Chapter 1
The Origin and Character of SRI

The Origin of SRI

Informal discussions about a research institute at Stanford University were held on campus as early as the 1920s. But it wasn't until 1942 that a serious proposition was made, and that initiative had to await the end of World War II before enough momentum could be gained to pursue it to completion. That momentum ultimately came from the confluence of the desires of the University leadership for more contact with Western U.S. industry and a set of those same Western industrialists wanting a place to bring problems of importance to them. It was a fortunate, if slightly chaotic, confluence of complementary needs.[1]

The first formal step in the creation of Stanford Research Institute came when the Trustees of Stanford University voted in February 1946 to establish in principle a research affiliate of the University. Over the subsequent summer, the University and business leaders in the San Francisco Bay Area, aided by suggestions from other research foundation leaders, developed a charter for the Institute. Their justification came from Stanford's Founding Grant, which states: "the public at large, and not alone the comparatively few students..., are the chief and ultimate beneficiaries of Stanford University." Acting on behalf of the Stanford Trustees, a small incorporating board filed the Institute's articles and bylaws with the State of California in November 1946, and the Trustees accepted the Charter and appointed SRI's new Board of Directors the following month. The Charter, defining SRI as a nonprofit subsidiary of the University under the laws of the State of California, set forth a set of purposes that benefited both the University and industry in the western United States. A few of the more important stipulations of the Charter follow:

- To promote the educational purposes of the...University...in the conducting of pure and applied research...in the promotion and extension of knowledge and learning.
- To provide...laboratories...and other facilities...for scientific and industrial research.
- To engage...a staff of qualified educators, scientists, and research experts...
- To establish a center for the accumulation of information...and foster...[its] exchange...with other research and educational institutions...and publish...findings...deemed in the general public interest.
- To promote and foster the application of science in the development of commerce, trade, and industry..., the industrialization of the Western United States..., and the improvement of the general standard of living and the peace and prosperity of mankind.

While a few in the University discussed such an institute as early as the 1920s, SRI owed its real genesis to perhaps four or five, somewhat loosely correlated efforts starting just after the conclusion of World War II: Western industrialists were looking for a Pacific Coast research enterprise that would operate under the aegis of a university. And within Stanford itself, the defining effort was that of its President Donald B. Tressider and his Vice President for Development, Alvin Eurich. Stanford's lawyers, with input from one of the industrial groups led by Atholl McBean and the insights of Henry Heald, then President of the Illinois Institute of Technology (IIT), drafted the Institute's Charter. The Charter gave the University two means of controlling its new offspring: allowing the Board of Trustees to select SRI's directors, and having Stanford's President serve as the Chairman of the SRI Board. SRI's initial directors consisted of 32 of the most prestigious western executives imaginable, giving SRI, it seemed, a good

[1] Appendix B provides a more complete account of SRI's genesis and the major aspects of its history. A much more detailed coverage of the SRI founding process and its players can be found in two books by Weldon B. Gibson: *SRI – The Founding Years* and *SRI – The Take-Off Years,* William Kaufman's Publishing Services Center, 1980 and 1986, respectively.

bloodline.[2] In addition, in a departure from similar research organizations, Stanford's president did not limit SRI's field of research to the natural sciences, indicating instead that it could pursue "all research problems."[A]

To get the Institute under way, Stanford was to advance $500,000 to SRI. But according to the *San Francisco Chronicle* of December 15, 1952, the University's advance amounted to $625,000 with another $600,000 lent by six San Francisco banks. While there were the normal jitters associated with a fledgling enterprise, and although there were times in the first year or two when it looked as though the fledgling might die, all of these loans were eventually repaid. The Institute started on Stanford's campus but soon moved its growing staff to a surplus Army hospital in nearby Menlo Park, portions of which Stanford had acquired from the government. That location still houses SRI's main campus.

Since the founding documents didn't stipulate *how* SRI was to be built, during the Institute's formative years, differences in opinion regarding SRI governance were held by Stanford President Tressider and SRI's first director, William Talbot. Treating SRI and Talbot much as he would an on-campus department and dean, Tressider reviewed in detail each SRI expenditure, which at the time were managed just the same as other accounts handled by the University. The early projects were approved by the SRI Board but were also subject to University policy, particularly when cooperation or competition between the two institutions might arise. Talbot saw the need for greater operational independence, especially when requests as mundane as those for administrative supplies would find their way to Tressider's desk. This conflict between Stanford's husbanding of funds and an SRI bent on greater self-determination led to Talbot's resignation by the end of SRI's first year.

But SRI continued its path toward greater autonomy with two important events in early 1948. President Tressider died unexpectedly in January, and his and Eurich's choice as the Institute's second director joined the Institute in late March. The new leader was the energetic, independent-minded director of the Armour Research Foundation, Dr. Jesse Hobson. He quickly developed a good working relationship with Alvin Eurich, who had become Stanford's acting president, and thus chairman of SRI's Board, and he gained the confidence of the University Trustees. Hobson's acumen and enthusiasm garnered the investment money needed to launch the Institute into 20 years of remarkable growth.[3] Though Hobson would leave SRI at the end of 1955, SRI had grown from a staff of 50 to 1,161 with annual revenues exceeding $10 million. Under his successor, Finley Carter, the staff reached 3,000, and revenues grew to more than $54 million annually by 1966. This was all real, not inflationary growth.

Thus, without explicitly violating Stanford's governing stipulations, SRI had become an eclectic and self-sufficient research institute. The one area of SRI that the University continued to monitor, however, was business consulting. The University wanted SRI to objectively research a given situation and lay the results before clients for their own interpretation and not to interpret the research findings nor consult regarding their implications. SRI's commercial business groups would have difficulties with this distinction until SRI separated from the University in 1970.[4] Except for a relatively small number of shared staff (faculty) and projects, the rest of SRI operated quite autonomously from the University once it relocated in Menlo Park.

How SRI Conducts Business

The pattern that defined how SRI would do business derived from a combination of its discipline-oriented University heritage and the U.S. marketplace for research funding. The establishment of laboratories with the freedom to pursue self-defined research interests and goals existed almost from SRI's beginning. Subject only to the "consulting" restrictions mentioned above, the Institute expanded into applied research in engineering, science, and economics. Those research areas were eventually augmented with significant research in education, government policy, and international development.

[2] Appendix C lists the members of two early SRI Boards.

[3] Perhaps as significant as any of Hobson's insights was his belief in the need for comfortable separation between the University and the Institute. According to William McGuigan, SRI Director of Planning in the 1960s, Hobson had learned that necessity well from his sojourns at Armour and IIT. (Interviewed by John Lomax, July 20, 1998)

[4] Appendix B discusses the separation, the reasons for it, and its consequences, in addition to an account of the Institute's acquisition of RCA Laboratories in 1987.

The marketplace also had its influence on what SRI was to become. Though created for the benefit of Western U.S. industry, SRI's client base immediately expanded to include U.S. government research entities. Its first contract, in fact, was for the Office of Naval Research to look into alternative sources of natural rubber. Work for governments would continue, and over the years SRI's client base was apportioned on the order of 60% government and 40% commercial. Moreover, with the blessing of its Board, SRI broke away from serving only a Western U.S. industry client base and started to undertake international work as early as 1950—a move that would eventually give SRI a worldwide presence.

SRI's core business is contract research and development. While other forms of income have been and are being explored, working for clients on a research problem has been SRI's enterprise engine for more than 55 years. The spectrum of the Institute's contracts is extremely broad, defined primarily by the expertise and predilections of its staff and by opportunities in the research marketplace.

But contract research is not necessarily a lucrative business. Work from the federal government is normally constrained in regard to fees—ranging from nothing on research grants to negotiated cost-plus-fixed-fee arrangements prescribed by federal guidelines.[5] Commercial contracts are often characterized by tasks that are not only limited in scope, but ones the client also expects SRI to execute frugally. Over the years, some exceptions to this way of building revenue and income have occurred, but not many. Since the U.S. Bayh-Dole Act was passed in 1984, nonprofits have been able to retain the intellectual property developed under government contracts. That stipulation clarified SRI's ability to leverage such property into selected commercialization activities to supplement its normal income from contract fees. Accordingly, in recent years SRI has turned to the formation of equity by spinning off start-up companies and by licensing intellectual property for royalties.[6]

The Role of SRI Staff

With a few exceptions, SRI's contract research operations are defined by the initiatives and expertise of the first two levels of its staff hierarchy—the program and laboratory levels.[7] These are the levels where choices are made about what to pursue in the field of endeavor and where hiring of qualified staff occurs. Programs consist of ongoing collections of similarly oriented projects, run by a program manager, and laboratories (or centers) are made up of a family of similar programs. The laboratory or center is SRI's first level of fiscal accountability. The present organizational taxonomy includes only two higher levels: divisions, which are aggregations of laboratories and SRI's highest level, its president. But from perhaps the 1960s through much of the 1990s, when the Institute was larger, the divisions were consolidated as Groups in Engineering, Sciences, Business, and Education and Policy. All of these organizational elements will be repeatedly referred to, either generically or specifically, in the project descriptions presented in the following chapters.

The roles played by SRI staff depend, logically, on their position in the above research hierarchy. As mentioned, the preponderance of research ideas and contract sales occurs in the programs and the laboratories. Within those levels are cadres of qualified support staff, who usually divide their time among multiple projects. At the program level and above sit research managers, whose job it is to monitor the quality of work, assess client satisfaction, budget and track the fiscal performance of the various laboratories and programs, and decide when to close or initiate programs. Most of SRI's seats of innovation lie within the laboratories and centers. Individual researchers in the laboratories help advance the state of their chosen discipline and provide clients with solutions that are realistic and innovative and that will stand the test of time. Because of the diversity of talents and disciplines among this set of professionals and their sheer number, they collectively represent a stable marketing and sales force for the Institute as a whole. When SRI was at its largest, their—not always coordinated—marketing efforts produced roughly 2000 new projects a

[5] "Fee" in this case is viewed as profit, which, in the case of a nonprofit institute, forms a pool of funds that is reinvested for a variety of capital and business development needs.

[6] Appendix D provides a more complete discussion of SRI's business model and the growing importance of intellectual property commercialization. Some mention of that transition also appears in Appendix B.

[7] Appendix E provides a more extensive account, based on the author's own views, of the roles of research staff and managers.

year. Some of those projects bring several years of consistent and focused research and thus offer their type of operational stability; but even the most transitory projects, if plentiful enough, offer another, more aggregated stability.

Some people are uncomfortable with such dynamics. When interviewing people for a position, I would sometimes ask them how they would feel being in a laboratory that was often less than a year away from going out of business. That was, after all, the nature of much of the work. But, given the ability of the staff to be both innovative and adaptive and given enough different projects to even out the revenue flow, laboratories and sometimes programs can be quite stable. It's just that at any given moment, some subset of staff may not feel that way.[8]

But the uneasiness created by the transient nature of SRI's contract research is often supplanted by the feeling of independence it provides individual staff members. An SRI project leader has great latitude in the area he/she chooses to address. In a real sense that leader has complete control over the technical and financial aspects of each project. His supervisors are there mostly to encourage an adequate backlog of work, to provide the environment needed for conducting the work and, as mentioned, to occasionally check on the quality of the work when a leader is new or a project entails some unusual risks. Managers are also there to help an innovative researcher engage other insights or skills when an interdisciplinary solution best satisfies a client need.

This type of environment has a distinct quality to it. Though immersed in a large organization, the researcher is, in a very real sense, working directly for the research client. If the work done pleases both the client and the responsible research leaders, other judgments about the work become secondary. On the other hand, when a researcher is not meeting the obligations expressed in the contract, normally little external motivation is needed for the marshalling of supplementary effort. The scientific ethic and the self-imposed expectation of performance quality have created an atmosphere of integrity and objectivity at SRI.

The Allure of Innovation

It is hard to conceive of a research organization, either basic or applied, that doesn't encourage and reward fruitful innovation. Such applied imagination results in fresh solutions to a problem or advances in the state of an art. For researchers, it is also the most important ingredient of self-satisfaction—the exhilaration that comes from doing something for the first time. It doesn't have to be of Nobel Prize caliber at all, but it should capture the acclaim of peers and the client.

Of course, not all such innovation needs to be individualistic. In today's technical world, a lot of innovation lies at the intersections of existing disciplines and is, by nature, a collaborative effort. But no matter how many collaborators are involved, there is an intrinsic joy in discovery, and everyone in a research organization strives to cultivate an atmosphere that fosters such discovery—even in the somewhat constrained environment of contract research. Those who have spent their careers at SRI invariably know that feeling.

These two attributes, innovation and noteworthy solutions to a clients' problems, go a long way toward defining the pride and motivation the SRI staff feel about their place of work. While administrative and support staff participate in that general feeling, the pride of individual researchers is often influenced, perhaps dominated, by their own perceived contributions. In support of these contributions, many mid-level managers at SRI believe their most important job is to build an atmosphere where important and fruitful innovation can unfold. After all, innovation comes from original and creative thinking in a conducive and receptive atmosphere.

The personal drive required of principal researchers at SRI is, quite expectedly, very akin to the motivations of an entrepreneur. To be responsible for all aspects of getting and executing a project, both technically and financially, is to exercise the rudiments needed to create a business. And many of those who

[8] Clearly, a finite pipeline or backlog of work is simply the nature of most service businesses including law firms and medical clinics. Within contract research, some areas may provide more opportunity than others. As a case in point, in my nearly 24 years as a laboratory and division director in the field of communications, computer networking, and computer science, in only one brief episode when a large, longstanding project was not renewed, did we have to lay staff off for lack of work. Some SRI laboratories have been in continuous operation for four or even five decades.

have "cut their teeth" at SRI have decided to leave to found companies or more individual business pursuits. Because SRI has not kept a record of such departures, the list in Appendix F is a very partial one. Nonetheless, the creation of the more than 80 companies listed can be viewed as another facet of the culture at SRI, the kind of people it attracts, and the ideas it engenders.

The SRI "Diary"

Another way to gain an appreciation for the character of SRI is to travel through what might be called its "diary"; that is, the chronological collection of considerably more than 50,000 individual projects that serves to communicate just what SRI has been and continues to be. This logbook of thousands of researchers, all heading into usually uncharted territories of every imaginable description, is a highly dimensional, eclectic journey that is nothing short of amazing and certainly tantalizing to the curious. Each project's tale begs to be told, and, having dipped in just a bit, it is clear to me that a huge number of project tales are worth telling. Therein lies the inevitable frustration in being able to address but a relative few.

Just the first pages of the log reveal the vast diversity of SRI's work over the years. The very first project in 1946 was an exploration of a new source of natural rubber to relieve the great shortage evidenced during World War II. Another early effort was a campaign by the Western Gas and Oil Association to understand the constituents of what came to be called smog in the Los Angeles Basin. SRI held the first nationwide conferences on identifying the constituents of smog. Later, carbonation in beverages was studied for Pepsi-Cola, and not long thereafter, for the American Chicle Company SRI examined why peppermint flavor waned too quickly in Chiclets. Soon Spreckels Sugar wanted to know the optimum conditions for storing concentrated raw juices, and the port of Richmond, California wanted a review of its harbor operations.

Examples from 1950 include measuring the demand for cotton textiles along the Pacific Coast, researching ovarian cancers for the American Cancer Society, finding means for reducing brush foaming of paint for W.P. Fuller & Company, testing antennas for Douglas Aircraft, conducting work for the Bank of America that would revolutionize how banking was to be done, and designing pulse transformers for the Army Signal Corps. SRI's 342nd project brought its first overseas work, an economic study of Cuba and, one project later, a study of the revitalization of the war-torn Italian mechanical industries for the Italian Government. In November 1956, SRI, in partnership with the University of Arizona, held the world's first major conference on the capture and use of solar energy. Over 5 days, approximately 500 energy scientists and engineers, industrialists, and government officials from around the world heard about solar furnaces, photovoltaic cells, solar space heating and cooling, solar stills for making drinking water, and even algae and higher plant cultures that were potential energy storage systems. Some 29,000 members of the public and press toured the technical exhibits and saw how India, Africa, Europe, as well as the immediate U.S. Southwest, were interested in developments in this field. It was a landmark event.

Also in the 1950s, there were sugar beet hydration methods, ultra-high-frequency antennas for Learjets, diversification studies for the Rohr Corporation, project "Mickey" that helped found Disneyland, a study of Israel for the U.S. Foreign Operations Administration, an exploration of the psychological factors of using colored hair rinse, the design of wooden boxes for who else but the Wooden Box Institute, the solution of problems in the manufacture of phonograph records for Capitol Records, creation of printed circuit countermeasure antennas for the Air Force, and the development of Hydracushion railcars for Southern Pacific that ultimately changed how most railcars would be built.

The variety of SRI research is staggering: the development of quick-drying ink that prints on vinyl for Plastic Fabricators, the study of the absorption patterns of salicilate, evaluation of instant mashed potatoes for the American Potato Co., examination of high-temperature oxidation and nitridation of niobium in ultra-high vacuum, and a toxicology analysis of muscatel wines for the State of California's Wine Advisory Board.

While vague research titles often mask detailed investigations, some projects can still be quite general in nature: conducting a market analysis for the Asparagus Board; structuring complex man-machine systems for the Air Force project in 1961, which led to the first

development of personal computing; assessing manufacturing opportunities for the Ethyl Corporation; analyzing command, control, and communications for the Army Signal Corps; and undertaking the ubiquitous "technical service" projects, which were usually both small and very directed. SRI even undertook studies for the U.S. Congress when in 1959 it assessed those fields of science and technology that might affect how the Senate Foreign Relations Committee made foreign policy decisions, and in 1960 made recommendations concerning the U.S. balance of payments.

Among projects in 1969 was work for NASA: building simulated lunar rocks, developing tactile feedback for teleoperations, and studying the noise characteristics of jet turbulence. Also, in that year SRI forecast Iowa's long-term airport needs, developed a fire retardant for polymers, figured out how to clean and debark wood chips for the U.S. Plywood Association, and formulated post-attack survival and recovery strategies for the Office of Civil Defense.

The 1970s saw a study for the Colorado Legislature of that state's Department of Education, the development of a saline removal process called reverse osmosis for the Department of the Interior, a small project in denying bank vault penetration for Diebold, a sensory evaluation of Oreos for the Keebler Corp., an auroral radar installation in McMurdo Sound for the National Science Foundation, a 911 emergency number system design for the Miami Police Department, an evaluation of the air quality impact of a proposed winter resort north of Lake Tahoe for Walt Disney, and determination of the fluency of speech over packet-switched communications systems (now, called Internet speech or Voice-Over-IP) for the Navy. In the wake of the reactor accident at Three Mile Island in Pennsylvania, the U.S. Nuclear Regulatory Commission called on SRI to evaluate various ways to cool the reactor core. In a related vein, the Wisconsin Electric Power Association asked SRI to examine its needs for future nuclear power plants. SRI not only didn't find any need, but that finding coincided with the end of nuclear power plant construction starts in the United States.

As you might expect, undertaking some projects has been open to question. SRI decided not to conduct studies for the Nevada Gaming Commission but it did look at the transportation options to bring more people to Reno to gamble. SRI did undertake a project in 1978 for the Edgar Cayce Foundation in exploring archaeological sites in Egypt, a small project for astronaut Edgar Mitchell's Institute for Noetic Sciences, and several paranormal investigations for both private and government sponsors.

The diary, of course, goes on and on. Today, SRI is studying projects like miniature fuel cells to power laptops and cell phones, techniques to develop magnetic levitation, wearable polymer batteries, and power generators imbedded in the heels of soldier's boots. In the case of the latter, a company has recently been formed to pursue the broad applications inherent in the SRI technology called electroactive polymers. On the other hand, SRI is also investigating age-old phenomena such as how deep ocean waves intersect with a shoreline. The stream of projects is as exciting as it is endless. If you are at all curious, watching this flow is very much like viewing a fantastic, eclectic parade that you can't quite leave. But those who work here, those who find themselves inside the parade, get to see only that which is immediately around them.[9] I claim even that limited view has been exciting. Regrettably, from the continuous flow of projects and the incredible concentration required by researchers toward their own endeavors, most SRI staff do not have the time to publicize their part in the parade or even to watch much of it pass by. That is just one reason for this book.

As another comment on SRI's work, I have the distinct sense that it has never been sufficiently credited for its contributions. Contrary to the public exposure the Charter suggests, much of SRI's work goes unheralded. Of course, that must be the case for projects that the sponsoring agents consider proprietary and for classified work for the U.S. government. Other reasons are less clear. They include insufficient money at the end of a project to write articles about its innovative aspects, as well as the pressure of moving on to new

[9] One personal experience that shows the unannounced skills that exist in our colleagues occurred in a 1998 meeting of the U.S. Air Force Scientific Advisory Board of which I was a member. Each year they recognize a single Air Force researcher for his or her accomplishments. That year it was given to a young biochemist who, in the introduction of his invited talk, mentioned that none of what he had accomplished would have been possible without the help and inspiration of Ron Spanggord of SRI. "But that's my tennis partner!" I uncontrollably blurted out, knowing but vaguely the kind or significance of his work.

projects that leaves little time for such announcements. Nevertheless, some of SRI's technical laboratories have policies that encourage the use of discretionary money to publish any advance in the state of the art they practice. In my division, an explicit management goal was to publish and, with that policy in place, we easily achieved on the order of one professional paper per researcher per year. Although in recent years SRI is paying much more attention to publicity, over most of its existence it has chosen not to publicize its work. This is yet another reason for writing this book.

One final feeling the "diary" may suggest is that with all of its breadth and diversity, defined as it has been by the initiative, instincts, and insights of its legion of project developers for over 50 years, SRI is truly an uncommon, perhaps unique, place to be. Without belaboring the truth of that feeling, its acceptance by the staff can only help to make it so.

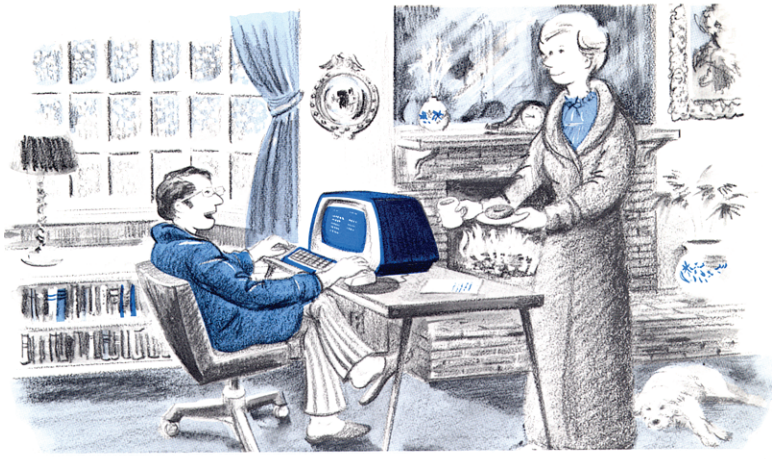
SRI's Dominant Character Traits

Though shifts in the research marketplace require SRI to adapt over time, there is an unchanging essence that those who have spent meaningful time here come to know. To experience it requires your having been "in the trenches," so to speak: having lived with the excitement of forming a new concept, solution, or vision; having struggled to find the needed support; and having known the euphoria of bringing an idea to realization. Some of the magic of SRI is the creative atmosphere that pervades the Institute and becomes intensely personal for all principal investigators and those who support them. Even many who leave SRI under less than ideal circumstances, can't shake the feeling engendered by that creative or innovative process. In the image painted up front in The Setting, creativity is seen as an ethereal quality, something that you know when it has visited you but are uncertain as to how to make it appear. Here we can simply attribute it to a happy confluence of the right people and a supporting atmosphere or culture.

One of the most important traits of the early years of SRI was the freedom people felt. Within the scope of a researcher's skills, almost any honorable endeavor was not only allowed but supported. One retired leader mentioned that during the 1960s, some staff who discovered they could realize their passion only outside the Institute were given, in the most positive sense, encouragement and even financial assistance to do so.[10] The atmosphere seemed oriented toward individual fulfillment, always tempered, of course, by the necessity of finding sponsorship for whatever that fulfillment might entail. To that atmosphere, add the opportunity to affect the future, where creativity is not wasted. Fortunately, SRI has been attractive to innovative people who feel invigorated by that kind of environment. Perhaps that is as much as one need say.

As one brief example of the kind of forward-looking, creative thought evidenced at SRI, notice the figure below of a person enabled to work at home through the use of a computer terminal, in this case, in his living room. The remarkable thing about the figure is that it is from a SRI promotional brochure called *Investments in Tomorrow* issued in 1974! Such an arrangement was seen at SRI at that time as a network-enabled, multitasking environment for the work of a specialist lending his talents to a variety of projects centered at different times and locations.

Few know of such prescient visions. Many SRI researchers have such visions of their own,



"What! Coffee time already?"

[10] Conversation with former SRI COO, Charles Cook (Feb. 23, 2000). He mentioned that some SRI people were even known to dip into their own pockets to help someone realize his or her goal on the outside. Often, SRI has also allocated time or money to help in relocation.

visions from which they are not easily distracted. As a consequence, most SRI staff members know little about the individual projects and accomplishments of their colleagues. What, in fact, has SRI done that made a difference? Some who are familiar with SRI will easily cite the mouse or perhaps the world's first computerized banking system but in all likelihood that may be as far as they get. Well, this book is intended to help correct that. Here, you will find plenty of examples of how other SRI researchers, by doing what SRI people do every day, with some serendipity, have changed the world.

Endnote

[A] "The Story of SRI," *SRI Journal*, Feature Issue 4, December 6–11, 1966 (a review of SRI's first 20 years).