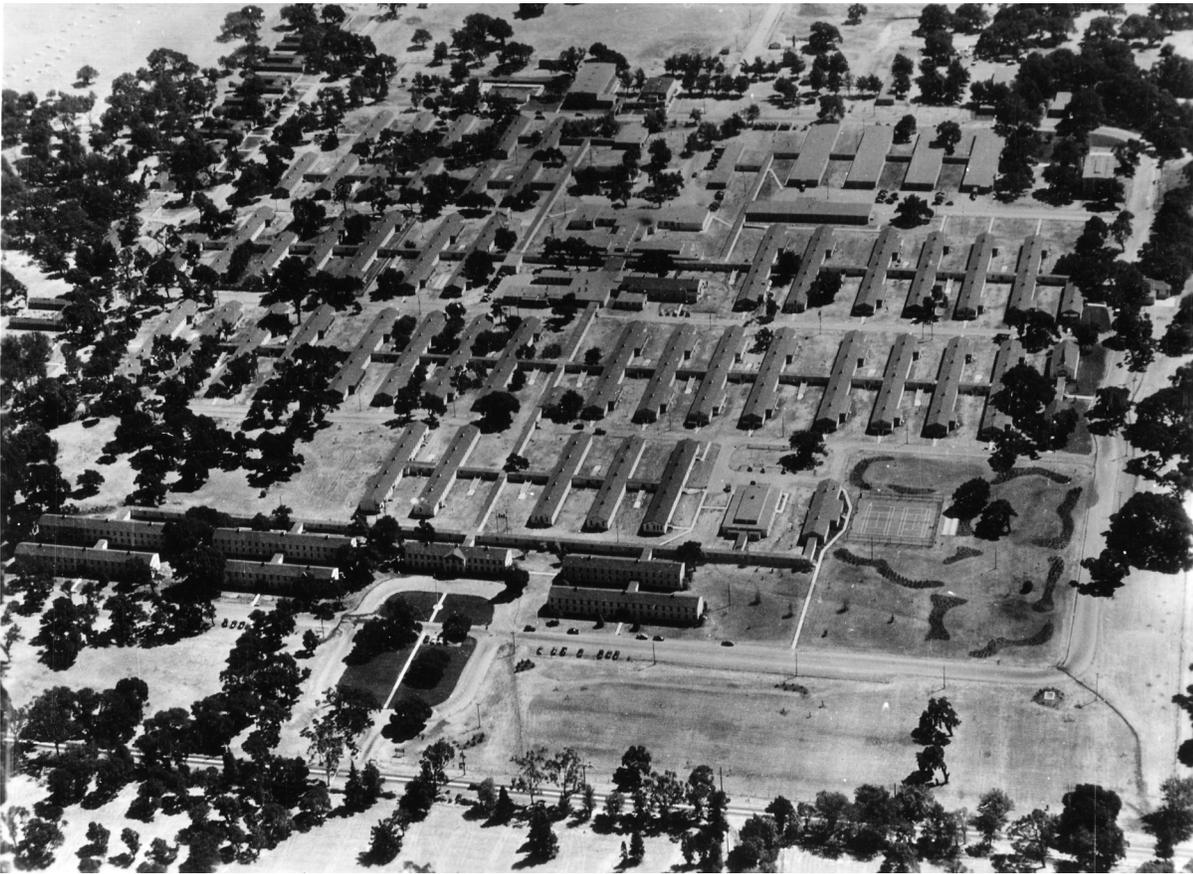


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Dibble Army Hospital, SRI's Future site ~1946



SRI International ~1989

**A
Heritage
of
Innovation**

SRI's First Half Century

Donald L. Nielson



1947



1952



1955



1962



1965



1977

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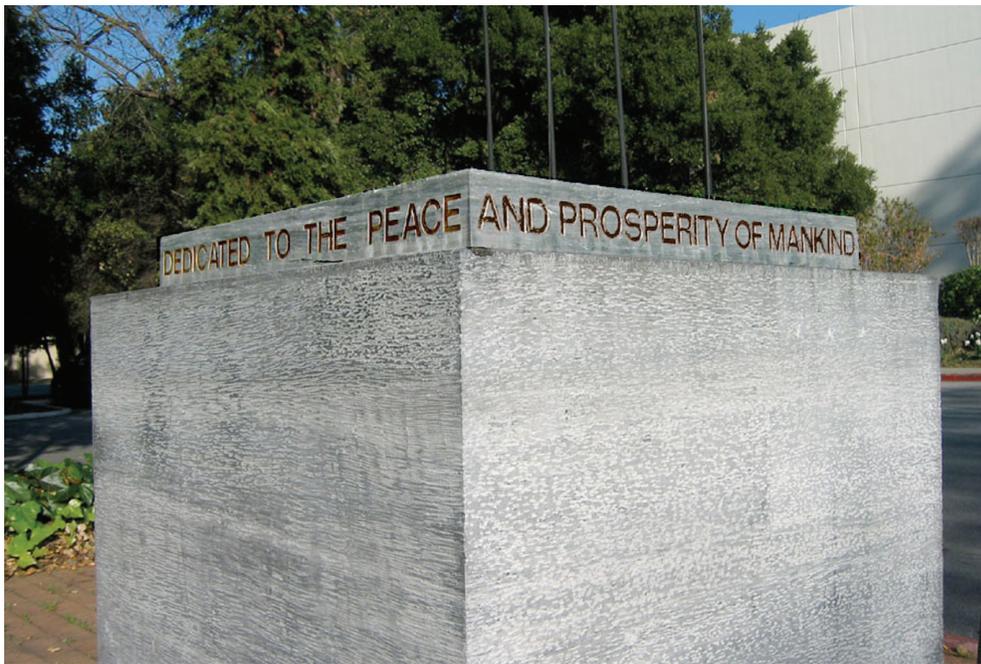
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SRI International
333 Ravenswood Avenue
Menlo Park, California 94025

From the SRI Charter

“...to promote and foster the application of science in the development of commerce, trade and industry, the discovery and development of methods for the beneficial utilization of natural resources, the industrialization of the Western United States of America, and the improvement of the general standard of living and...



...DEDICATED TO THE PEACE AND PROSPERITY OF MANKIND.”

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The Setting

*Just whose vision gets to define the future?
What confluence brings a place or a season of innovation?
Does creativity respond to rules or just to will,
 And a dream, nourished inside by
An atmosphere as illusive as it is magical,
Like a fragile zephyr that reflects
Its presence only in the trees it visits?
If so, one has passed this way for a time
Leaving a fragrance of inquisitive openness,
Amid the sunshine and oaks,
 For us to delve...freely.
Here, a unique and fertile valley gave root
To fertile minds that helped change the world.*

At the southern end of San Francisco Bay lies one of the world's most appealing climatic settings. Over a half-century ago, before its major crops were silicon and equity, before venture capital inflated the soil, and before the grazing land and orchards were sold by the square foot, there was born a place of uncommon inquiry. It was 1946 and with some aim at growth, the Fathers of Stanford University formed a subsidiary, Stanford Research Institute, that became one of the largest independent research organizations in the world. In just over a half century it has provided a wealth of innovation about which that same world is largely oblivious. Today, it struggles for recognition in what has become a cauldron of creativity known the world over as Silicon Valley. That SRI helped in significant ways to formulate this pattern for progress is mostly unappreciated, even here in this Valley where it was born. To those who come to add their part to the regional luster, including the recent wave of Internet entrepreneurs, its history and even its beautiful climate seem as irrelevant as the vale in its famous name. Such is the preoccupation and consuming power of innovation.

Preface

Most Americans, perhaps most people in the industrialized world, have a certain reverence for research. We see it as the necessary wellspring that launches those concepts that elevate our standard of living, ease our burdens, or enable us to live and work more productively. We subscribe to the overly simplistic model that science or research begets technology, which in turn begets substances, devices, and systems that enrich our lives. These processes that touch us every day are much more complex than such a linear notion implies, but clearly research and development, or R&D, are critical to a growing industrialized economy. Our economic practices and our reward system, together with a penchant to innovate, go a long way in explaining the economic vitality of the United States in the world setting.

This is a story about an active, ongoing research institute created at Stanford University in the latter half of the 1940s. It consists of a brief look at that institute's origins and a much longer review of some of its important accomplishments. The institute began life as the Stanford Research Institute (SRI) and, given a half-century of achievement in a turbulent world of research priorities, its history provides a framework for discussing the relevance of its particular form of research. SRI has always engaged in contract research, in effect seeking to do something not done before, but under the stipulations of a client contract. Though SRI calls itself a *contract research* organization, some of its contracts are, in fact, grants. Grants are usually the province of more fundamental research and they often permit more latitude in both approach and outcome. However, as in the case of grant-issuing foundations, the nature of the client organization can also define the type of working agreement. Another distinction is financial, with a grant implying some type of cost sharing, including no fee or profit. Research institutions like SRI, even though nonprofit, usually prefer fee-bearing contracts, for it is accrued fees or profit that enable discretionary investments. In spite of these distinctions, either type of research can be a recipe for researchers' exhilaration or frustration, or both. Even though it has more

rigorously defined expectations than grant research, contract research is anything but dull.

This book is also about innovation—the act of introducing something new. Many avenues other than research lead to innovation, but most of what SRI has done over the years could be classified as just that, innovation through research. Research differs from innovation in that it generally involves newly discovered facts that revise or add to fundamental knowledge. SRI is a research institute, and how such an institute wends its way for a half-century or so is an intriguing process in itself, as will be evident in the chapters that follow. Like any aspect of a market economy, research also has its ups and downs, and some time is spent here exploring how contract research is expected to fare in the dramatically changing world of research in both industry and government.

To set the stage for a discussion of research, it is necessary to mention two, but not always separable, kinds of research. The timeworn expressions are “basic” and “applied” research, and differentiating between the two types is about as confusing as distinguishing between the terms “science” and “technology.” Basic research generally deals with discovering unknowns, the consequences of which, beyond obvious contribution to knowledge, are not easily foreseen. Applied research begins with envisioning a fairly specific end use for an investigation and is based, at least in part, on existing knowledge. Both are full of discovery, but the reward system for each is usually different.

Characteristically, the more basic the research, the greater the freedom about where the work can lead. Time horizons are long, and researcher distraction associated with attaining funding renewals or immediately satisfying clients is minimized. Applied research, on the other hand, is more focused, may have imposed deadlines, and is often accompanied by requirements for salesmanship and detailed accountability. Both kinds can be very engaging for researchers who are passionate about and dedicated to their work. Traditionally, basic research has often been thought of as a lonely, sometimes romantic adventure whose reward

system consists mostly of recognition for an individual's discovery. Increasingly, however, the complexity of modern science demands more collaborative efforts, often from different laboratories. Applied work, on the other hand, is highly collegial and intensive and its researchers are more likely rewarded by seeing an ultimate use. Sometimes they may even receive royalties or equity for their efforts. Basic research is increasingly the province of universities because many corporate or government research laboratories have been forced to pursue more predictable near-term outcomes. Contract research, such as that done by SRI, is by nature almost totally applied, but it is a measure of the ingenuity of SRI staff that they also are able to perform some fundamental work as well.

This book thus describes an independent research organization that has successfully carried out contract research for more than 55 years—without endowment or top-down largess—by providing a framework within which innovation can happen. While its half-century has not all been growth and progress for SRI, it continues on its course, exploring new orientations of itself and helping define the character of research in our increasingly rapid, information-intensive world.

The book provides glimpses into the excitement of discovery, conveyed through the lives of many SRI people, their projects, and those projects' notable and positive effects on the world. Keep in mind that apart from perhaps one or two well-known scientific prizes, little public recognition is afforded those whose everyday job it is to break new ground, bringing innovative and useful changes for our world.

Deciding What to Tell About SRI

During its lifetime, the Institute, as I like to call it, has completed well over 50,000 projects. With such voluminous output, selecting examples that illustrate the creativity and resourcefulness of SRI staff from many disciplines has involved several choices. First, I have chosen to concentrate, but not exclusively so, on project outcomes rather than on the work of specific individuals or for specific clients. Second, I have looked for significant impacts from projects; that is, noteworthy

alterations in how science or technology is practiced, how our economy or social systems operate, or how ordinary people conduct their lives. Moreover, with but a few exceptions, I have sought to describe areas that a typical reader can understand.

I started out seeking 30-40 such impacts, but my investigations were not that easily contained. To try to be representative of the Institute's breadth the number has swollen to more like 60, and some of those are more comprehensive than I once anticipated. Regrettably, by providing insights about any small set of chosen outcomes, I risk having some readers conclude that the vast majority of SRI work is unimportant; that these major impacts are all that are worth knowing about. Such a notion would be emphatically wrong, for SRI's real strength is its collective and continuous contribution to its clients, and there are thousands of interesting and meaningful stories to tell. In any case, you will thus find the work described here wide-ranging—breadth that is typical of what goes on at SRI every day. The danger in that breadth, of course, is that unless you have a healthy curiosity, a research bent, or simply want to know more about SRI, only parts of the account will hold your interest.

Through research and other insights, SRI's world is clearly one of innovation. It is built into the life cycle of thousands of projects that are SRI's life blood. Indeed, for over a half century the people of SRI have provided, by almost any reckoning, a long and striking heritage of innovation. It is the embodiment of its culture.

But one topic of SRI's operations I have chosen to avoid is the detail of its overall financial history. Certainly, contract research has its financial constraints, aggravated at times by changes in the research marketplace and the absence of that always critical combination: a creative and compelling idea matched against a corresponding and expressed client need. SRI's first 2 decades saw solid growth, followed by 2 decades of relative stability, and then a decade of challenge stemming mainly from the restructuring and subsequent demise of its business consulting group. Over the past few years, SRI has again hit its stride and is growing. In a demonstration of broad-based innovation, each of its individual and varied research divisions is doing very well. That means that its

varied disciplines, as well as its unique inter-discipline strengths, continue in evidence.

Discovery and Impact: The Core Motivations of Research

For those wishing to dedicate their lives to research, the principal motivation is usually not money because, with some exceptions, such careers are not lucrative. Instead, most of those who become researchers do so for other reasons. One is the thrill of discovery or the satisfaction of solving an unsolved puzzle. Often, success in achieving these goals is manifested by advancing the state of knowledge and documenting findings for the research community. Another motivation is to create something new that can have an important result for a research client and for the world beyond. The typical SRI researcher thus seeks the challenge of discovery, which if successful can result in a common but often unspoken exhilaration of doing something for the first time.

But research also carries with it the obligation of adhering to scientific ethics or professional standards. These overlays on the work require that the research context and background be studied sufficiently and cited to prove to *others* that new ground has been covered, and this process must occur even if the results appear obvious or if a client insists they remain confidential. Such integrity is not just desired in a research environment, it is its very essence.

While doing things for the first time is an inherent part of a good research environment, making an impact is not. Whether or not new outcomes will have an impact is often unclear when they are first realized, and sometimes the subsequent extent of such impacts depends purely on serendipity. In most cases, of course, outcomes do not result in momentous impacts, and when a research outcome does have an impact, it may not take place until a great while after the research has been completed. Many are surprised to learn that the first Internet transmission occurred at SRI more than 30 years ago (or 37, depending on which benchmark is used). Even startling change and exponential growth patterns may be rooted in modest and often obscure beginnings.

Though SRI has a rich history of firsts, client desires for confidentiality and

government classification sometimes restrict the Institute's ability to publish, resulting in lack of credit for such discoveries. SRI always describes the results of its work to the clients for that work, but there is some truth in asserting that something happened only if it actually occurred and *was written about openly*. Over and above restrictions on disclosing work, SRI researchers, their managers, or their clients may judge publishing to be unnecessary or extravagant. As a consequence of these constraints, much of SRI's research legacy has been hidden, and ferreting it out is often difficult. (Appendix A provides a few examples of such lack of attribution.)

One of the regrettable aspects of compiling a historical account is that it tends to relegate all the excitement of discovery and innovation to the past, when we all know that these events are in fact continuing all about us, especially at SRI. In this light, in a few cases I have, and possibly been foolhardy in doing so, predicted an important impact that may never actually occur. But SRI continues its work and some will assuredly result in innovations and impacts that we currently cannot imagine. As long as research is the Institute's middle name (figuratively if no longer literally), that will happen.

Finally, although discussions of research tend to dwell on science and technology, innovations in social and economic fields have clearly been part of SRI's applied research horizons as well. Over the years, these SRI disciplines have also made significant contributions to their fields and they too will be touched on.

The Biggest Burden

My major regret as I finished this book was the necessity of leaving out so much important material and so many talented people because of space limitations. I could not mention many of the bright, dedicated, objective, and thoroughly honest people who were instrumental in keeping me, and many others like me, in just this one place for our entire working lives; I would be proud to be with them anywhere. Working on research of one's choosing, espousing the scientific ethic, and finding the resources to do so attracts, I believe, such people. As with all enterprises, most of SRI's dedicated, hardworking contributors will never achieve prominence, nor will their work

be widely acclaimed. Though working to satisfy their clients, SRI researchers also set their own goals that serve to stretch their minds into new territory. Whatever other recognition they may receive in that process, meeting or exceeding their own expectations is always the most rewarding. Failing that, no other award is worthwhile.

Thus this book seeks to illuminate a somewhat invisible Institute, known well only in the limited contexts of research and consulting. It also seeks to provide those around the world already acquainted with SRI with broader information about SRI's accomplishments. I tell the stories of 60 or so projects or programs, selected from the 50,000 SRI has completed, that in some way changed the world. As you might expect, these stories can convey only a small part of SRI's history, adventures, and impacts. While SRI has supported much of the cost of editing and printing this work, there has been no influence or stipulations on what I have written. What you read, then, will be unfettered expressions about topics of my own choosing. That latitude, common in the SRI culture, is, of course, appreciated.

Finally, a personal note. I have spent almost my entire professional life at SRI, about 40 years. During that time, I filled a number of roles in the organization that, I believe, have given me a reasonably good perspective on its culture. But perspectives in a large and complex organization, particularly one as internally diverse as SRI, will obviously differ. Although I have endeavored to recount SRI's achievements objectively, I admit a certain bias in favor of the individualistic, self-determined inventiveness of the place and its people. In retrospect my stay here has been a very positive one and I hope that my perspective sits well with SRI's research staff and that my fondness for that culture will be apparent in what you read. Though I would have liked to be completely representative of the Institute's broad range of work, I have admittedly lent more coverage toward those areas with which I was already familiar.

Just one note of guidance: the references given are divided into footnotes, which appear on the same page and are generally explanations or expansions on the text, and endnotes, which are information sources and are located at the end of each chapter.

While this effort has been almost totally my own, I would like to acknowledge the help of

those who took the time to make my accounts concerning them more accurate and interesting. You will find many of their names in the project accounts. I have a few others to thank as well: Lisa Beffa, who cheerfully tolerated my countless investigations in SRI's archives; the editors who made English of my efforts, most particularly Jeanie Graham¹; Ray Vincent, who gave me entry into this amazing institution; the wonderfully interesting people of SRI who made 40 years go too quickly and whose individual pursuits were so often contagious; the wonderful colleagues and associates who over the years walked the SRI path close beside me, particularly those in the laboratory, division, and group offices and organizations in Engineering. Some of their images can be found just inside the covers of this book, but in any case, they know who they are without my saying.

But far above all, there is my devoted lifetime partner, Helen, who has tolerated this other love in my life and who, although she thought my retirement was at hand in 1998, graciously accepted what were supposed to be a few more years of sharing me with the Institute as I researched and wrote this account. To her and to the rest of my real family, David, Richard, Sandra, and Greg, this book is gratefully dedicated.

Don Nielson
Menlo Park, California
December 2004

¹ Other editors were Michael Smith, Kitta Reeds, Lynn Johannesen, and especially Klaus Krause. Sheila Igne did the layout and Shari Fisher helped with the incovers, printing, and required permissions.