Michigan, but Alice was in the hospital about to have their third child. They had just settled into their home in Cambridge. Alice has also said, "I'll tell you why he did it and that's because he likes people better than he does mountain-top strange astronomers....The point was that he's good with people; not everybody is good with people and he is. That was the real turning point" (AIP, 1990, p. 23).