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Guide to the John Clifford Shaw Papers

NMAH.AC.0580

Brian Keough

2007

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Collection Overview

Repository:	Archives Center, National Museum of American History
Title:	John Clifford Shaw Papers
Date:	1933-1993 (bulk 1950-1971)
Identifier:	NMAH.AC.0580
Creator:	Shaw, J. Clifford (John Clifford), 1922-1991 (Creator)
Extent:	20.5 Cubic feet (59 boxes, 4 oversize folders)
Language:	English .
Summary:	The John Clifford Shaw papers contain reports, research notes, correspondence, memorandum, and diagrams documenting Shaw's development of one of the earliest list processing languages (IPL) and an early interactive, time sharing program, the JOHNNIAC Open Shop System (JOSS). The collection also contains printed material on the RAND Corporation and the evolution of the artificial intelligence and electronic computer industry in the 1950s and 1960s. In addition there is biographical material documenting Shaw's personal interests, family, and academic career.

Administrative Information

Acquisition Information

The collection was donated by John Clifford Shaw's eldest son, Doug Shaw, March 1997.

Related Materials

Material in the Archives Center, National Museum of American History

Computer Oral History Collection, AC0196

Material in Other Institutions

Charles Babbage Institute

L.A. County Museum

For RAND reports see www.RAND.org

Processing Information

Processed by Brian Keough, August 1997; supervised by Alison Oswald and Craig Orr, archivists.

Preferred Citation

John Clifford Shaw papers, Archives Center, National Museum of American History, Smithsonian Institution.

Restrictions

The collection is open for research use.

Conditions Governing Use

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Biographical / Historical

John Clifford Shaw (1922-1991) was born in Southern California. Shaw went to Fullerton High School, the same high school as Richard Nixon. Shaw's English teacher was Nixon's high school debate team coach. Shaw attended Fullerton Junior College from 1939 until February 1943. At the same time, he worked as a timekeeper at the Douglas Aircraft Company, where he was responsible for time-card calculations and reports. He served in the Army Air Force for three years during World War II as a navigation instructor and then aircraft navigator in the 4th Emergency Rescue Squadron in Iwo Jima, Japan. Shaw returned to California in 1947 and began working for the Beneficial Standard Life Insurance Company as an assistant to the actuary, compiling actuarial calculations of premium rates, reserve liabilities, and annual reports. Shaw and his wife Marian had four children: Doug (b. 1948), David (b. 1950), Donna (b. 1952), and John (b. 1962). By 1948, Shaw received his Bachelor's degree in Mathematics from UCLA and in 1950 joined the newly formed RAND Corporation as a mathematician.

The RAND Corporation evolved during the years after World War II amidst the escalating Cold War. Project RAND was originally carried out under a contract with the Douglas Aircraft Company. RAND was incorporated in May 1948. RAND, a California nonprofit corporation, was one of the earliest Cold War "think tanks" that functioned as an interdisciplinary research and development facility; it received large sums of money from the Air Force and Atomic Energy Commission. Throughout the 1950s, other agencies such as the Department of Defense, the Atomic Energy Commission, and the National Aeronautics and Space Administration (NASA) solicited scientific and foreign policy research from RAND. During Shaw's tenure (1950-1971), money flowed into RAND and enabled many scientists and researchers, including Shaw and his colleagues in the Math and Numerical Analysis Department, to explore new avenues of discovery.

Shaw's early work at RAND involved administrative matters, such as improving the processes of company management through automation of the computation and calculation techniques. This work included collaboration with Allen Newell on a radar simulator. In the mid-1950s, Newell and Shaw, and later Dr. Herbert Simon of the Carnegie Institute of Technology, formed the team known by the mid-1950s in the artificial intelligence field as NSS (Newell, Shaw, and Simon). The NSS team broke much ground in the field of artificial intelligence, programming languages, computer simulation of human problem solving, and man-machine communication. The radar simulator project involved studying how humans made decisions and whether one could design a program that could simulate human decision-making. While Newell and Simon concentrated on the human behavior aspect, Shaw focused on creating a programming language that would implement Simon and Newell's concepts.

When Shaw began working in 1950, RAND was using six IBM 604 calculators to satisfy its scientific computing needs. In the early 1950s, RAND decided that it needed more computational power to accomplish projects for the Air Force and decided to build a Princeton-type computer named JOHNNIAC, after computer designer John von Neumann. The Princeton Class computer was considered state-of-the-art and was running at RAND by the first half of 1953. William Gunning was the project leader and Shaw worked on the selection of the instruction set and the design of the operator's console. The JOHNNIAC became the basis for Shaw's work on conversational time-sharing in the 1960s.

During the early 1950s, the dynamic of the innovative process was at work as Shaw and Newell in California, and Simon in Pittsburgh, were theorizing about human decision making, programming languages, and how computers could be manipulated to process information more productively. Air Force funding enabled Shaw and his colleague's considerable intellectual and academic freedom to explore various hypotheses. In the mid-1950s, NSS began forming the theoretical basis for what they called Complex Information Processing (C.I.P.). C.I.P was the basis for the three main computer programs developed by NSS: the Chess Program,

Logic Theorist (LT), and the General Problem Solver (GPS). By 1954, Shaw's focus was on utilizing the power of the JOHNNIAC to develop a viable language that could simulate human behavior.

In early 1954, Newell left RAND for Pittsburgh to work with Simon; Shaw remained at RAND. The NSS team focused on creating programs that would enable a machine to exhibit intelligent behavior and "think" like a human. Chess and the Logic Theorist (LT) were the first programs that evolved from their work. Shaw dealt with the programming aspects, as Simon devoted his time to human thinking processes for chess, logic, and problem solving. Newell, who was still employed by RAND, was the middle man who worked both in programming and human behavior. He flew back to California every couple of months in 1954 and 1955 to confer with Shaw. Because of language limitations, the chess program was temporarily put aside as NSS decided to finish the LT. Known as IPL (Information Processing Language), the language developed by Shaw was one of the first list processing languages. Through experimentation with assemblers, compilers, and interpreters, Shaw developed list processing sequences that allowed the computer to arrange and store data more effectively. The effectiveness stemmed from links that formed the lists. From a storage point of view, lists were inefficient. Shaw translated Simon and Newell's ideas into IPL. The IPL interpreter was able to compile and translate higher level language statements into machine language. The interpreters process the statements and carry out the indicated operations without generating machine code which must then be executed. Although not specifically programmed so, one of LT's innovative characteristics was that it proved mathematical theorems from Whitehead and Russell's *Principia Mathematica*, including a proof from Theorem 2.85 that the authors had missed. This was the most fascinating aspect of the program because LT was not programmed to find alternative proofs.

The NSS team's work on the LT was completed by the end of 1955, and it perfected the program language in the winter and spring of 1956. LT was one of the earliest programs to investigate the use of heuristics in problem solving. It was capable of discovering and working out proofs for theorems in symbolic logic. In the summer of 1956, NSS presented the LT program to the artificial intelligence community at the Dartmouth Artificial Intelligence Conference. Relatively unknown at the time, NSS excited the conference with the LT and the possibilities it opened in the study of programming languages and artificial intelligence.

The NSS team continued to focus on developing artificial intelligence. By 1957, NSS had constructed the General Problem Solver (GPS) program that attempted to demonstrate various human thinking processes in a variety of environments. At RAND and Carnegie Tech, studies were conducted that had human subjects think aloud in hopes of identifying human problem solving techniques and simulating them in GPS. NSS codified some human problem solving techniques such as means-end analysis, planning, and trial and error. Through the end of the 1950s, NSS produced improved versions of the IPL language and studied heuristic methods of decision making.

By 1960, when the JOHNNIAC was of insufficient computing power to support the level of computation needed, and IPL had been reprogrammed for the IBM 7090, List Processing (LISP), a high-level programming language had overtaken IPL as the language of choice for Artificial Intelligence research. Shaw's interests had shifted towards attempting to simplify the use of computers for all types of computer users. Simon and Newell continued to study how they could simulate human cognitive processes on a computer. Until this point, a user would have to be adequately trained in programming or need assistance from a programmer to use a computer like JOHNNIAC. Shaw was interested in programming the JOHNNIAC so RAND staff could utilize the computer for small as well as large scientific computations. The JOHNNIAC was available for experimental research projects because RAND owned a newer IBM 7090 (acquired in 1960) which handled the bulk of RAND's production computing load. Although JOHNNIAC was no longer state-of-the-art by this time, its major appeal was its reliability and capability for experimentation.

These factors were the impetus for the initiation of the JOHNNIAC Open-Shop System (JOSS) project in November 1960. JOSS was intended to be an easy to use, on-line, time sharing system. The JOSS research, conducted under the Information Processor Project, was formalized in 1959 as part of the RAND Computer Science Department and was heavily funded by the Air Force. The innovative character of JOSS was in the ease of use for the non-programmer, its remote access capabilities, the establishment of an interactive environment between user and computer, and the capability for RAND scientists and engineers to use the computer without an intermediary programmer. It was hoped that the JOSS project would bridge the communication gap between man and machine. JOSS's user language achieved this goal. It featured

a small set of English verbs and algebraic symbols which did not need a programmer as intermediary between user and computer. During 1961-1962, Shaw selected the character set that would be used to write JOSS programs, its syntax, and grammar. The conversational environment included a Model B IBM Electric Typewriter. Tom Ellis and Mal Davis directed the hardware configurations and Ike Hehama, Allen Newell, and Keith Uncapher participated in the project discussions with Shaw.

The very limited JOSS experiments on the JOHNNIAC began in May 1963, with five consoles, one connected to the JOHNNIAC and four others located in the offices of various RAND staff. By June, a schedule of operations was in place and by January 1964, JOSS was fully implemented. The use of JOSS by RAND staff was higher than expected as users taught other users how to run the system. However, Shaw and the other designers worried that JOHNNIAC's hardware placed limitations on speed and storage which might taint the evaluation of JOSS. In July 1964, a second version of JOSS was proposed on a more powerful computer. C.L. Baker was named project head, and Shaw focused on developing the programming language for JOSS II.

After accepting numerous bids to replace JOHNNIAC, a contract was signed with Digital Equipment Corporation (DEC) promising the installation of a PDP-6 computer and thirty consoles at RAND. The installation was completed by October 31, 1965. At the Fall Joint Computer Conference in Las Vegas in December 1965, the first demonstration of remote use of JOSS II was given. JOHNNIAC was retired on February 18, 1966, with Willis Ware delivering a eulogy and Shaw loading a final JOSS I program. By the end of 1966, JOSS II was available to users 24 hours a day, seven days a week on the new PDP-6/JOSS computer, which had thirty times the speed and five times the storage capacity as the JOHNNIAC version. In April 1967, the maintenance and improvement of JOSS II was transferred from the development group to a small staff under G.W. Armending. In 1971, at age 49, Shaw left the RAND Corporation.

In 1971, Shaw took a one-year appointment as a Research Associate in the Information Science Department at the California Institute of Technology. In 1972, he began working as a consultant which he continued for the rest of his professional career. Much of his work in the 1970s and 1980s consisted of formulating new ideas on operations research, video games, man-machine interfaces, interactive computer systems, time-sharing, information architecture design, and artificial intelligence. During the 1980s, Shaw also became more involved in church-related activities.

Shaw's work on creating the Information Processing Language in the 1950s and the JOSS program in the 1960s were the two major contributions he made to the fields of programming and artificial intelligence. His IPL-I programming language is one of the earliest examples of list processing languages now in widespread use. The JOSS program was one of the first easy-to use, remotely accessible, interactive programs that allowed non-programmers to utilize the power of a computer.

Scope and Contents

The John Clifford Shaw Papers contain reports, research notes, correspondence, memoranda, and diagrams documenting Shaw's development of one of the earliest list processing languages (IPL) and an early interactive, time sharing program, the JOHNNIAC Open Shop System (JOSS). The collection also contains printed material on the RAND Corporation and the evolution of the artificial intelligence and electronic computer industry in the 1950s and 1960s. In addition, there is biographical material documenting Shaw's personal interests, family, and academic career.

Series 1: Shaw's Career at Rand, 1950-1971, documents Shaw's most significant work. The subseries are arranged by specific projects and illustrate his pioneering work on programming languages, interactive time-sharing systems, heuristic problem solving, logic programming, stored programs, and artificial intelligence. This work included his role in the development of the JOHNNIAC computer and programs such as the Logic Theorist (LT), General Problem Solver (GPS), and the JOHNNIAC Open-Shop System (JOSS).

The materials include technical reports, research notes, correspondence, memorandum, coding sequences, and system tests. In addition, there are reports documenting the collaborative nature of the NSS team's work on human problem solving, computer simulation of human thinking, and complex information processing.

The subject files in Series 1 document the Advanced Research Projects Agency (ARPA) role in the JOSS research and other work done by Shaw.

Series 2: Rand Environment, 1951-1986, is arranged into three subseries containing technical reports that document other computer related research being conducted at RAND during Shaw's tenure. These materials are not directly related to his work, including reports documenting defense related research. The series contains memoranda and correspondence illustrating the internal workings and daily operations at RAND from 1950 to 1971 and various sets of annual reports, progress reports, and newsletters from 1960 to 1971. In addition, there are historical materials commemorating RAND anniversaries, profiles of the company, and indexes to RAND publications and abstracts.

Series 3: Computer Industry, 1947-1973, consists of printed matter that documents developments at other institutions and companies engaged in artificial intelligence and programming research. The printed matter includes reports, manuals, brochures, and reprints of articles about research by other institutions, companies, and individuals. Also, there are materials from trips, conferences and seminars attended by Shaw.

Series 4: Consulting Work, 1972-1990, comprises Shaw's work after he left RAND in 1971. It consists of reports and reprints from companies and institutions for which Shaw worked or from those he saw as potential clients. Of particular interest are the research notes, on note cards and 8.5" x 11" paper that illuminate Shaw's ideas and thoughts regarding artificial intelligence and programming languages during this period.

Series 5: Biographical Information, 1933-1993, consists of printed matter regarding Shaw's life and accomplishments. It contains resumes, list of publications and lectures, salary history, and the outline for a book on JOSS. Material on Shaw's personal life includes information about his family, personal correspondence with Herbert Simon, Allen Newell and his wife, Marian, Chuck Baker, Edward Feigenbaum, and correspondence from authors requesting information or comment on future publications. Additionally, there are reprints and clippings that reveal Shaw's personal interests in political issues such as the Pentagon Papers, Watergate, the making of the hydrogen bomb, and Star Wars Defense Technology.

Arrangement

The collection is organized into five series.

Series 1: Shaw's Career at Rand, 1950-1971

Subseries 1.1: JOHNNIAC, 1950-1968

Subseries 1.2: Logic Therorist [See also Complex Information Processing], 1956-1963

Subseries 1.3: General Problem Solver (G.P.S.) and Heuristic Problem Solving, 1955-1967

Subseries 1.4: Chess Program, 1954-1973

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Subseries 1.6: Information Processing Languages (IPL), 1956-1977

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Series 2: Rand Environment, 1951-1986

Subseries 2.1: Related Papers and Reports (RM-Series), 1951-1972

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Subseries 2.3: RAND Material, 1948-1988

Series 3: Computer Industry, 1947-1973

Series 4: Consulting Work, 1972-1990

Series 5: Biographical Information, 1933-1993

Names and Subject Terms

This collection is indexed in the online catalog of the Smithsonian Institution under the following terms:

Subjects:

Computational linguistics
Computer industry -- 1950-1980 -- Soviet Union
Computer industry -- 1950-1980 -- United States
Computers -- military applications
Decision making -- Mathematical models
GPS (General Problem Solver)
Heuristic programming
Iph (Computer Program Language)
Job Control Language (Computer program language)
List processing (Electronic computers)
Logic machines
Logic programming
Mathematical models
Mathematicians
Online data processing
Problem solving -- Data processing
Programming languages (electronic computers) -- 1950-70
System analysts
Time-sharing computer systems

Types of Materials:

Correspondence -- 1950-2000
Diagrams
Memorandums -- 1950-1980
Notes -- 1950-1980
Technical reports -- 1950-1980

Names:

ARPA (Advanced Research Projects Agency)
Association for Computing Machinery.
Dartmouth College
Digital Equipment Corporation
IBM (International Business Machines)
Massachusetts General Hospital
UCRL (University of California Radiation Lab)

Occupations:

Computer programmers

Places:

Cambridge (Mass.)
Palo Alto (Calif.)
Pittsburgh (Pa.)
Santa Monica (Calif.) -- 1950-1980

Preferred Titles:

JOHNNIAC computer
JOSS (Electronic computer system)

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Box 56, Folder 7	Newsletter-Charles Babbage Institute, 1980 - 1990
Box 58, Folder 1	Simon, Herbert, and James G. March. Organizations. New York: Wiley. First edition, signed by Simon. , 1958
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Box 58, Folder 3	Simon, Herbert. The Shape of Automation for Men and Management. New York: Harper and Row. First edition, signed by Simon. , 1965

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