NASA Reshapes Libraries:  
The Space Program’s Impact on Academic Libraries,  
Special Libraries, and Archives

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ABSTRACT
The National Aeronautic and Space Administration (NASA) has enriched many fields through its scientific discoveries and new technologies, but its impact on information science, though lesser known, may be among its most significant contributions. From the reconceptualization of librarians as information scientists by NASA leaders like Von Braun and Day, to NASA’s massive program of knowledge dissemination including breakthroughs in hardware and software, NASA’s informational initiatives helped to lay the foundation of modern information science. This report will describe these developments to give some perspective on what academic libraries, special libraries, and archives owe to NASA.

INTRODUCTION
Since a Library of Congress analyst, Eilene Galloway, helped write the National Aeronautics and Space Act creating the National Aeronautics and Space Administration (NASA) (Billings 2009), it seems fitting to consider how NASA has influenced academic and special libraries. NASA’s mission has always been not only to advance space exploration and discovery, but also to share its knowledge and discoveries for the advancement of the nation. NASA developed strong relationships with libraries and librarians as part of this mission, and libraries have benefitted in multiple ways.

Indeed NASA has helped to launch the library and information science field into a whole new world. In recognizing the importance of library and information science to America’s celestial enterprises, the space agency’s early pioneers re-conceptualized libraries, pointing the nation’s libraries toward becoming high tech information centers in addition to storehouses of books. Further, NASA’s knowledge diffusion and technology transfer programs utilized libraries and librarians to reach scientists and engineers beyond those who were already working with the space administration, thereby giving special and academic libraries access to vast amounts of information as well as accentuating the roles of librarians and informational tools in scientific research. NASA also developed computer databases and computer-aided indexing to provide improved access to the numerous reports the agency produced, eventually leading to the many government and commercial databases in use in libraries today. Finally, a number of spinoff technologies from NASA have helped libraries and archives in unexpected ways.
This report will describe these developments to give some perspective on what academic libraries, special libraries, and archives owe to NASA. NASA has enriched many fields through its scientific discoveries and new technologies. For example, it has built satellites that have improved national defense and meteorology. The heart monitors NASA designed for astronauts have enhanced medical care in hospitals (NASA Spinoff. 1996). The guidance systems created for satellites have helped improve tractors on America’s farms, and the transportation industry has raced forward because of NASA contracts and innovations (NASA. OCT 2008). Schools have gained a huge boost from the educational materials and inspiration provided by space scientists and astronauts (Dunbar 2015). NASA has made invaluable contributions in all these areas, but its impact on information science is lesser known. However, the space agency’s effects on specialized librarianship and the knowledge industry must surely rank among its most significant contributions to human society.

LIBRARIES AND THE SPACE PIONEERS

Some of NASA’s space pioneers highlighted the role of libraries in their campaigns to explore the stars, and prophesied about how the space program would transform libraries. Interestingly enough, they viewed space exploration as largely an information science challenge—an effort to collect and catalog the findings of thousands of scientists in a way that would foster the creation of technologies that could make space flight a reality. They realized that in order for engineers to develop new technologies they would need to perform reviews of the literature to determine if a particular technology had already been developed and build off the work of past researchers. Otherwise, space science research efforts (transpiring at various labs, firms, and centers all over the world) would never have the cohesion and synergy necessary to achieve truly phenomenal feats. Further, the early space leaders knew that space exploration would only enrich civilization here on Earth if the information it generated could be effectively organized and diffused among all industries, fields, and peoples.

Wernher Von Braun, the father of rocketry and director of NASA’s Marshall Space Flight Center, illuminated the importance of libraries to America’s future space efforts and explained how NASA’s information needs would reshape libraries in a 1962 article for the ALA Bulletin, “Libraries and the Space Age.” Von Braun pointed out that knowledge was exploding due to new scientific enterprises, and librarians would have to grapple with organizing it. The role of the librarian was thus vital to NASA, and their role was evolving as a result of the need to disseminate the discoveries of NASA’s scientific programs:

The demands of our times should dispel forever the antiquated image of the librarian as … nice but somewhat fussy…with no special training who talks in whispers as she checks her books out and in. Our modern librarians play an increasingly important role in progress by obtaining reports of new discoveries and circulating them for immediate use. Their specialized knowledge in speedy classifying, cataloging, circulation techniques, and the use of advanced communication methods reflects an emphasis on utilization rather than preservation. It demands a new breed of librarian who is also a technical and scientific information specialist (Von Braun 1962, 525).
Von Braun announced that the Marshall Center was creating a special library on rocketry that would embody these ideals. He said the new library would be staffed by librarians who could help NASA’s engineers locate reports that could save time in developing new space technologies, noting that librarians “may be able to find the answer to a perplexing research or development problem in current literature more rapidly than the laboratory can find it in the bottom of a test tube” (Von Braun 1962, 526).

Von Braun related that America’s space achievements would have immense political advantages on the world stage, but the expansion in scientific information sparked by space exploration would offer the greatest benefit to the country, and NASA was “counting on librarians to assemble the resulting new knowledge and make it readily available to all who are interested” (Von Braun 1962, 528).

Likewise, Melvin S. Day, deputy assistant administrator of NASA’s Office of Technology Utilization, highlighted the importance of the NASA-librarianship connection in a 1966 article for Wilson Library Bulletin, and encouraged librarians to reformulate libraries for the space age. He defined NASA’s Scientific and Technical Information Division as a “library” that aimed to collect, index, and disseminate information that could sustain the space program and technological development in general (Day 1966, 396). In discussing the space agency’s new libraries, he explained how libraries were evolving from book depositories into specialized electronic centers:

[M]ention of ‘library’ first calls to mind a pleasant room, lined with books, presided over by the kind [librarian] who could direct one to the sources of information needed in pursuit of one’s pleasure or profit. But that older and comfortable image must immediately by magnified by realization of the tremendous expansion in the number and kinds of items to be shelved, the increasing demands by selected users for specialized services, and the inevitable effects of the techniques which have been developed to assist the library in fulfilling its functions. In fact, the image may be so magnified that the library is no longer a room to which one goes, but a service which comes to the user, and the direction finder is an announcement medium or a journal or a literature search—all materially assisted by that impersonal but fascinating tool of our age, the computer (Day 1966, 396).

Day pointed out that NASA’s library system exemplified the library of the future. The space agency had designed its libraries so that scientists working at labs or offices at any of its test sites could identify relevant documents through computer indexes based on magnetic tape and obtain those documents through U.S. mail. The “shelves” of the NASA library were the centralized storage rooms of technical documents; the “card catalog” was magnetic tape; the “circulation desk” was phones and mail service; the “reading room” was the lab or office anywhere in America where a scientist was working. Day hoped that libraries would metamorphosize into an incorporeal form, no longer bound by physical walls and available everywhere in order to accelerate scientific research. The mission of the new type of library was “selective dissemination of information to users with specialized interests” (Day 1966, 396).
Embedded in NASA’s paradigm of a library were the modern concepts of remote access, computerized indexing, and a high level of specialization.

Von Braun and Day, early in the Space Age, had not only recognized the significance of library and information science but had challenged librarians to create a new type of library that could meet the growing scientific and technical needs of the space program. While America’s orbital ambition was not the only force reshaping libraries, the space program played a significant role in pioneering the modern concept of special librarianship. In hearings before Congress in 1971, Day would explain:

We believe that the establishment and growth of an information sciences industry in the United States, providing technical information in a vast number of fields for a large number of varied users, has followed the development of this concept by NASA a few years ago. Research performed and concepts demonstrated relating to information search and retrieval techniques and means of working with clients to adapt information to their needs, have provided starting points from which both other Federal agencies and the knowledge industry have built their programs (1971 NASA Authorization, 1635).

As will be seen, Day’s report about NASA’s impact on special librarianship was quite accurate. NASA’s dissemination of high caliber technical content and its invention of new computerized techniques for indexing information would help put libraries on a trajectory toward becoming specialized electronic centers.

KNOWLEDGE DIFFUSION, TECHNOLOGY TRANSFER, AND “NEW-TYPE LIBRARIANS”

NASA viewed space research as a cycle consisting of knowledge, diffusion, and innovation. As knowledge was generated, it was diffused to the scientific world, and this diffusion gave rise to innovation, which fueled the generation of more knowledge (Pinelli 1991). Libraries facilitated the diffusion stage, aiding the transfer of technological knowledge to scientists and playing a support role to hundreds of NASA-sponsored innovations that made extraterrestrial travel possible. NASA’s diffusion efforts would impact the library and information science field by providing vast amounts of specialized information to libraries for free, and creating new libraries, librarian job roles, indexing tools, and information distribution systems in the process.

NASA harnessed libraries to broadcast information about space science to the public in general as mandated by Congress, but it also used special and academic libraries to disseminate its technical reports to scientists and engineers working at industrial firms and universities throughout the country. The National Advisory Committee for Aeronautics (NACA), the forerunner of NASA, had set a precedent by distributing copies of its technical documents to special libraries within industries, libraries at major universities, and larger public libraries before the start of the space race (Roland 1985). In official literature about its dissemination program in 1971, NASA reported that it distributed its publications to many types of libraries, and that the most complete collections were found at the central facilities of the nation’s largest
public libraries. In addition, NASA’s technical literature was deposited in eleven special
libraries at universities (NASA 1969, 23).

Libraries of all types provided integral support to NASA’s early dissemination
program, with academic and special libraries focusing on diffusion of the most technical kinds of
information. Many academic libraries offered access to NASA’s Scientific and Technical
Aerospace Reports (STAR), a semi-monthly journal that abstracted most of NASA’s contractors’
research reports. An additional semi-monthly journal, International Aerospace Abstracts (IAA),
was contracted by NASA with what became the American Institute of Aeronautics and
Astronautics (Geise 1971, 12). STAR and IAA served as both current awareness tools and
powerful searching tools, with multiple entries for each report and cumulative journal indexes
issued four times a year (NASA 1969, 3-4).

In the early days of the space age, NASA also created a path-breaking information
service called Selected Current Aerospace Notices (SCAN) that relied heavily on special and
academic librarians. As NASA’s Scientific and Technical Information Facility received new
reports each week, a computer scanned the reports for information on 200 aerospace topics
(including topics like gravitational collapse, microwaves, lunar surfaces, weather forecasting)
and printed out notices with bibliographic information. The Facility sent the notices to librarians
at research firms and universities, and the librarians in turn disseminated the notices to the
researchers in their organizations. Each researcher could select which topics they wanted to
receive notifications for, thus permitting NASA and the librarians to customize the notices. If
the researcher saw a report they wanted, they could checkmark the item, write their name and
mail code near it, and return the notification to their organization’s librarian. The librarian
would then check their own library’s holdings first, and if the item was not available, the
librarian would order it. In these ways, special and academic librarians provided the link
between NASA and thousands of scientists working on bleeding edge projects. The SCAN
system delivered relevant information to scientists working on projects extremely quickly
(NASA 1969, 13). It was a hybrid system that relied on a NASA computer for cataloging but
also relied on a network of human librarians for help in distribution, customization, and retrieval.

One 1968 article further described NASA’s dissemination efforts, pointing out that
NASA’s library system was serving 250 companies contracting with the space agency. It noted
that the role of the science librarian was becoming more and more critical as the costs of research
and development grew. The librarian could often find a report of a previous experiment that
could save vast sums of money by preventing engineering firms from having to repeat the same
experiments (Lasworth 1968).

In its relentless efforts to disseminate its reports as widely as possible, NASA also shaped
special librarianship by establishing a number of new special libraries outside of its own
organization through grants. By 1969 NASA had provided grants to start six nonprofit special
libraries, often housed on university campuses. Corporations and research organizations
consulted with these libraries to locate reports or make contacts with scientists researching the
same problem, thus accelerating the research process. The 1969 Los Angeles Times article
“Computer Breeds New-Type Librarian” noted that these NASA-inspired firms were
transforming librarians into “information scientists” who consulted with scientists to help them
mine computer systems for abstracts on their topics. NASA funding for special libraries was helping to change the paradigm of a librarian beyond a book searcher; librarians were also becoming specialists who helped engineers with the “research logic” needed to utilize computer indexing (Steiger 1969). The fusion of NASA’s high technology indexing systems and librarians’ traditional helpfulness produced a robust information service for specialized clientele. Computer search systems were so complex that they required these librarians-turned-information-scientists to search for the patron, which added to search costs and limited the systems’ use primarily to corporations and special libraries at large universities (Gardner and Wax 1976).

A 1979 study documented the essential role played by special libraries in circulating NASA research reports within private aerospace firms, surveying scientists as well as special librarians in the firms about dissemination channels. It found that of the corporations surveyed, 68% had at least 13 divisional libraries—in addition to their companies’ central libraries—suggesting that “the storage and retrieval of technical information is important to companies and the functioning of their employees.” Further, most companies had an average of 11 full-time librarians on staff, additional evidence “of the important function that libraries serve for aeronautical companies.” The libraries were substantial, averaging 104,910 books and journals each (Monge et al. 1979, 34). These corporate libraries were considered “a crucial link in the dissemination of NASA documents” (Monge et al. 1979, 40). In surveying the researchers about how they found out about new NASA publications, the study revealed that the largest percentage of researchers found out about NASA materials through newsletters created by their special libraries or information services, a finding that indicated the pro-activeness of the special librarians in the diffusion of NASA knowledge (Monge et al. 1979, 39). These aerospace companies, nourished as they were by NASA information offered by their special libraries, developed many innovative technologies.

Academic and special libraries continued to serve as significant dissemination channels for NASA and aerospace research during the 1990s. In the 1991 NASA/DoD Aerospace Knowledge Diffusion Research Project, aerospace researchers were queried about their use of libraries and technical centers. About 94% of academic aerospace researchers had visited a library or technical center in their college or university, and they visited it on average 24 times in a 6 month period. Industry and government aerospace researchers visited their libraries and technical centers 13 and 12 times in the same period. Researchers of all kinds received help from a librarian during two-thirds of their visits (Pinelli 1991, 314-317). The study concluded that “libraries and technical centers are used and are important to U.S. aerospace engineers and scientists.” (Pinelli 1991, 334).

By the twenty-first century, NASA had created a number of electronic science resources that are now featured in thousands of academic and special libraries’ database listings. For example, the NASA Technical Reports Server (NTRS) offers free access to 500,000 science citations and 90,000 full-texts, and allows researchers to scour the information systems on many of its major space centers. Around 218 libraries worldwide have formally cataloged NTRS, and hundreds of others have added it to subject guides (NTRS 2012).
NASA’s early diffusion programs had generally accentuated the roles of specialized librarianship. NASA had created jobs for special librarians and started entirely new special libraries as part of its dissemination efforts, as well as creating new specialized indexes, journals, and other information systems for research. NASA’s own space center libraries, the nonprofit special libraries it funded on college campuses, and the special libraries in scientific industries all helped to create a research network that would help Americans launch their first forays into the stars. Beyond spawning these new collections and libraries, NASA would also develop innovative tools and techniques that would transform many of the core functions of nearly all special and academic libraries.

**THE INTERNET, DATABASES, COMPUTER-AIDED INDEXING, AND OTHER SPINOFFS**

NASA spinoffs in the field of information science have furthered the mission of libraries in many ways. NASA has invented many information systems on its own, and more often its funding and support have made it possible for many individuals and firms to develop spectacular new technologies as part of NASA contracts. Some of these included desktop computers, the expansion of the internet, faster interlibrary loan service, and electronic databases with computer-aided indexing.

**Desktop Computers**

After Robert Noyce of Fairchild Semiconductor and Jack Kilby of Texas Instruments invented the microchip in 1959, NASA became the “microchip’s first major champion” in the 1960s when it bought a million chips to support the lunar missions. The microchip’s subsequent spread made it possible to create small computers that still had great processing power, in contrast to the huge computers that relied on vacuum tubes or transistors (Moschovitis et al. 1999, 45). NASA had helped the microchip go from the lab to the field, as smaller computers would eventually make their way onto desktops everywhere, including libraries. A NASA grant also helped Doug Englebart to invent the mouse in the early 1960s, which has made computers into the interactive and accessible tools they are today for researchers (NASA 2004).

**An Internet for Civilian Research**

NASA, along with the National Science Foundation and the Department of Energy, supplied the funding and technical expertise for the National Science Foundation Network (NSFnet), a computer network in the late 1980s that made the internet a tool for civilian research. The Advanced Research Projects Agency (ARPA), a group inside the Department of Defense that designs new technologies for warfare, created the first version of the internet in 1969, ARPANET. However, its use was limited to defense-related researchers. The developers of NSFnet took the old ARPANET and expanded it for broad civilian use. The birth of NSFnet sparked an exponential growth in the number of web sites, and the network became the foundation of the modern internet (Moschovitis et al. 1999, 125-127, 134). NASA, along with its agency partners, had helped make the internet a resource for peaceful research at universities and firms everywhere.
Faster Interlibrary Loan

NASA also helped blaze the path for new interlibrary loan and document delivery services. NASA underwrote funding for the first online searching system that researchers could use to order documents (Banks 2008, 9). NASA also sponsored a study in 1972 to evaluate the possibility of using telecommunication technology in library services, especially interlibrary loan (Niehaus 1972). Because of developments and studies like these, patrons now receive many needed items in hours instead of weeks.

Databases and Computer-Aided Indexing

NASA helped give rise to the database collections now accessible through library websites by creating computer programs in the early 1960s to retrieve bibliographic data, all in its efforts to organize and make accessible the galaxies of technical papers related to space exploration (Wente 1990). NASA contracted first with the Bunker-Ramo Corporation, then Lockheed Corporation, to build RECON, the government’s first major database system (Steinke 1991, 51; Bourne and Hahn 2003, 3, 141). Lockheed called its system, developed in 1965, DIALOG, which became a commercial database in 1978 (Kowalski 2011, 96). DIALOG became the first electronic information system for many academic and special libraries in the 1980s, heralding a revolution in searching. It “helped make commonplace the online searching and storing of computer-readable reference and bibliographic resources by libraries and information centers throughout the United States and the remainder of the industrialized world.” (Herner 1984, 162).

NASA continued to achieve milestones in online searching and innovative database architecture in the final decades of the twentieth-century. NASA pioneered computer-aided indexing techniques based on lexical association in the 1980s (Buchan 1987; Wilson 1987). In the late 1980s and early 1990s, NASA’s Technology Utilization Program designed software that could carry out relevancy ranking of database search results, as opposed to random or date ranking (Huffman, Vital, and Bivins 1990). Another NASA–sponsored development with international importance was the Astrophysics Data System (ADS) for astronomical papers, a database that made up the heart of “the most sophisticated discipline-centered bibliographic system ever developed.” (Kurtz et al. 2005, 36). Lexical association, relevancy ranking, and highly specialized search options are all features that now characterize databases commonly found in academic and special libraries.

As a search for NASA in Library and Information Science Abstracts (LISA) and Library Literature shows, scholars working inside and outside of NASA have continually enriched library and information science by publishing studies of the space agency’s initiatives in LIS journals and textbooks (Weinberg 1998, xi, 11, 96, 101, 113, 115). NASA has thus not only strengthened academic and special libraries by disseminating scientific knowledge through them, it has also pioneered many of the features and techniques that have shaped commercial and academic database development. As another researcher has noted, NASA’s database development projects have driven the creation of online searching as we know it (Nakamoto 1988).
MIRACLES IN ARCHIVAL SCIENCE

NASA’s technology also worked miracles for document preservation and archival science in the twentieth century, thanks to the ingenuity and generosity of NASA’s technicians. NASA gained justification and visibility for its scientific efforts by helping special libraries and archives preserve important books and records. Amazingly, the ability of NASA and its affiliates to simulate outer space conditions has unexpectedly had immense benefits to libraries, including vacuum drying of water-damaged materials, book deacidification, and revival of indistinct texts in historic documents.

Vacuum Drying

Space industries affiliated with NASA have helped save thousands of books and records damaged by flooding. For example, in 1972 the Klein Law Library at Temple University caught fire, and, in the effort to extinguish it, 60,000 books were damaged by flooding caused by the fire hoses. GE’s Space Division, which collaborated with NASA on Landsat and Nimbus satellites, allowed Temple to access its vacuum chamber, used to replicate outer space conditions. With great ingenuity, Temple’s insurance company and GE space technicians had the idea of placing the damaged books in the vacuum chamber. The low atmospheric pressure in the chamber caused the moisture on the books to evaporate at lightning speed, and then a special chemical was pumped into the chamber that caused the water to freeze. This process salvaged the books, many of them rare items. GE’s Space Division continued to refine this “space simulator” recovery technique, which could save books for only two dollars per title in comparison to the one hundred dollars per title when done by human dryers, and went on to salvage mountains of damaged rare books, blueprints, medical records, historical materials, and government documents for academic libraries as well as special libraries in hospitals, governments, and corporations (NASA Spinoff 1979).

Book Deacidification

NASA collaborated with the Library of Congress to develop new book preservation techniques during the 1980s. At Goddard Space Flight Center NASA technicians helped librarians test vapor-phase deacidification through the use of a vacuum chamber normally used to test satellites. The Library of Congress, as well as the National Archives, Yale University Library, New York Public, and several other libraries, compiled 5,000 books for the test and placed them in the vacuum chamber. The librarians needed an airless environment for the test because the chemical used in the process exploded if brought into contact with oxygen. NASA participated in the pilot project under the aegis of its Technology Utilization Program, an effort to show the public how its technologies could be used beyond space science. The test proved the viability of vapor-phase deacidification as an economical form of mass book preservation, and the Library of Congress later built a facility at Fort Detrick, Maryland, that utilized the technique. Although not as heavily used in the present day, librarians and archivists treated thousands of rare books with vapor-phase deacidification in the twentieth century, extending the lives of these books by five or six times (NASA Spinoff 1983).
Revival of Historic Documents

NASA’s satellite technology has also helped to resurrect historic texts. As books fade over time, the texts become less and less readable until they disappear entirely. In the 1970s, NASA’s Jet Propulsion Laboratory (JPL), working in collaboration with the California Institute of Technology, developed a process for restoring lost texts using photographic technology that NASA space probes had used to map Mars and other planets. Space probes transmit images consisting of hundreds of tiny dots to earth, but by the time the images travel across millions of space miles and reach the earth, their resolution weakens considerably. NASA invented super enhancing technology to pick up the faded dots and make them readable. Space technicians imaginatively realized that this same technology could be used to scan historic documents and enhance the indistinct texts in the resulting images. Their first project was a 600-year-old medical text, *Speculum Medicine*. Their technique not only allowed historical researchers to view the formal text, but also exposed previously-hidden handwritten notes in the margins. They also decoded illegible versions of ancient Roman and eighteenth century American materials (NASA Spinoff 1978).

CONCLUSION

NASA’s role in the history and growth of academic and special libraries was significant. While NASA was not the only force shaping libraries into the specialized electronic information centers of today, it did play an important role. Early in the Space Age, NASA leaders like Von Braun and Day called for a new type of library that could meet the needs of America’s massive campaign to explore the great abyss. They recognized that effective information science systems would provide a launch pad for efforts to invent spaceships, satellites, and all the other technologies needed to reach the stars. In the library fields’ journals, these pioneers had challenged readers to envision libraries that offered electronic access and specialized dissemination systems that could sustain scientific enterprise at research centers throughout America. Their concept of a library in the early Space Age was a blueprint for the twenty-first century library, a library based more on bits and bytes and less on bricks and books.

Beyond simply helping the information science profession to imagine this new cyber-concept of libraries, NASA carried out a program of dissemination--and achieved breakthroughs in the hardware as well as software used to sustain its dissemination--that helped make this vision a reality. NASA vastly enhanced library collections by providing premium technical information to many libraries for free, creating a print distribution system at first that utilized special libraries as depositories and special librarians as search and retrieval agents. The space agency also developed new electronic delivery systems that utilized libraries as access points and librarians as consultants for scientists using the new systems. NASA’s informational initiatives reshaped libraries and their tools outside the space program, and NASA’s work received wide coverage in library science journals, manuals, and textbooks that employed these projects as instructive case studies.

NASA’s programs thus helped to lay the foundation of modern information science. It can even be said that today’s special and academic libraries are creatures of the space age.
NASA has developed through its own efforts, or by sponsoring the efforts of other inventors, many of the components of a library that patrons use each day. The massive networks of computers in today’s libraries, interconnected with each other through the web, now empower researchers to access information through databases and rapid interlibrary loan services with unimaginable speed and precision. NASA provided a major impetus for these developments, all in its efforts to relay findings between thousands of space scientists working on projects all over the country.

Yet, even while sparking futuristic technologies in libraries, NASA technicians have also helped special librarians and archivists recover and preserve the past through new techniques and tools for protecting records and rare books. NASA has shown that developments in the hard sciences and technology have the potential to further preservation and study in the humanities. Along with other groups, it helped to set a precedent for the use of cutting edge technologies in archival science.

In turn, libraries helped NASA with its dissemination mission by making space information available to scientists at research firms and universities around the country. They supported, and continue to support, reference and retrieval services for NASA personnel and affiliated engineers throughout the world, helping researchers build on past discoveries in the science literature. Libraries and archives, as historic and respected institutions of knowledge in America, also helped NASA demonstrate the value of its spinoff technologies by providing outlets for its innovative searching tools and textual conservation efforts.

Perhaps the most interesting conclusion that arises from this story is that information science provides a foundation for the advancement of all other sciences. NASA’s leaders recognized that the ability to access relevant information would enable scientists to determine whether a particular experiment or project had already been carried out, and thereby allow scientists to build on each other’s research. Without effective dissemination, indexing, and retrieval systems, scientists and engineers would be doomed to repeat the same projects over and over. Hence, NASA developed information systems--using human librarians or new electronic tools or both--that could support rapid dissemination and searching of the body of scientific knowledge. The faster, more comprehensive, and more precise these systems could become, the more effectively could NASA and its affiliated scientists engage in path-breaking research in rocketry, biology, chemistry, physics, and the other sciences. Information science may be thought of as the ultimate science, the science of organizing the knowledge of all other sciences so as to allow them to advance. If science can be viewed as a brain, the other sciences make up the frontal lobes that hold the processing centers for reason, while information science is the hippocampus that houses long-term memory, allowing the frontal lobe to draw on past ideas and avoiding the process of having to constantly relearn.

NASA’s achievements in information science thus rival those in space science, even though these informational achievements are lesser known. Behind the fantastic landings on the moon and the inspiring space shuttle missions lay people and systems that could organize and make readily available the results of thousands of prior studies. As NASA soars deeper into space, the ability to make future discoveries depends on building powerful new information
systems that will allow researchers to access past discoveries with even greater speed and efficiency. Science and technology librarians can play roles in this development.

Before closing, we should also look more broadly than the sciences in order to recognize the full historical significance of NASA’s impact on special librarianship and information science. NASA has pioneered new technologies and created invaluable spinoffs that have reshaped the military, medical, business, and educational worlds. However, the milestones it achieved in library and information science must be counted as some of its most significant, since they have had a universal and immeasurable impact on modern society by enhancing the collections, search tools, and indexing systems that serve all of the other professions. The advancements made possible by NASA’s information science achievements express themselves in countless scientific innovations—as well as in many discoveries in the social sciences and humanities—because NASA has bolstered the overall research capabilities of America’s libraries.
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