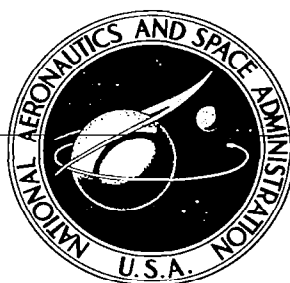


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**EVALUATION OF USER REACTIONS
TO A PROTOTYPE ON-LINE
INFORMATION RETRIEVAL SYSTEM**

by David Meister and Dennis J. Sullivan

Prepared by

BUNKER-RAMO CORPORATION

Canoga Park, Calif.

for

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ON-LINE INFORMATION RETRIEVAL SYSTEM

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SUMMARY

Reactions of a user population (scientists/engineers and librarians) to an operational test of an on-line system for retrieving document citations (RECON) were studied at several NASA facilities. During a two month operational test period, data were collected regarding frequency of usage and degree of success encountered in conducting on-line searches. Additional data were gathered by observation, interviews, questionnaires and controlled experimental tests concerning those features of the system which were most acceptable to the user population and the adequacy with which this system could retrieve citations in comparison with off-line machine search methods.

The user population used the system extensively (better than 6,000 searches in 6 weeks) and is interested in the implementation and extension of such a system. Results indicate, however, that users are extremely critical of system deficiencies such as down time, and response time. Included with the results, and conclusions, are suggestions by users of desirable features to be included in advanced information retrieval systems.

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INTRODUCTION

The purpose of this report is to describe the evaluation of the NASA/RECON document retrieval system developed by The Bunker-Ramo Corporation under Contract No. NASw-1369 as installed and operational within the NASA facilities at Washington, D.C., College Park, Md., Cambridge, Mass., Hampton, Va., Bloomington, Ind. and Detroit, Mich., (see Appendix C). It documents the type of evaluation conducted, the results obtained, and the conclusions reached.

The rationale for this evaluation stems from the reasoning that there are only two basic methods for determining the acceptability and usability of an information retrieval system of this type. The first of these methods is to determine the acceptability of the system to the user population as manifested in two separate measures: (1) frequency of system usage; and (2) personal opinion of the user population. Since the users of the system were under no constraint to use RECON, their choice of RECON over other available methods of conducting library searches (i.e., off-line machine and manual searches), provides a comparative frequency of usage indicative of their preference for or against RECON. Data regarding frequency of use, in terms of the total number of searches conducted, and the number of successful searches, were automatically collected during the course of the evaluation and are presented in this report. In addition, members of the user population at each NASA site actively participating in this evaluation were asked to rate their attitudes toward the RECON system.

The second of the methods available for system evaluation, was to measure the accuracy and speed of RECON when contrasted against the major existing information retrieval method. This method was the conventional off-line search by computer, after the search has been programmed by librarians.

SYSTEM DESCRIPTION

How to find an article of special interest in the holdings of a library is a problem as old as the library itself. Librarians over the years have created many clever techniques to help the researcher find his article. However, the ever-increasing body of literature soon makes each technique too costly in time and effort. Furthermore, most of these techniques require the researcher to be physically present in the library. This fact alone makes these systems so costly in time for the average researcher that he seldom seeks his answers from sources outside his office or laboratory.

This problem has been a persistent one, and in recent years one that has shown geometric increases. Many solutions have been proposed, mainly, in the area of increasing the accuracy, accessibility, and usability of referencing techniques. To be acceptable by the researcher, the referencing technique must be simple, direct, and easily learned. The system response to an inquiry should be so rapid as to appear instantaneous. The user should be freed of any necessity for dealing with accession or shelf numbers, scanning lengthy lists,

consulting a thesaurus, or performing other repetitious time consuming actions. The system should be automatically coupled to the delivery arrangements so that the user can order the document by simply selecting the title from those presented and providing the essential delivery information.

In line with this philosophy, the Bunker-Ramo Corporation developed an on-line document retrieval system, which it called the "Direct Electronic Library" (for NASA contract purposes it was termed "RECON"). The system consists of a number of remotely located consoles, each of which contains a cathode ray tube (CRT) display screen and an input keyboard (see Fig. 1), each console being associated with a central computer via common carrier telegraph lines. This system is designed to permit anyone to search a suitably prepared body of literature (at the present time approximately 270,000 citations) for documents of specific interest from any one of a number of consoles remote from the storage location of the collections. Available search criteria include subject terms, author, corporate source, and report or contract number. System response to any set of search criteria is a statement of the number of documents related to that particular set of search criteria, specified in that particular logical expression, and a display of the document citations.

Searches are accomplished through an 8 step procedure (see Fig. 2). The user initiates the search by depressing the USER control key and typing his name; Step 2 entails the selection of the individual collection of citations which the user wishes to search. In this prototype system eight collections were available, each of which could be selected by depressing the LIST key and the appropriate number keys. In the third step the first criterion of the search is entered. The user depresses the key controlling the type of search (e.g., SUBJECT key for a subject search) and types the necessary search information (e.g., AERODYNAMICS). This results (Step 4) in the display of an alphabetically-near list of terms from which the user must select one or more terms, again by depressing the key controlling his type of search, together with the number keys representing his choice from the list (e.g., S 1, 2, 52). Selection of these terms results in the display (Step 5) of any terms cross-referenced to those selected from the previous alphabetical listing. Both the alphabetical and cross-reference lists display the number of citations referenced to the major terms presented. In the next step (6) the user is provided with a display indicating the structure and stage of his search to this point ("search status display") together with the cumulative number of all citations referenced to each selected term in order.

At this point the user may opt to further modify his search by adding additional specification terms of any type (up to this point only one specification term of a given type can be entered) or he may utilize the citations the system has indicated are relevant to his search. He may also delete specification terms (Step 7).

These citations are displayed (Step 8) at the user's request, on the CRT screen, one at a time. If the user wishes to order one or more of the displayed documents, he may do so by making the suitable entry on his keyboard (i.e. order key), causing the request to be printed out at the teletype associated with a console located in the local library. This printout identifies the user, the citation requested, plus any comments regarding reproduction and delivery.

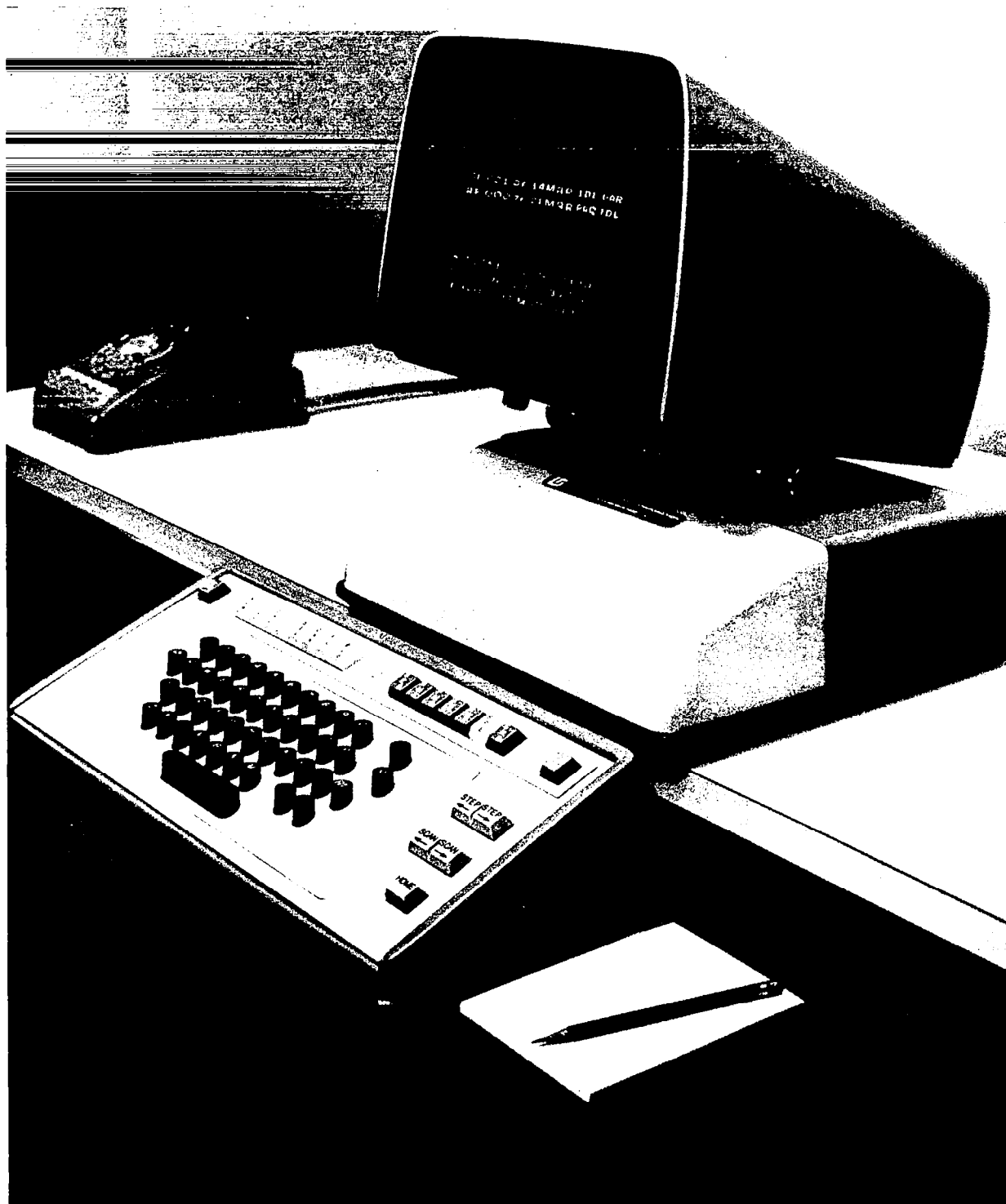


Figure 1. - NASA/RECON'S user console

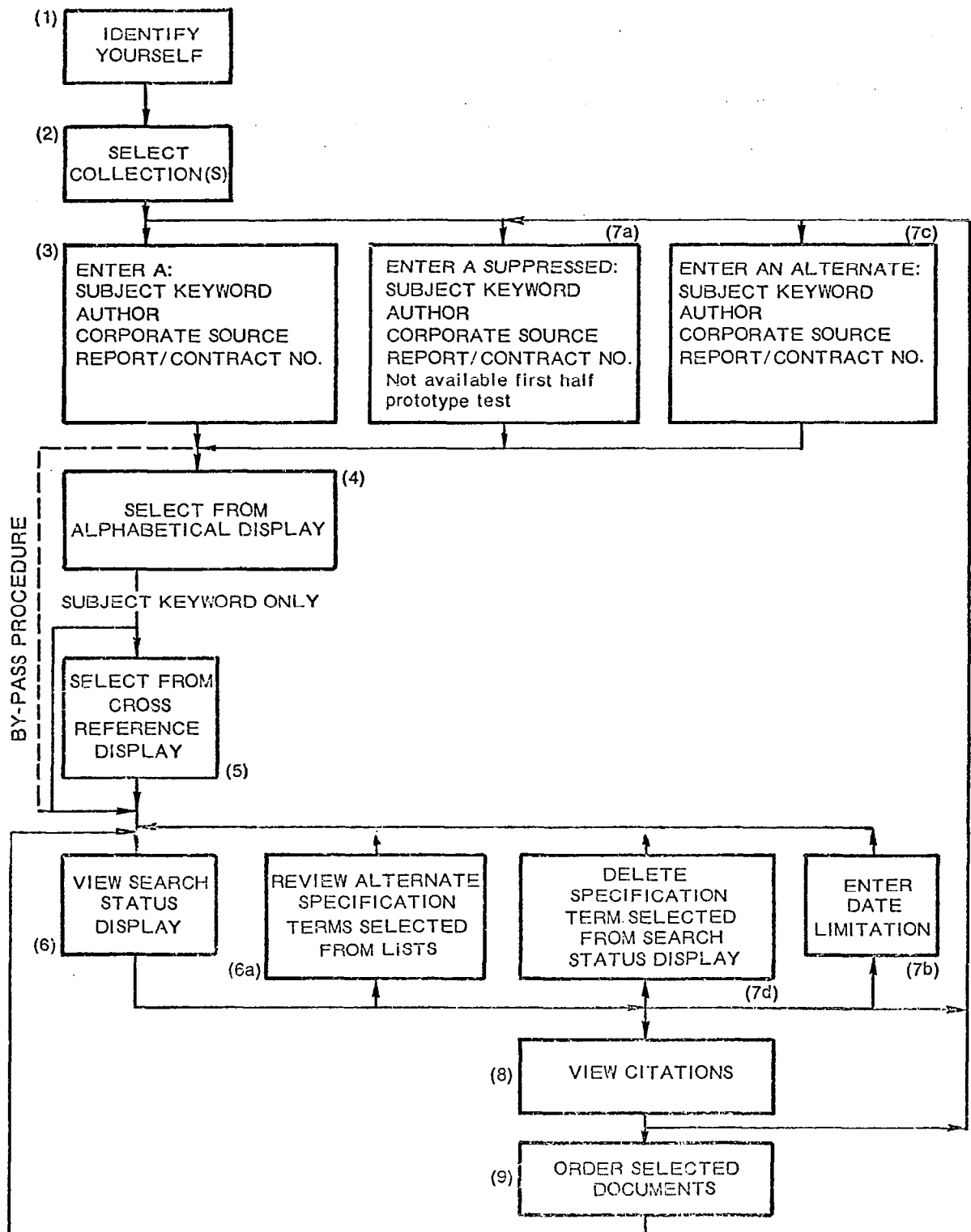


FIGURE 2 Steps in RECON Search

A bypass feature has been incorporated in the system to allow those who are certain of the accuracy of their specification terms to proceed directly from Step 3 to Step 6 (status display). This avoids the alphabetical listing, but only if the specified terms are referenced in the system memory. Another feature of the system is the provision of a delete function which allows the user to go back one step and remove the last term he has entered as part of his search structure.

The Bunker-Ramo Corporation's implementation of the RECON system comprises remote consoles (Teleregister Model 203 Display Station), control units (Teleregister Model 222 Universal Control Unit), a communications network, a central computer facility, and a large, fast, random-access storage system (Fastrand II Drum Storage Subsystem). The Model 203 display station is an electronic typewriter with full alphanumeric keyboard, a bank of function keys, and a CRT screen on which twelve lines of 32 characters each may be presented, either from the keyboard or the connected communications network. The user may enter new information, erase old information, or make corrections and additions to the message prior to transmission. The central computer facility and its associated random-access storage system were provided from the Bunker-Ramo Corporation's Tele-Center in New York City, where a Univac 1050 Computing System was operated on a time sharing basis with two other users. The computer subsystem is comprised of the computer, its associated peripheral units, and the Fastrand II Drum Storage Subsystem. The central computing facility and the remote Universal Control Units were interconnected by 3 leased telephone lines, each operating at speeds of 1200 bits per second. This rate is asynchronous and requires start and stop bits as well as data bits yielding only 120 ASCII characters per second. The number of consoles that theoretically could be accommodated per line within the response-time limitations of 3 seconds average and 10 seconds maximum was 14. However, computer processing of request and generation of responses placed a substantial further limitation on the number of consoles that could be served within a 10 second response time -- the exact number depending upon the types of questions being asked.

EVALUATION PROCEDURE

Formal evaluation of the RECON system began after the completion of a series of instructional lectures to representatives of the potential user populations at each of those NASA installations taking an active part in the evaluation. The initial part of the evaluation consisted of a series of informal, in-depth discussions with small groups of the user population; these discussions were directed by the authors and were climaxed by having those attending fill out an evaluative rating form (See Appendix A). The scales comprising this form are seven point, semantic differential, bi-polar scales with equal appearing intervals between points, similar to the example below.

			Neutral				
	1	2	3	4	5	6	7
Easy							Difficult
Complex							Simple

It had been anticipated these scales would be administered early in the evaluation period (as they were) and again at the end of that period, providing both a measure of the degree of change produced by exposure to the system, and a measure of the reliability of the scales; however, practical difficulties and time constraints enabled the investigators to obtain only a single set of ratings.

The second and third segments of the evaluation were conducted concurrently after several weeks. This resulted in the collection of responses to the formal questionnaire (Appendix B) and the gathering of controlled performance operational testing measures.

The Controlled Performance Test (CPT) methodology employed the same search criteria utilized previously in off-line searches. These criteria were given to the RECON user (optimally the same individual who had requested the off-line search earlier) and he was asked to search again, this time using RECON. The RECON searcher in the CPT configuration was also asked to indicate the relevance of the citations he finally retrieved on RECON. These were then compared with the list of citations produced by the previous off-line search which furnished the CPT search criteria. The total number of citations retrieved in the two CPT configurations (RECON vs. off-line) was also compared.

Because of unforeseen complications in RECON system operations, the number of such CPT tests were minimal; consequently formal comparison data are not provided in this report. However, observations made during the four or five CPT searches made were used to verify subjective responses secured from subjects. The example provided below is a reconstruction of one of the CPT's run in the performance of the study:

The subject (selected for his knowledge of the subject area and his familiarity with RECON) was presented with 4 subject terms (Thermotropism, Phototropism, Photothermotropic Material, and Photochromy) and instructed to conduct a search utilizing these terms. The subject was given no direction as to the manner or order in which these terms were to be entered. The subject's first attempt at a search utilized the logic:

1. Thermotropism
and
2. Phototropism
and
3. Photothermotropic Material
and
4. Photochromy

This search pattern resulted in the number of citations referenced going to 0, indicating to the subject that his search logic was inappropriate. The subject started over, this time utilizing the logic:

1. Thermotropism
or
Phototropism
or
Photothermotropic Material
or
Photochromy

This logic pattern produced 56 citations referenced to these particular subjects. This contrasted with an off-line search conducted 9 months earlier, using the same subject terms in the same logic format which produced 27 referenced citations. This discrepancy is explainable by the updating of the bibliographic collections during the intervening time period.

RESULTS AND DISCUSSION

Originally it was intended that the evaluation of NASA/RECON would involve all facilities having access to the system; however, it was found that only Langley Research Center had enough RECON operational usage to warrant evaluation as construed in the original test procedures. As a result, the responses to the evaluative rating forms (Appendix A), questionnaire (Appendix B) and the results and recommendations described here are almost entirely the result of data secured at NASA's Langley Research Center. It should be noted that confirmation of the results obtained at Langley were obtained from the small amount of data available at NASA Electronics Research Center, and at NASA Headquarters.

Frequency of Usage

Data relative to the usage the system received is summarized in Table 1. The percentage of successful searches, defined as those searches resulting in the viewing of one or more titles, in weekly increments, by installation, provides the most meaningful indication of the two major variables in the evaluation of RECON: how often is it used, and to what degree users are successful when they use it. No detailed statistical treatment of this data has been performed, the presentation of percentages providing an adequate representation of the system's effectiveness. Table 2 represents a percent breakdown of the searches conducted by the mode of search used; subject, author, etc.

Table 1. - Frequency of RECON searches attempted, percent successful,* and number of citations viewed

	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7	
Washington, D.C.	130/26%	239	72/54%	257	lost		81/53%	250	210/32%	398	74/57%	243	97/47%	314
College Park, Md.	228/52%	819	100/53%	547	252/61%	1,338	193/53%	653	246/51%	705	144/54%	735	293/46%	399
Hampton, Va.	405/54%	1,722	330/55%	2,179	396/55%	1,975	389/43%	2,250	424/35%	2,091	273/45%	1,504	192/51%	334
Boston, Mass.	79/14%	104	70/25%	375	78/44%	374	52/29%	103	45/22%	81	50/4%	139	42/33%	58
Detroit, Mich.	59/28%	151	252/9%	381	252/9%	648	81/48%	136	51/21%	1	80/1%	1	--	--
Bloomington, Ind.	(-----Not Operational-----)										293/32%	582	200/44%	459
Total Citations Viewed	3,035		3,739		4,335		3,392		3,276		3,204		1,564	
Total Searches/Avg. Success	901/34.8%		824/39.2%		978/42.5%		796/46.2%		976/32.2%		834/38.4%		824/44.2%	

* Successful - Searches resulting in citations being viewed.

Table 2. - Percentage of searches by specification term

% of Searches using at least 1 Subject Term	% of Searches using at least 1 Author Term	% of Searches using at least 1 RPT/CONT. #	% of Searches using at least 1 Date Restriction	% of Searches using at least 1 Corp. Source
74%	13%	5%	1%	5%

Avg. number of Terms per Search = 3.0

User Ratings

The rating scales used to obtain a sampling of user acceptance of NASA/RECON have been summarized in the two tables (Tables 3A and 3B). Table 3A presents user opinion of the existing NASA off-line machine search system. The sampled population has been divided into two sub-groups; the reasoning for this, born out by the results, is that professional librarians are more familiar with the intricacies of citation searching and therefore represent a population distinctly different from the scientist/engineer user. Table 3B presents the ratings of the subject population with regard to RECON. The same division of sample population has been retained in accord with the reasoning presented above.

In both sets of ratings, those of the library staff tend to be more critical than those of the general user. However, the trends of the ratings given by the two groups are much the same. Ratings of NASA/RECON's attributes tend to be favorable for all but speed, precision and sophistication. The off-line system is viewed as also being slow. In the case of RECON, the negative ratings are explainable in terms of the system's hardware difficulties and shortcomings within the logic of the operating programs.

For each subpopulation means and standard deviations for each scale were computed. Student's "t" test (ref. 1) was performed to obtain the significance of the difference in mean user attitude toward the two systems. The differences between these means suggests that user attitudes toward the two systems are essentially the same. In this connection it should be pointed out that the interfaces of both populations with the off-line system are limited to indicating the subject keywords of interest in a particular search, and then viewing a printout of citations provided. Thus, their reaction to the off-line system's inadequacies has been buffered. On the other hand, the immediate first hand exposure provided by RECON results in a magnification and reemphasis of its shortcomings.

Questionnaire Results

Responses to the questionnaire were returned by 37 NASA employees ranging in grade from GS-9 through GS-14 and in education from BA to PhD's. These personnel were a mixture of mathematicians, physicists, chemists, and technical library specialists. Respondants averaged approximately 10 searches each on the RECON system and requested to be shown at least one title at a rate of 3 in 10; that is, they requested titles in about one-third of the searches they conducted. This is corroborated by the tabulations gathered automatically (see Table-1).

All but a small percentage of the respondents indicated that they felt themselves to be competent in the operation of the RECON system, and 75% indicated that the system was either easy or extremely easy to use.

Table 3A. - Ratings given to Off-line System (7 point scale)

Attribute			Mean and Standard Deviation (SD) of Ratings			
			Professional Staff (N = 20)		Library Staff (N = 8)	
	<u>Low</u>	<u>High</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
1.	Unsatisfactory	- Satisfactory	5.80	1.47	5.10	1.13
2.	Worthless	- Worthwhile	5.90	1.54	6.00	1.00
3.	Useless	- Useful	6.05	0.25	6.00	1.00
4.	Unproductive	- Productive	5.85	0.78	4.90	1.28
5.	Difficult to Use	- Easy to Use	6.10	1.29	4.90	1.44
6.	Crude Results	- Precise Results	4.80	1.12	4.10	1.91
7.	Unacceptable	- Acceptable	5.85	1.10	4.25	1.12
8.	Slow	- Fast	2.35	1.61	1.50	1.32
9.	Defective	- Workable	5.55	1.61	5.10	0.95
10.	Crude	- Sophisticated	4.55	1.28	5.10	0.94
		Combined Mean	4.88		4.68	
		Combined SD		1.20		1.20

Table 3B. - Ratings given to RECON System (7 point scale)

Attribute		Mean and Standard Deviation (SD) of Ratings			
		Professional Staff (N = 30)		Library Staff (N = 8)	
<u>Low</u>	<u>High</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
1. Unsatisfactory	- Satisfactory	4.70	3.01	5.37	0.92
2. Worthless	- Worthwhile	6.53	1.42	6.12	0.65
3. Useless	- Useful	6.50	1.93	5.87	0.84
4. Unproductive	- Productive	5.63	2.47	4.75	0.82
5. Difficult to Use	- Easy to Use	4.76	4.61	6.00	1.81
6. Crude Results	- Precise Results	5.36	1.76	3.87	1.83
7. Unacceptable	- Acceptable	5.03	2.60	5.12	0.04
8. Slow	- Fast	3.40	4.87	2.12	0.13
9. Defective	- Workable	4.40	5.14	4.50	1.10
10. Crude	- Sophisticated	<u>5.10</u>	<u>2.06</u>	<u>3.62</u>	<u>1.57</u>
	Combined Mean	4.14		4.73	
	Combined SD		2.98		0.87
t-test results (3A vs. 3B)		t = .1.04*		t = 0.79*	

* Non-significant

With regard to the step by step "building block" procedure of pursuing a search (see Fig. 2), the subjects were asked whether they desired the elimination of any of the steps. Responses to this question, when asked in a general manner, revealed about one-third of the users felt that the selection of collections to be searched was unnecessary and could easily be eliminated. When asked to appraise the values of certain specific steps, the respondents were more critical in their judgments, i.e., when asked to rate the value of the Alphabetical List Display, approximately 60% found this step useful or highly useful; when queried as to when this step was of particular use, responses indicated that it was most useful when the entered term either is not indexed in the file collections or it is not the proper spelling of term (a common error); it is also used to check for other possibilities when the user wishes to make a very comprehensive search.

When questioned as to the value of the Cross Reference List display, respondents were evenly divided as to its value, with those who valued it indicating that it enabled them to broaden their searches, and those who decried its usefulness, citing the inadequacy of the indexing -- again a reflection of a problem troubling all forms of information retrieval.

Almost all respondents had discovered RECON's bypass capability and utilized it as the primary mode for their searches; this was prompted, mainly, by the slow response time of the system and user's subjective certainty as to how a subject would be indexed (experience/familiarity with subject matter).

All respondents found the display of the number of citations referenced to a given term to be beneficial in defining their searches.

Interrogation of the types of search strategies used revealed almost 100% of the population ranking subject searches as the most valuable with Author, Corporate Source, Report Number, and Contract Number searches following in that order. When asked to describe the nature of their searches, 75% responded that they were searching only for those documents most relevant to the subject they had specified. Regarding the manner in which they conducted their search, 65% indicated that they began their searches by defining it as precisely as they could.

When questioned regarding difficulties encountered in the application of AND/OR logic within their searches, approximately one-third of the respondents indicated definite problems had been encountered while the others - including the library staff - indicated no particular problems with the logic. Where users experienced no difficulty with the AND/OR logic employed in RECON, this may be attributable to two factors; one, the conduct of very simple, well defined searches not requiring logical intricacies; and two, the realization of and avoidance of the logical limitations of the system. All respondents indicated either an inability to move backward at all or dissatisfaction with the limitation of only being allowed to move back one step.

Another aspect of the system's logic that was examined in terms of respondent opinion was the error messages provided to the user; better than 80% reported dissatisfaction with the present format and indicated a desire to be informed of the nature of the error and the steps required to resume searching. Users were also questioned concerning the relative value of those items appearing as part of the citation. The item ranked as most important was the title, followed by the author, and keywords. Little value was placed upon the rest of the citation content, except for the library staff who had a professional interest in the citation. Indexing terms or keywords were valued for several reasons: they are used to verify the usefulness of a citation, to validate the logic of one's approach, and to provide a basis for modifying a subsequent search.

In eliciting the advantages of the RECON system as contrasted with the present off-line search system, some complaints were stated against both types of systems. The general consensus was that the overwhelming advantage of RECON would be in terms of its speed and flexibility when contrasted against any known method of information retrieval; however, the major complaint lodged against RECON was what appeared to be its inordinate response time. The ability to browse in RECON or just to update one's knowledge of items available in a particular discipline were also cited for their value. Relevancy was brought up in terms of the opportunity the user had with RECON to make a judgment of the relevancy of a given document at a much earlier moment in time than was available with the off-line system. The problems created during RECON operation are explicated in fuller detail elsewhere in this document; however, these can be summarized as logical difficulties, speed and random error transmissions. User opinions concerning the physical and operating characteristics of the RECON console indicated no specific complaint other than a desire by 15% of the respondents for a larger CRT display.

The major source of user satisfaction with the RECON system was the speed with which a search could be initiated and completed. Compared with either the laborious hand searching of files and bibliographies or the existing NASA off-line machine search system, RECON has an infinitely quicker response time. In terms of the actual searching of memory storage, the off-line machine search is far faster than any human paced search; however, the time required for the user to structure his search, the codification of the problem into Boolean logic acceptable to the computer, transmission of the problem to the computer center, its preparation for computer usage (keypunch, etc.), actual computer time, return to the library, and then to the user, may consume as much as 1 to 4 weeks. Within the constraints imposed by the prototype nature of the RECON system searches could be structured, run against the collections on file, the resultant citations viewed, and then the search modified or the pertinent documents ordered, all in one sitting. In addition to its significant performance in its primary role, RECON was successfully utilized to (1) update the very bibliographic collections upon which it is based, (2) trace the evolution of work in a given field, (3) provide a chronological record of an author's work, and (4) trace the history of corporate involvement in a given field.

The operational testing of all systems reveals discrepancies between its projected capabilities and the reality resultant from the translation of theory and principle into an operational system. The problems realized during the evaluation of RECON have been categorized as falling into three areas: Logic, Hardware, and Content.

The first of these, those problems stemming from the logic of the system, was the least expected and was not fully apparent to users until late in the evaluation period. The discovery of this weakness by only one small segment of using population is explained by the fact that the average user of RECON utilizes a much simpler logic in his searches than the Boolean logic used by the librarians in preparing an off-line machine search. The librarians' familiarity with and utilization of Boolean logic plus their greater familiarity with the indexing, specification, and coordinate terms causes them to be much more sensitive to, and critical of, the crudities of this on-line system. The average user employs a significantly more primitive logic in his searches, and seems to be more easily satisfied with the results he achieves in this manner. However, as he gains sophistication through repeated searches, his awareness of inadequacies in logic tends to increase.

Evidence of the problem was revealed in the form of a discrepancy between the number and relevancy of citations produced in answer to a given set of search terms, when contrasted with results achieved with the same terms used for the off-line machine search. The causal factor here was the relative inflexibility of RECON's prototype logic in the structuring of its OR function. When the OR function was employed, the term which had been ORed was locked to the immediately preceeding term in that logical statement and could not be dissociated from it. This difficulty occurred, when, for example, the user had already designated that the documents he was seeking should be referenced to both (A and B), and he desired to add a third specification (C) in such a way that the documents retrieved would be referenced to (A and B) or C. If the term C were ORed to the existing statement of A and B, the result was the statement A and (B or C). To accomplish the desired results it would be necessary to enter (A or C) and (B or C).

A second problem reported with regard to RECON logic was the inadequacy of the present deletion function. Users reported that RECON's ability to step back to the previous term and delete it was a useful tool, but desired the capability to delete any term, no matter how far back it was in the search.

The most severe problem associated with the hardware aspects of the RECON system was the length of time required to reach the computer and receive a response from it. Occasional delays of several minutes in securing a response to a message occurred daily. Although such time delays may occur in a system, previous studies have indicated that such delays in an on-line system comparable to RECON are responded to in a particularly negative way by users. User reaction increases negatively by a factor of 10 when the user is subjected to what he considers to be excessive on-line computer downtime; operational experience has indicated that the user is tolerant of downtime as long as it does not exceed approximately 5% of the available time.* The experience of the

* Statements made at 1966 Society for Information Display Meeting.

Bunker-Ramo investigators in conducting three discrete searches on three separate days produced mean delay times of 38.5, 133.7, and 74.5 seconds. Such delay times were the major factor tending to downgrade the system in user's eyes. Other hardware problems (e.g., console malfunction) were minor and tolerable in any prototype test context.

The Content problem experienced with RECON is one which is common to all information retrieval systems; the adequacy of a search, no matter how conducted, is directly influenced by the accuracy of the indexing terms utilized to describe catalogued items. RECON users were brought into very close personal contact with the characteristics of the present indexing system; this intimacy caused them to attribute some of their dissatisfaction with indexing terms to RECON.

CONCLUSIONS AND RECOMMENDATIONS

Despite the crudeness of the evaluation reported here, certain significant conclusions can be made:

- Despite its experimental nature RECON appears in user's eyes to be a significant improvement over the present state-of-the-art in citation retrieval.
- The system, despite its faults, much of these attributable to its prototype status, was accepted by its intended users; they like the system, appreciated its convenience, found it easy to use, and were desirous of seeing its capability expanded.

Inquiry into the users population's preferences regarding expansion of RECON, provides an expression of what a using population would want in any advanced information retrieval system.

Regarding accessibility of remote consoles, even though 4 to 6 consoles provide a convenience exceeding a centralized library, users place extremely high value on close physical proximity to the information retrieval source as a measure of system value. Expansion of the system to provide the capability of viewing abstracts, if desired, and expansion of the accessible collections to include such other items as books and additional subject areas for both published and report literature. Simplification of the logical intricacies required to complete a search was desired, preferably by allowing the user to make his initial entry to the system in a very detailed form, thus eliminating the need for further entries. One thing that would have a beneficial effect on all users would be a visual indication of the time delays to be expected and overall system status (e.g., existence of system malfunction).

The following recommendations can be made:

- . Any extension or continuation of the system should employ a larger, faster computer, or, as a minimum, sole use of the present computer.
- . The communications lines used to transmit messages should be of high reliability in terms of their freedom from noise and interruptions.
- . The AND/OR segments of the system's logic should be improved to provide an independent OR function.
- . A positive visual indication of the system's operating condition and expected time delays should be incorporated.
- . Consideration should be given to providing a printout of titles pertinent to a given search.

With regard to the future development of advanced on-line information retrieval systems, it appears that much greater consideration must be given to user interfaces with that system. In particular, attention must be paid to the intricacies of computer logic as these affect the user's interaction with the system. It appears mandatory that before such an advanced system is produced, its prototype should be exposed to test with a sample of users to determine and eliminate those features of the system which may be objectionable to the user population.

REFERENCES

1. Edwards, A. L. Experimental Design in Psychological Research. Rinehart & Company, 1950.
2. Siegal, S. Non-parametric Statistics. New York, McGraw-Hill, 1956.

APPENDIX A

NASA/RECON EVALUATION

The purpose of these ratings is to determine your reaction to RECON as an information tool and simultaneously gain a comparison of this search method with that of the present off-line bibliographic search, the NASA Literature Search. Consequently you should carefully consider each aspect of the scales.

Please answer the following questions:

Name _____ Address _____

(1) Have you ever requested a NASA Literature Search of document citations at NASA? Yes () No ()

(2) If so, how many times? _____ Were you satisfied with the results? _____

If you answered yes to question (1), please complete both rating scales on the following pages. One is to rate the off-line method, the other is for RECON.

If you have never requested a NASA Literature Search of document citations at NASA, complete only the rating scale for RECON.

On the following pages you will find a list of descriptive words and their opposites. Each word-pair represents two ends of a scale which you are using to rate. Your task is to place an "X" in the appropriate column that most closely reflects your opinion about off-line or RECON. Consider each judgment carefully before selecting the column. Once a check has been made, please do not change it, since we are interested in your first impression.

Here are some examples to demonstrate the technique. Assume you are rating a new type of automobile in terms of its efficiency, just as you will rate RECON and the off-line system, and that the descriptive words and their opposites read as follows:

	Neutral							
	1	2	3	4	5	6	7	
Easy								Difficult
Complex								Simple

If you felt that the automobile was very easy to operate, you would place an "X" in column 1. If, on the contrary, your reaction to the automobile was that it is very difficult to operate, you would place an "X" in column 7. If your feeling about the automobile was neutral (you felt the automobile was neither particularly easy or difficult to operate), you would place an "X" in column 4.

After completing the first pair of words you would rate the next pair -- complex-simple. The same instructions are followed. If you felt that the automobile was complex in its operation, you would place an "X" in columns, 1, 2 or 3, depending on the strength of your feeling. (The stronger your feeling, the closer to (1) you rate). If you had no particular feeling about the automobile in terms of its complexity-simplicity, you would place an "X" in column 4. If you felt that the automobile was quite simple to operate, you would place an "X" in columns 5, 6, or 7, again depending on the strength of your feeling. The strength of your opinion is reflected in the column selected for your rating. The word in the list to the left would have the strongest response associated with column 1, gradually decreasing in strength until column 4 is reached, which indicates that you are neutral in your feeling. The right hand word of each pair has the strongest feeling associated with the higher numbers. This situation is the same for all pairs of opposites.

Do not hesitate to use the extreme categories of "1" and "7". Each pair of words should have only one "X" to describe your reaction to both words. You must mark an "X" for each word-pair.

[illegible]

RECON SYSTEM

Neutral

	1	2	3	4	5	6	7	
1. Results Precise								Results Crude 1.
2. Difficult to Use								Easy to Use 2.
3. Productive								Unproductive 3.
4. Useful								Useless 4.
5. Worthless								Worthwhile 5.
6. Satisfactory								Unsatisfactory 6.
7. Sophisticated								Crude 7.
8. Defective								Workable 8.
9. Slow								Fast 9.
10. Unacceptable								Acceptable 10.

APPENDIX B

TABULATION OF RESULTS NASA/RECON EVALUATION QUESTIONNAIRE

I. DEMOGRAPHIC BREAKDOWN (N=37)

GS Level	<u>9</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>Other</u>
# of Subjects	7	9	11	6	3	1
Highest Degree	<u>BA/BS</u>		<u>MA/MS</u>		<u>PHD</u>	
# of Subjects	22		12		3	

II. QUESTIONS

- How many RECON searches have you attempted? M = 18
- How many of these searches were successful (i.e. you were able to view citations and/or ordered documents)? M=45%
- Do you feel that you are reasonably competent in operation of the RECON system? Yes 32 No 5
- How Easy/Difficult is it to operate RECON?

*(1)	(2)	(3)	(4)	(5)
Extremely Easy	Easy	Neither Easy Nor Difficult	Difficult	Extremely Difficult
4	22	9	2	0

M = 2.0

- How useful was the Alphabetical List Display?

Completely Useless	Of Little Use	Useful	Highly Useful	Extremely Useful
4	9	13	8	2

M = 2.78**

*All scales are of the five point, Guttman type with the low end having a value of 1 and being the left most item in all cases.

**Certain subjects failed to complete every item producing an N of less than 37. The mean (M) is based on total number completing the individual item.

- a. If you found the Alphabetical List Display of some use, please describe the circumstances under which you found it of most use.

- When starting a search "cold" (entering a new or foreign area of interest)
- When the original search term was not indexed
- To determine what terms are related to the original subject term
- When searching authors, or corporate sources

6. How useful was the Cross Reference List display?

Completely Useless	Of Little Use	Useful	Highly Useful	Extremely Useful
5	14	12	2	2

$$M = 2.48$$

- a. If you found the Cross Reference List display of some use, please describe the circumstances under which you found it of most use.

- In order to expand the area of a search, especially when searching an unfamiliar area.

7. How useful was the display of the number of citations referenced to a particular specification term?

Completely Useless	Of Little Use	Useful	Highly Useful	Extremely Useful
0	1	13	15	8

$$M = 3.81$$

8. Of the 7 steps in the RECON search process (e.g., Identification of User, Selection of Collections, Alphabetical Listing, etc.), do you feel any of these should be eliminated? If so, indicate why.

- Eliminate Selection of Collections to be Searched - 29%
- Do not modify present procedure - 32%

9. How useful do you find RECON's bypass feature?

Completely Useless	Of Little Use	Useful	Highly Useful	Extremely Useful
0	0	9	10	15

$$M = 4.17$$

10. What are the main things you look for when viewing a citation?

- Title	= 81%	- Corporate Source	= 21%
- Author	= 43%	- Date of Publication	= 16%
- Keywords	= 35%	- Accession #	= 8%

11. How useful do you find the index terms in the citation?

Completely Useless	Of Little Use	Useful	Highly Useful	Extremely Useful
1	6	20	4	3

M = 3.15

12. Read the following statement and indicate your reaction to it:

When I receive an error display, I want to know what I did wrong and what my alternative courses of action are.

Don't Care	Slightly Agree	Strongly Agree
2	0	25

M = 2.62

13. List in order of importance to you the search strategies you use.

Median values assigned =	<u>2</u>	Author
	<u>3</u>	Report #
	<u>1</u>	Subject
	<u>4</u>	Corporate Source
	<u>5</u>	Contract #

14. What is the longest period of time you will wait for a response from the computer?

Analysis of responses to following question was performed in the following manner: Ordinal values of 1-7 were assigned to the scale intervals with 1 representing the time interval of less than 30 seconds (in actuality this becomes 15 seconds or less) and 7 representing time intervals exceeding 360 seconds. The mean time till response was computed and converted into seconds.

Less than 30 seconds (less than 7 (15 secs.) (Write In)	30	60	120	280	360	longer
	5	2	7	3	5	4

M = 105 seconds

15. Which of the two statements below best describes your objective when you make a RECON search.

29% A complete survey of the subject
67% Only those documents that are most relevant
to the subject

16. When you began your RECON searches, how precisely did you specify your subject terms?

- As precisely as possible - 59%
- In General terms, sharpening my search as I proceed - 24%
- Varies with each particular search - 16%

17. Did you experience any difficulty in applying "AND"/"OR" logic to the search process? (Explain)

- Yes
- due to inadequate familiarity/instruction = 45%
- failure to function properly
- No = 43%*

*Where percentages fail to total 100, it is because certain subjects failed to answer particular items.

18. Were there any occasions when the "AND"/"OR" logic did not seem to help in precisely defining your search? (Explain)

- Yes Most respondents assumed it was their own ignorance/lack of familiarity that was responsible = 40%
- No = 21%

19. Did you experience any difficulty in moving backwards from a later to an earlier stage of your search? (Explain)

- Yes To a large extent due to this function being inoperative over a long period of time = 59%
- No = 21%

20. What is the maximum number of citations you would be willing to view on screen as the result of a search? (Explain)

- 25 or more = 29%
- 10 to 25 = 8%
- Varies with each search = 35%

21. Check any of the features listed below that you would like to see incorporated in the ideal information retrieval system.

	<u>13%</u>	Provides citations only on screen
	<u>91%</u>	Provides citations plus abstracts on screen
	<u>81%</u>	Provides citations as a printout as well as on screen
	<u>72%</u>	Ability to insert any number of specification terms as soon as search begins
	<u>78%</u>	Ability to bypass any intermediate step in the search
	<u>78%</u>	Capability of returning to any earlier step of the search without disrupting the search
Percentage of Respondents indicating Preference =	<u>40%</u>	Capability of temporarily storing any search product while proceeding with another aspect of the search
	<u>62%</u>	Capability of obtaining a printout of any phase of the search
	<u>64%</u>	Ability to delete any previous part of the search strategy
	<u>64%</u>	Ability to suppress any coordinate specification term
	<u>45%</u>	Ability to limit searches by date specifications
	<u>13%</u>	No need for any conscious logical structuring of the search

(Explain any of above if you wish)

22. How many machine/off line searches have you made up to this time? _____

Respondents reported mean of 2 searches per individual (excluding the library staff)

23. Assuming that the NASA/RECON system operates as specified, what advantages do you feel it would have over the present NASA machine search system? (Explain)

- Faster than the present system = 67%
- More flexible and versatile than the present system = 24%

24. What kinds of problems have you typically encountered in making RECON searches? (Explain)

- Delays = 81%
- Logic problems = 21%
- Error displays presented for no particular reason = 37%
- Other reasons given
 - Too sensitive to spacing and punctuation errors
 - Collections do not contain enough information
 - Deletion function as presently existent is inadequate

25. List all the possible uses you can think of for the RECON system.

Respondents provided a variety of uses for the RECON system; no attempt at tabulation has been made, but a simple listing of them is provided.

- To determine organizations or people conducting research in a given area.
- To determine history of research (what, where, when, who) on a given subject.
- Follow a given authors progress
- As a library of computer subroutines
- Creation of bibliographies
- As an aid in cataloging
- As an aid in structuring off-line computer searches

26. By selecting a number from the scale below, indicate the relative efficiency of searches for:

	<u>4.03</u>	Authors
Mean	<u>3.57</u>	Report #
Ratings =	<u>3.61</u>	Subject Terms
	<u>3.00</u>	Corporate Sources
	<u>3.71</u>	Contract #

Very		Neither Efficient		Very
Inefficient	Inefficient	Nor Inefficient	Efficient	Efficient
1	2	3	4	5

27. Have you experienced any problems with RECON's physical configuration?

<u>13%</u>	Size of CRT screen (would like a larger one)
<u>5%</u>	Legibility of Messages (messages garbled or misspelled)
<u>5%</u>	Keyboard Arrangement (relocate function keys)
<u> </u>	Other (Explain) Would like a lighter touch for the Keyboard

28. Do you feel that typing ability (or the lack of same) affects RECON search success?

- Yes - 10%
- No - 62%

29. Does the physical availability of RECON consoles have any effect on the frequency of your RECON usage? (Explain)

- Yes (availability has a definite positive affect on usage) = 72%
- No = 18%

Responses to questions 30 and 31 are simply listed as they were given

30. Assuming that the RECON system operates adequately, what recommendations would you wish to make to improve its search capability?

- Add access to open literature such as Chem. Abstracts, books, etc.
- Expand alphabetical and cross reference listings
- Increase operating speed

31. Are there any functions you would like to see added to the RECON system.

- Abstracts
- Printout of citations
- A printout of the report itself
- Ability to interrupt a transmission
- Addition of a "List of Titles" function
- Indication of time delay expected

APPENDIX C
RECON LOCATIONS

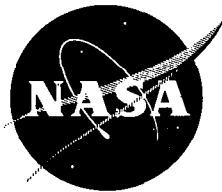
Organization	Location	Consoles	Number Control Units	Printers
NASA Headquarters	Washington, D.C.	6	3	1
NASA Scientific and Technical Information Facility	College Park, Md.	2	1	1
NASA Langley Research Center	Hampton, Va.	8	4	1
NASA Electronics Research Center	Boston, Mass.	3	1	1
Aerospace Research Applications Center	Bloomington, Ind.	2	1	1
Center for Application of Sciences and Technology	Detroit, Mich.	$\frac{2}{23}$	$\frac{1}{11}$	$\frac{1}{6}$

APPENDIX D

NASA/RECON

USER'S MANUAL

A TEST OPERATION FOR REMOTE CONSOLE RETRIEVAL
OF SCIENTIFIC AND TECHNICAL AEROSPACE INFORMATION
CONDUCTED BY BUNKER-RAMO CORPORATION,
CANOGA PARK, CALIFORNIA
UNDER CONTRACT NASW-1369



SCIENTIFIC AND TECHNICAL INFORMATION DIVISION - October 1966
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C.

NASA/RECON ACTION KEYS

KEY	FUNCTION
<u>U</u> ser (<u>U</u>)	To identify entry as user's name and address
<u>L</u> ist (<u>L</u>)	To enter list or collection to be searched
<u>A</u> uthor (<u>A</u>)	To enter author's name as specification term
<u>C</u> orp (<u>C</u>)	To enter corporate source as specification term
# (#)	To enter report or contract number as specification term
<u>D</u> ate (<u>D</u>)	To enter date limit as specification term
<u>S</u> ubject (<u>S</u>)	To enter subject keyword as specification term
<u>T</u> itle (<u>T</u>)	To call for display of citations
<u>O</u> rders (<u>O</u>)	To order document described by citation
<u>I</u> nterpret (<u>I</u>)	Not operational
<u>M</u> essage (<u>M</u>)	Not operational
<u>F</u> ile (<u>F</u>)	Not operational
. (period)	To terminate search (only when used as action key at start of message; when used in body of message, acts only as period)
+ (plus)	To request next page of current display
	Followed by <u>A</u> , <u>C</u> , <u>S</u> or #, it means you want to enter another specification term on an either/or basis with the immediately preceding specification term.
- (minus)	To request previous page of current display. To delete previous specification term (if followed by <u>A</u> , <u>C</u> , <u>S</u> or #).
\$elf Inst (<u>\$</u>)	To request display of instructions
	Followed by any other action key, it means a request for display of instructions in use of that key.
	<u>\$</u> <u>\$</u> calls for instruction in use of \$

NASA/RECON---COMPUTER/LIBRARY AT YOUR DESK

INTRODUCTION

WHAT IS NASA/RECON?

NASA/RECON (Remote Console) automates the process of searching lengthy report files. It permits you to sit at a desk and interrogate a library of document citations without the trouble of turning thousands of pages. Through RECON's console you have direct access to a central computer in which the citations you want are stored in a high-speed, random access memory. All of the documents presently cited in the STAR and IAA announcement journals (as well as some others which are available only to specially authorized individuals) are at your fingertips in a fraction of the time that was spent previously in programming and performing a machine document search.

RECON represents the application of on-line computer technology to the researcher's need for references. It consists of a central computer complex and a large number of user consoles located at various facilities, all tied together by means of ordinary telephone lines. Indexes to the document collections which can be searched by RECON are stored in the central computer. The specification terms (indexing terms or phrases describing the documents you want) that you enter through the RECON console activate the computer to search through these indexes. RECON then notes all the documents that satisfy your specifications and displays (at your command) the resultant list of citations. You scan these to select the most relevant ones and order them from your local library automatically.

RECON has three major advantages over your present search method:

1. Feedback: You receive immediate information on the progress of your search.
2. Flexibility: If, as a result of feedback during the search, you modify your specification terms, RECON will search for the documents corresponding to the new terms.
3. Ordering: You may order a document from your local library by depressing a single key.

THE PURPOSE OF THIS MANUAL

To get the greatest efficiency out of RECON, you must follow operating procedures correctly. The purpose of this manual is to explain those procedures. Keep it close by and take it with you when you use RECON. Review the manual from time to time. Should you make an error, RECON will tell you so and refer you to an appropriate instruction. By learning to operate RECON correctly, however, you can avoid trouble and loss of time.

The efficiency of RECON's search also depends on the specification terms you enter. It will accept any terms you enter (within the limits described on Page 8) and use them to select relevant documents; but you can help RECON to help you by specifying your interests as precisely as possible.

THE NASA/RECON CONSOLE

PHYSICAL CHARACTERISTICS

The RECON console is both a display station and an electronic typewriter (see Figure 1). The messages you compose and those that RECON sends you are displayed on the $5\frac{1}{2}$ " x $7\frac{3}{4}$ " cathode ray tube (CRT) screen which presents up to 12 lines of 32 characters each. This display can be completely changed and filled with new information in three seconds.

You can communicate with RECON by typing your message on the keyboard half of the console (see Figure 2). The central module in the sketch is a conventional typewriter keyboard. Above this central module are individual control (action) keys which command RECON to respond to your message. The keys and their functions are described on page ii of this manual and will be explained in more detail below.

It is impossible, of course, to supply each staff member with his own RECON console. Console stations, are, however, conveniently located at your facility. The various locations are shown in a sheet appended to this manual.

ACTIVATING RECON

At the start of a search, depress the CL (Clear) key. This places the entry marker (a solid rectangle, ■) at the first character position of the first line. CL can be used at any time to remove data from the screen. The HOME key moves the marker, but does not clear the screen.

TYPING A MESSAGE

When you depress a key, the corresponding character will appear on the screen where the entry marker has just been. (The entry marker always appears one space ahead of the last character typed.) The entry marker is automatically positioned at the next character position.

CARRIAGE RETURN

Push the ↵ (Carriage Return) key; the entry marker will move to the first character position of the next line.

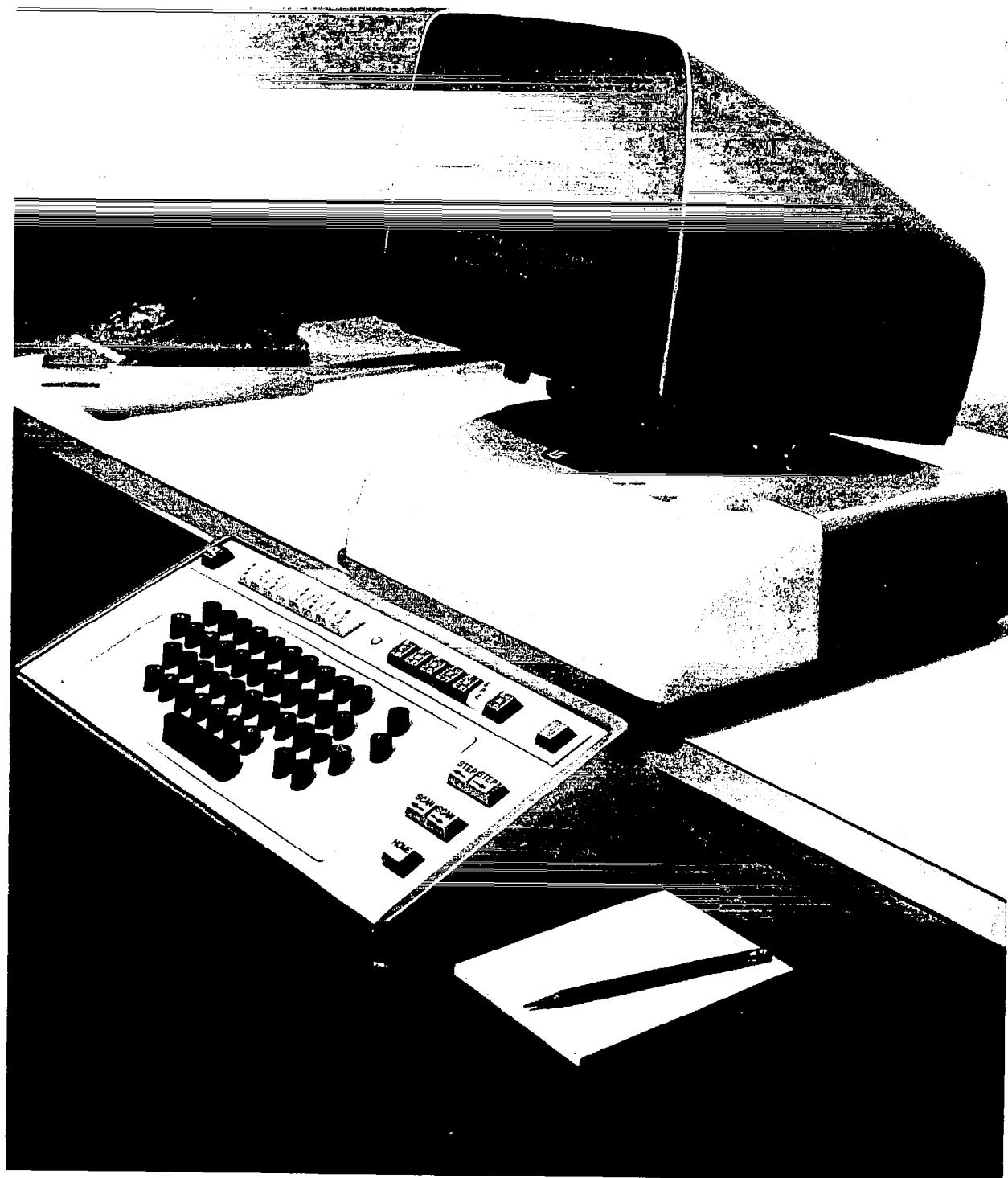


Figure 1. NASA/RECON's User Console

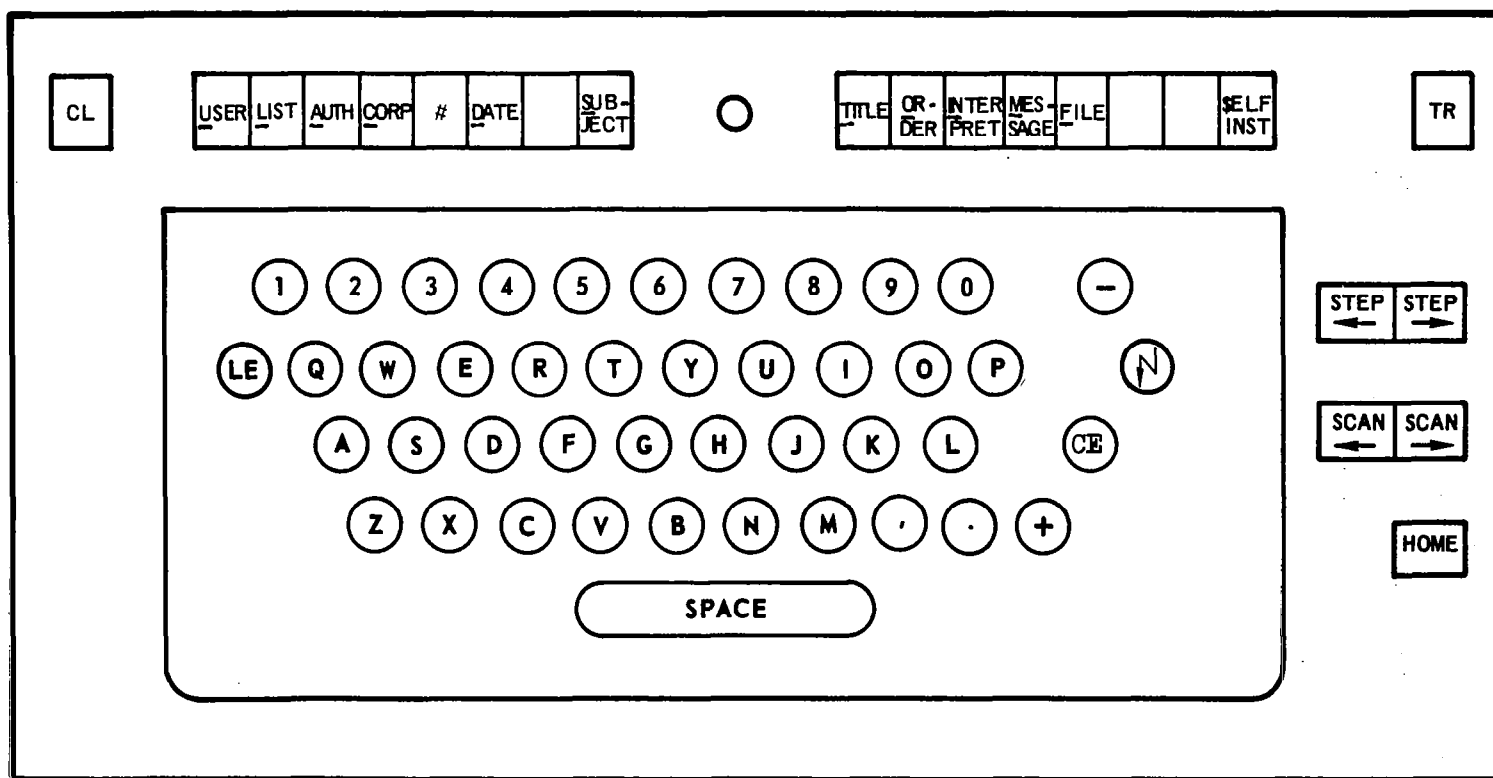


Figure 2. NASA/RECON Console Keyboard

CORRECTING A TYPING ERROR

Position the entry marker over the incorrect letter and depress the correct key. To move the entry marker use your STEP Right and STEP Left keys; the entry marker will move one position to the right or left. Depressing the SCAN Right or SCAN Left keys will make the entry marker move right or left on the line at the rate of 10 characters per second. If you over or undershoot with these, use your STEP Right or STEP Left to correct.

ERASURE

Should you wish to erase a typing error in one or two letters or numbers, first position the entry marker over the erroneous character and depress the CE (Character Erase) key. If you want to erase an entire line or part of one, position the entry marker over the first letter in the sequence of letters to be erased. Then depress the LE (Line Erase) key. All letters, including and to the right of the entry marker in that line, will be erased.

TRANSMITTING A MESSAGE

After you have typed your message, transmit it to RECON by depressing the TR (Transmit) key. Unless you do so, RECON will not receive your message and your screen will not change its display.

Once you transmit, you cannot type another message until RECON releases your console. During this time the letter T will appear in the last character position on the screen. This position is not available to you for typing. When the letter T disappears, you can transmit again. This loss of control will last only a few seconds.

Note that if you have made an error you can correct your message only before you depress TR. After that, the message has been received by RECON.

There will usually be space at the bottom of the display that RECON presents in response to your previous message. You may therefore type your message in that bottom space. However, if you feel you need more room, clear the screen (using the CL key) before making your next entry. In either case RECON will clear the screen when presenting a new display in response to your message.

DISPLAYS

Whatever you type on your keyboard will be displayed on the RECON screen. It will remain on display indefinitely unless and until you depress the TR key.

After you transmit a message the response to that message will start to appear on the screen usually within ten seconds.

As many as 12 lines of 32 characters each will appear on a display. If a response requires more than 12 lines, the word "MORE" will appear at the left hand side at the end of the 12th line. The word "MORE" tells you that there is another "page" of the display to be viewed. Depressing the plus (+) key will cause the next page of the display to appear. The word "END" at the bottom of the display indicates that a display has been completed.

BASIC SEARCH CONCEPTS

All of the documents which can be searched by RECON are uniquely identified by an accession number and each document has a citation (a brief summary of pertinent information) stored in RECON memory in accession number order. Typically the searcher knows the subject matter (subject keywords), or perhaps the author, corporate source, report or contract number or an approximate date of publication. Consequently, a RECON search is performed according to one or more of these criteria.

The documents are grouped by general similarity into collections. STAR, and IAA are examples of collections available to RECON. A RECON search makes it possible for you to identify a collection and search it for all documents having certain attributes (specification terms) which you specify. For example, all documents indexed under the subject term HIGH TEMPERATURE MATERIAL "AND" subject terms ELECTRICAL RESISTANCE "OR" SKIN RESISTANCE, all documents from a certain source except those by a certain author, etc.

In general a large number of documents may have one attribute; more will have one attribute OR another attribute; fewer will have one attribute AND another attribute. As you enter specifications describing the documents you want, RECON counts the number of documents meeting the specifications you have entered. You may easily try alternative strategies to quickly reduce the number of citations to a small number, examine these and order those you desire.

The possible logical relationships among the specification terms entered in RECON can perhaps be better understood if we take a simple example. Suppose we have a large number of objects that can be classified according to certain attributes such as, cold, cool, lukewarm, hard and spherical. We want to select only a few objects with particular combinations of attributes. We might ask for objects which are either cold, or cool or lukewarm, and which are also hard.

THE OR FUNCTION

The effect of saying that we will accept objects that can be cold or cool or lukewarm is to select a fairly wide range of objects, since all objects having any of these attributes would be included in our selection.

Each attribute, in other words, has equal value in terms of our search. If there are 10 cold objects, 15 cool objects and 12 lukewarm objects, and if we select any or all such objects, we get 37 objects. This process is what we call the OR function.

THE AND FUNCTION

On the other hand, if we specify that these 37 cold, cool, lukewarm objects must also be hard (what we call the AND function), we narrow the range of objects that meet our specifications, because now we select only those objects which (1) meet the temperature requirements AND (2) the hardness requirement as well. Since we become more demanding in our requirements, the number of objects meeting those requirements will decrease. We ordinarily reduce the number of objects selected by an additional requirement; for example, only 23 objects may be hard as well as cold, cool or lukewarm.

THE "AND NOT" FUNCTION (Not available during prototype-test period.)

In the same way, if we specify that these objects we have selected so far must also NOT BE spherical (the AND NOT function), we reduce the number of objects still further, since this new requirement will eliminate marbles, ballbearings and basketballs from the objects selected.

In terms of RECON capability the searcher uses the OR function when he makes multiple selections from a list (since items in lists are related, the OR function is almost always the one desired) or by the entry of an alternative specification term. The AND function would be chosen by the ordinary entry of a specification term. Finally, the AND NOT function would be chosen if one entered a specification term that was to be suppressed.

The usual course of a RECON search involves, as you will see later, first the determination of the widest possible range of documents to be selected. This is done by presenting you with the possibility of selecting multiple terms from alphabetical and cross reference lists (use of the OR function). After you have made these selections (cast the widest possible net, so to speak), you may either narrow your selection criteria by entering additional terms in the AND mode, maintain them as before, or even broaden those selection criteria (by additional OR functions). If you have not narrowed your search sufficiently, you can restrict your selection criteria further by commanding RECON to suppress certain additional terms that you perhaps are not really interested in.

This search strategy, is of course, an iterative one, and the particular choices you make, whether you use the OR or the AND functions, etc., depend on your particular search interests and the feedback RECON gives you.

OPERATING PROCEDURES

GENERAL

To conduct a RECON search the following general procedure (illustrated in Figure 3) should be followed. Specific details are presented in a subsequent section of this manual.

Step 1. Identify yourself to RECON.

Step 2. Select the collection(s) to be searched from a list displayed by RECON.

Step 3. Enter any one of the following as a specification term for your search:

- a. Subject keyword Example: nuclear spin.
- b. Author's name Example: Smith, R. W.
- c. Corporate source Example: General Electric Company, Palo Alto, California.
- d. Report or contract number Example: NASA CR-57439; NASW 1000.

You may enter only one of these at the start of your search. You will be able to enter additional terms later on in the search (at Step 7). In other words, you cannot initially combine a subject keyword with an author term. You can of course type a message to RECON in which these are combined, but RECON will act only on the first term you entered.

Step 4. RECON will next display a list of terms alphabetically near to the specification term you entered. RECON looks at your term entry and locates it in its own master list of index terms. Then RECON selects the specification terms in its file that alphabetically precede and follow the term you entered and displays these terms. This list is presented for all specification terms, whether the term be subject keyword, author, contract or report number, or corporate source.

There are several ways in which this list can be used. In the event that the term you entered was not one of those on file in the computer memory, the list will suggest other choices you may make. If the term you entered is recognized by RECON, that term will appear in the alphabetical display, but the list will suggest additional terms which you may select in place of or in addition to the one with which you entered RECON. You need not change your original term if you are satisfied with it. Even in this case, however, you must still make a choice from the alphabetical display.

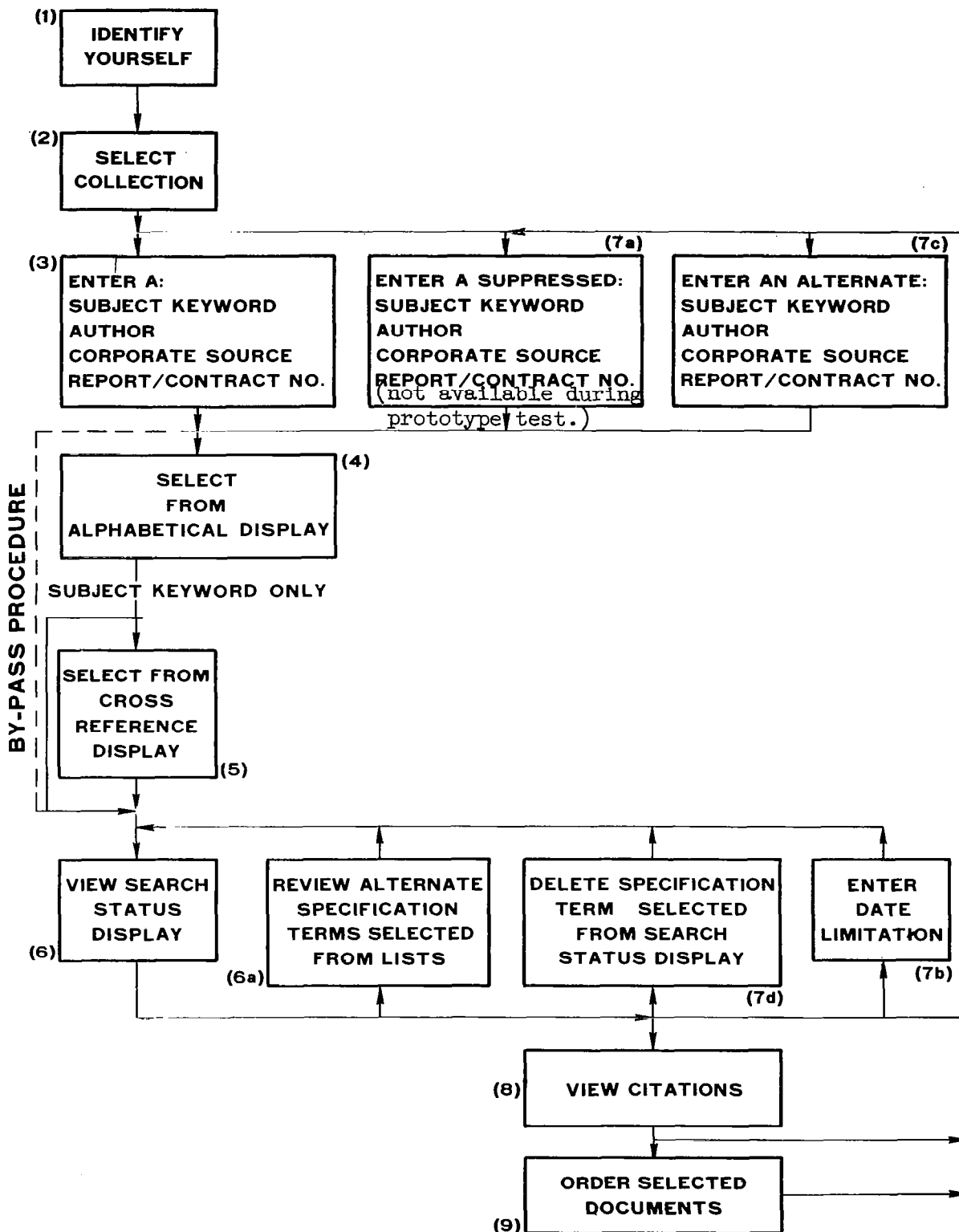


Figure 3. Steps in RECON Search

Step 5. For subject keywords only, RECON will next display a list of cross-references to each subject keyword term you selected from the previous alphabetical display. The cross-reference list will display the terms you selected from the alphabetical display plus all the terms cross-referenced to them. The purpose of the cross-reference display is to enable you to select additional terms that may be cross-referenced to your original choices. For each term you selected from the previous alphabetical display, the number of documents citing that term will now also be presented in the cross-reference display.

You must again choose the terms you wish RECON to search for from the cross-reference list. You may choose any or all of the terms listed in the cross-reference list, or repeat your previous selection or combine that previous selection with new terms. A cross-reference list will be presented for each subject keyword term that has a cross-reference listing in RECON's files.

Step 6. After you have made a selection from the alphabetical display, or, when the entry is a subject keyword, after you have made a selection from the cross-reference list which does not require an additional cross-reference list, RECON will present a "search status display." This display summarizes the progress of the search, displaying the specification terms finally accepted and the number of documents satisfying all the specifications to that point.

Step 6(a) Since several related terms could have been selected from the list, these terms are treated as alternative selections by RECON. You will have an opportunity to view the number of documents selected by each term in turn and you may accept or reject each term. Since these terms select documents that reference any one of them, i.e., if the document references term 1 OR term 2 OR term 3, etc., the total of selected documents will increase as each term selected from the list is accepted.

Step 7. When all of the alternatives selected from the alphabetic or cross-reference list have been reviewed, the search status display will show the alternative terms accepted and the number of documents selected.

The reason for presenting these numbers in the search status display is to let you know the number of citations you will have to view if you wish to view all the citations for a particular specification term or combination of terms. RECON can, of course, display (Max. 167) the citations for a given set of terms, but you may find it impractical because of time limitations to review a large number of citations. It is therefore recommended that you try to narrow your search terms as precisely as possible, to the point at which only a reasonable number of citations will be displayed for your viewing. This will be a convenience to you and a courtesy to others who may wish to use the RECON console.

In order to narrow your search it may be necessary to enter additional specification terms which "AND" with previous specification terms. That is, documents are selected which reference the previous specification terms AND the new term(s). To make such an entry, you simply repeat the initial entry process of Step 3.

Step 7(a) It may be desirable to prohibit selection of documents which reference a particular specification term. In other words, to select those documents which meet previous specifications "AND NOT" the new specification. This may be done by a suppression entry which will in general reduce the number of documents selected. This capability will be added subsequently.

Step 7(b) A date limitation may be entered as shown in Figure 3 to further reduce the number of documents selected.

Step 7(c) It may be desirable to enter a specification term on an either/or basis with the previous specification term. As we have seen, it is convenient to do this by multiple selection from an alphabetical or cross-reference list, but this is not always possible. For example you may wish an article by either Smith or Jones. For such cases, step 7(c) is available. The entry of an alternative term (OR function) will in general increase the number of documents selected.

Step 7(d) As you attempt to reduce the number of documents selected, it is possible to become overly restrictive: the number of titles satisfying all specifications may go to zero. Should this happen, you must add alternative terms or delete the previous step.

After the search status display is presented you may add additional, or alternate, subject keywords, authors, corporate sources or report/contract numbers. When you do this you will have to repeat the alphabetical and, for subject keywords, the cross-reference displays for these new terms before you receive the modified search status display. You do not repeat the alphabetical and cross-reference displays when you delete terms or enter date limitations.

It is possible to bypass the alphabetical and cross-reference displays if you feel sure that you have selected precisely the correct term. This can be done by depressing the term entry key twice instead of once, e.g. SS for entering subject terms, AA for author terms, etc. If the term you have entered is not in RECON's files, however, it will reject the bypass and present the alphabetical and cross-reference displays.

Step 8. When the number of documents meeting the specifications has been reduced to a reasonably small number by the entry of specification terms, you may elect to view the citations for the documents thus selected. If the citations are not satisfactory you may return to Step 7 for further entry of specifications.

Step 9. While viewing any citations you may order the corresponding document by depressing a single key. After ordering you may view other citations or enter additional specifications.

SEARCH STRATEGY DESCRIPTION

IDENTIFYING YOURSELF

Start the search by identifying yourself to RECON. Depress the U key (U), type your name and address, and finish with TR. When typing a message, you should follow normal spacing rules (i.e. single space between words). Your screen will read something like this:

```
U  SCIENTIST, J. Q.  
MAIL CODE USD, EXT 24970
```

This message is transmitted to your local librarian as delivery information for any document you order. If you fail to supply your address, the librarian will have to contact you personally to get the correct delivery information, and this will delay your order.

Remember to check your message before depressing the TR key. Remember also that you must always transmit the message you have composed by depressing TR. If you do not, RECON will not receive your message.

If you fail to start your message with U, you will receive an error display.

SELECT THE LISTS TO BE SEARCHED

RECON responds to your identification by listing the files you may search. RECON will display the following:

```
SELECT THE SERIES TO BE SEARCHED  
1. STAR                      N-10,000  
2. INTNL AEROSP ABSTRS      A-10,000  
3. ....  
4. ....  
5. ....
```

(Specially authorized stations will receive additional collections beyond STAR and IAA.)

The column on the right side of the display shows the particular accession number series involved. These numbers, when supplemented with a two-digit year (N66, A65, etc.) are used in the system as control and order numbers.

To select a series, depress the List (L) action key, followed by the number of the collection in which you are interested. For example, if you

had authorization for all eight NASA collections, and typed L 1, 2, 3, 4, 5, 6, 7, 8, RECON would search all the collections available to it.

You must select at least one collection for the search to continue. You cannot simply type in your specification term. If you do, you will receive an error display.

When you have indicated a choice of one or more of the above groups, RECON will display your name, address and the collections you have selected. For example,

```
SCIENTIST, J. Q.  
MAIL CODE USED, EXT 24970  
1. STAR N-10,000  
2. INTNL AEROSP ABSTRS A-10,000  
3. ....  
4. ....
```

RECON is now ready to accept specification terms.

SEARCHING BY SUBJECT KEYWORD

To enter a subject keyword as a specification term, depress the S Subject key (S), type the keyword or phrase that most precisely describes your search interests, then depress TR. For example,

```
S IMPACT TOLERANCE
```

Remember you may enter only one specification term at a time.

No restriction is placed on the manner in which you may enter a specification term. However, it makes sense to structure your term before you enter it, because RECON does not draw any distinction between sense and nonsense. Before initiating your search, you may wish to consult the "Guide to the Subject Indexes" for STAR and IAA.

Suppose, for example, you entered, "EFFECT OF VIBRATION ON CIRCUIT DESIGN". Because RECON cannot reason that you are really interested primarily in vibration or circuits, it will process your message as if the entire phrase is the indexing term. Consequently, it would examine its memory alphabetically for this phrase, which is not listed in the NASA index terms. The result would be an alphabetical listing which would include such diverse items as education, effusion and ego. Considerable time might be lost in your search.

If you enter more than one specification term at the start of your search, RECON will process only the first. For example, suppose you entered

```
S EXPANSION WAVE, SMITH T.
```

which is a subject keyword and author's name. RECON will process your entry, displaying it in exactly that form in the alphabetical subject listing.

ALPHABETICAL DISPLAY

In response to the specification term you have entered RECON will present you with a numbered list of recognized keywords which are alphabetically near the entered keyword (the list will include the entered keyword if it is a recognized keyword.)

Suppose you had entered

S. CIRCUIT DESIGN

RECON would provide you with the following display:

```
--SELECT ONE OR MORE BY NUMBER--  
50.  CIRCLE  
51.  CIRCUIT  
52.  CIRCUIT BOARD  
53.  CIRCUIT BREAKER  
    ---CIRCUIT DESIGN  
54.  CIRCUIT PROTECTION  
55.  CIRCUIT RELIABILITY  
56.  CIRCULAR  
57.  CIRCULAR CONE
```

Note that this is an alphabetical listing in which the specification term initially entered is displayed in its correct alphabetical sequence. Since CIRCUIT DESIGN is not one of the NASA indexing terms, it has no number associated with it, which means that it cannot be selected. If, on the other hand, CIRCUIT PROTECTION had been originally entered, it would have appeared where CIRCUIT DESIGN appears in the above example. Since CIRCUIT PROTECTION would be identical with the numbered entry below it you would be able to select it again.

You select from the alphabetical listing by again entering S and the number of the selected entry. If you decided CIRCUIT RELIABILITY was your best choice, you would type S 55. Or if you wished you could select several items on an "either/or" basis, e.g., S 52, 54, 55. If a suitable keyword is not displayed, you may "turn the pages" of the list by entering plus (+) to go forwards or minus (-) to go backwards for a more suitable term. You may select terms from the displayed list while at the same time, going forward or backward; for example by entering S+52, 54, 55.

CROSS-REFERENCE LIST

If you had entered S 51 RECON's response would be a cross-reference list to the term "CIRCUIT":

--SELECT ONE OR MORE BY NUMBER--
SELECTED AND INDEXED--

1. CIRCUIT-----4463
CIRCUIT IS CROSS REFERENCED
51. BISTABLE CIRCUIT
52. INTEGRATED CIRCUIT
53. LINEAR CIRCUIT
54. LOGIC CIRCUIT
55. MAGNETIC CIRCUIT
56. SWITCHING CIRCUIT
57. TRANSISTOR CIRCUIT

The number to the right of the major term selected previously is the number of documents which reference this term. The items numbered above 50 are those cross-referenced by the term "CIRCUIT".

Suppose you decided that BISTABLE CIRCUIT, LOGIC CIRCUIT and SWITCHING CIRCUIT more adequately described your interests than CIRCUIT alone. You would therefore enter

S 51, 54, 56

Note that each new list displayed will have its own set of identifying numbers. You enter the numbers of the latest list as your indexing terms; you do not have to refer to any previous numbering system.

The result is another cross-reference list. Any selection of a term above 50 produces a new set of references:

- SELECT ONE OR MORE BY NUMBER--
SELECTED AND INDEXED--
1. BISTABLE CIRCUIT----- 13
 2. LOGIC CIRCUIT-----181
 3. SWITCHING CIRCUIT-----178
- LOGIC CIRCUIT IS CROSS-REFERENCED
51. NEUTRAL NET
 - SWITCHING CIRCUIT IS CROSS-REFERENCED
 52. DUPLEXER

Notice that the number of documents cited by the indexed terms (those numbered 1, 2, 3) is again displayed.

Let us assume that you decide that the cross-references in the example above are not pertinent to your search, but the indexed ones are. You would therefore enter

S 1, 2, 3

Since no terms numbered above 50 were selected, no further cross-references would be available and you would be presented with a search status display.

SEARCH STATUS DISPLAY

When all of your selections are indexed, RECON processes the first term that you have most recently entered, storing the remaining entries temporarily. RECON presents the first term you selected from the previous cross-reference list:

```
--SEARCH STATUS--  
1S. BISTABLE CIRCUIT-----13  
MORE
```

The number at the right of the screen is the number of citations meeting all specifications to this point in the search. Based on this number, you may decide to accept or reject the term.

If you decide to keep the term, you enter +S. RECON then presents the next term you selected:

```
--SEARCH STATUS--  
1S. BISTABLE CIRCUIT-----13  
 S. LOGIC CIRCUIT-----194  
MORE
```

Note that the search status display is cumulative, so that each successive display presents the last term accepted plus the next one in order, as in the example above.

Suppose in the example above you decided to eliminate LOGIC CIRCUIT (i.e., not view the citations described by that term). You would enter -S. RECON would then present the next specification term in order:

```
--SEARCH STATUS--  
1S. BISTABLE CIRCUIT-----13  
 S. SWITCHING CIRCUIT-----191  
END
```

Note that by deleting LOGIC CIRCUIT, you have removed it from the display. This automatically calls out the next term that you had selected. It may also be accepted or rejected by entering +S or -S. This procedure continues for as many terms as you had previously selected from the cross-reference list.

Where specification terms have been entered on an either/or basis, as is the case when selecting more than one term from a displayed list of terms (i.e., term A, then term A + term B, then term A + term B + term C, etc.), the numbers of citations presented are, except for the first one, cumulative,

because they describe the number of documents referencing any of the terms. These numbers therefore appear in increasing order, the first term displayed having fewest accessions, the second term, a number equivalent to or greater than the second, etc. The search status display number must be differentiated from the cross-reference display number. The cross-reference number describes those documents referencing the indexed term by itself (not ORed with another term.)

It is important to note that you may request RECON to display the accessed citations without completing processing of all terms selected from the list. You do this by depressing the Title key (T) and TR. This automatically accepts the terms displayed to that point and causes RECON to start displaying the citations accessed to the terms you have just accepted.

However, once you decide to view a set of citations you automatically terminate the display of any further terms. So, if you had depressed T after BISTABLE CIRCUIT you would have received only the 13 citations indexed to BISTABLE CIRCUIT. If you had depressed T after BISTABLE CIRCUIT and LOGIC CIRCUIT, you would have seen all the citations indexed to both these terms, but you would not receive a search status display for SWITCHING CIRCUIT or the citations indexed on that term. If, after viewing citations for BISTABLE CIRCUIT and LOGIC CIRCUIT, you wanted to return to SWITCHING CIRCUIT, you could do so by entering SWITCHING CIRCUIT as an alternate term, e.g., +S. SWITCHING CIRCUIT. You would then receive the search status display for SWITCHING CIRCUIT, followed by its citations.

You must indicate that you have accepted at least one term before you request the citations.

BYPASS PROCEDURE

All of this may seem like a tedious procedure if you know the exact specification terms you want. In that case it is possible to bypass the automatic presentation of the alphabetical and cross-reference list. You do this by depressing the Subject key twice (SS) rather than once. When you enter the term, RECON will process your entry immediately if the term you have entered is an indexed keyword. If it is not, the alphabetically near list will still be presented.

SEARCHING BY AUTHOR

To enter an author's name as a specification term you depress the A Author key (A), type the author's last name, followed by a comma and his initials, if known, and then depress TR, e.g.:

A SMITH, S. G.

RECON will present a list of authors alphabetically adjacent to the entered name:

SELECT ONE OR MORE BY NUMBER

50. SMITH, R. V.
51. SMITH, R. W.
52. SMITH, S.
53. SMITH, S. D.
--- SMITH, S. G.
54. SMITH, S. G.
55. SMITH, S. H.
56. SMITH, S. H. JR.
57. SMITH, S. O.

The alphabetically near list of authors is presented even though you may have entered an acceptable name. If you are sure of the name, you can bypass the alphabetical listing by depressing A A when you enter the name.

Once the alphabetical listing is displayed, you may select one or more of the names presented, e.g., by entering A 54 or A 54, 55 (if you wish alternative authors entered).

RECON will then present the search status displayed for the authors selected (there is no cross-reference list for authors).

--SEARCH STATUS--
1A. SMITH, S. G. -----4

The remainder of the procedure is the same as with the subject keyword. If you had selected more than one author from the alphabetical display, RECON will present a progressive cumulative display of the authors' names and you can select or reject them by entering +A or -A. For example, if in the example above, you decided to keep SMITH, S. G., you would depress +A and RECON would respond with:

--SEARCH STATUS--
1A. SMITH, S. G. -----4
A. SMITH, S. H. -----5

SEARCHING BY CORPORATE SOURCE

To search on the basis of a corporate source you depress the C Corp action key (C), type the corporate name and depress TR.

For example, in response to C General Electric Co., RECON will present a list of corporate sources alphabetically adjacent to the original entry, just as with the author entry. You can then select from this list, after which RECON will present a search status display:

```
--SEARCH STATUS--  
1C. GJ 966330 -----27
```

There is no cross-reference listing for corporate source, and the corporate source will be displayed in coded form.

Because most corporate sources have multiword names, a convenient way to enter RECON with this specification term is to type the first word only and then select the correct entry from the displayed alphabetical list.

SEARCHING BY REPORT OR CONTRACT NUMBER

Depress the # action key, type in the report or contract number and depress TR. As with the other specification terms, you will receive an alphanumerical near listing of report/contract numbers unless you depress ##. If RECON recognizes the number as one on file, it will present a search status display such as

```
--SEARCH STATUS--  
1#. NASA-CR-57439-----1
```

or, in the case of a contract number

```
--SEARCH STATUS--  
1#. NASW-1000-----1
```

SEARCHING BY DATE LIMIT

There may be occasions when you wish to limit RECON's search to a specific time period. To enter a date limit, depress the Date (D) action key, and type the limitation in one of the following formats:

D. BEFORE YEAR

D. AFTER YEAR

D. FROM YEAR TO YEAR

D. BEFORE MONTH

D. AFTER MONTH

D. FROM MONTH TO MONTH

The years may be two or four digits. The months may be spelled out or abbreviated by the first three letters. The month designation automatically refers to the 12 months preceding the current month. The terms BEFORE and AFTER are exclusive: the month or year indicated is not included in the search. FROM/TO is inclusive. Note that you can enter only one date limitation during any one search. Note also that you can enter either a year limit or a month limit, but not both.

While it is desirable to have the date limitation apply to actual publication date, it is not possible to do so. Instead, the date of accession is used. The actual publication date is usually given in the title presentation.

The date limitation applies to all of the specification terms you have entered. Assume that RECON has presented the following:

--SEARCH STATUS--

1S. MAGNETOSTRICTION-----115

S. MAGNETOSTATIC FIELD-----196

and you wish to accept this term but limit it to citations after 1963. You would merely depress D and type in AFTER 1963, followed by TR. The next search status display you would receive would display:

--SEARCH STATUS--

1S. MAGNETOSTRICTION-----115

S. MAGNETISTATIC FIELD-----196

2D. AFTER 1963----- 72

The number opposite the date limitation indicates the number of documents referencing both the terms above after the date limit has been imposed.

At any time during a search the Search Status may be recalled by depressing D D.

ENTERING ALTERNATE SPECIFICATION TERMS

The alphabetical and cross reference displays enable you to select alternative terms as they are available in RECON computer files. You can secure these terms merely by selecting from the displayed lists. In addition, you have the opportunity during the search status display phase (not before) to enter any additional terms you wish, even if the term was not previously displayed in the alphabetical or cross reference displays. These terms might be an additional subject keyword, an author, corporate source, or report/contract number. You may enter any number of such additional terms.

Suppose, for example, RECON had displayed:

```
--SEARCH STATUS--
1S. BISTABLE CIRCUIT -----13
 S. LOGIC CIRCUIT -----194
```

Suppose you wanted to add an alternative specification term, such as MICROCIRCUIT. You would enter plus (+) and then Subject MICROCIRCUIT, followed by TR. RECON would respond by alphabetical and cross-reference displays for MICROCIRCUIT. During these displays the previous search status display is temporarily stored. After you had made your selections (if any) from the alphabetical and cross-reference lists, RECON would resume the search status display:

```
--SEARCH STATUS--
1S. BISTABLE CIRCUIT -----13
 S. LOGIC CIRCUIT -----194
 S. MICROCIRCUIT -----240
```

You would proceed from this display in the usual manner. Notice that the number of documents referenced to MICROCIRCUIT is greater than that for the preceding term. This is because the new term was "ORed" to the preceding terms, which means that the search for documents referencing MICROCIRCUIT is cumulative with the preceding terms.

The bypass procedure may also be used to enter an alternate specification term. In the above subject area the form would be +S S MICROCIRCUIT.

It is possible for you to add an alternative term while viewing citations, but in that event the citation display is interrupted, while you proceed through the alphabetical, cross-reference and search status displays. After the modified search status display you may again request citations (including the new term), but these citations will be from a different list.

SUPPRESSING A SPECIFICATION TERM (Not available during prototype test.)

Let us assume that during search status display RECON displays the following:

```
-- SEARCH STATUS--  
1S. BIOLOGY -----34  
S. MICROBIOLOGY -----56  
END
```

The titles indexed to these terms include certain related subjects, authors, work performed by particular companies or particular reports; these you may already know or might not wish to consider. For example, in searching for biological citations you might not be at all interested in viruses and might wish to eliminate from your viewing all citations referring to viruses.

To suppress a specification term you depress minus (-) Subject (S), and then the term, just as if it were an ordinary specification term, followed by TR, in the following manner:

-S VIRUSES

The result, after selection from the alphabetical and cross-reference lists, is a new search status display that records this suppression:

```
--SEARCH STATUS--  
1S. BIOLOGY -----34  
S. MICROBIOLOGY -----56  
2-S. VIRUSES -----23
```

This display means that 23 citations are accessed to biology and microbiology after those citations referring to viruses have been eliminated from the combined lists of citations that you are considering. While you will still receive 23 citations dealing with biology and microbiology, they will not deal with viruses. The suppressed term refers to the whole set of terms in the search status display.

It is possible to suppress a term while viewing citations, but the citation display would be interrupted while RECON displayed the revised search status display. A new list of citations would be presented following suppression.

DELETING A SPECIFICATION TERM

Once a specification term has been displayed in the search status display, it can be deleted. In deleting a term you remove it and the documents introduced by

that term completely from consideration. You may, however, still retrieve items that reference the deleted term, where these documents also reference another term in which you are still interested.

Deletion is accomplished by entering minue (-) followed by previous function code. Suppose RECON displays:

```
--SEARCH STATUS--
1S. BISTABLE CIRCUIT-----13
2A. SMITH, J. S.-----0
```

If you enter-A, SMITH, J. S. will be deleted as a specification term. RECON will then display:

```
--SEARCH STATUS--
1S. BISTABLE CIRCUIT-----13
```

DISPLAYING CITATIONS

Suppose your search status display concluded with the following:

```
--SEARCH STATUS--
1S. BISTABLE CIRCUIT-----13
S. SWITCHING CIRCUIT-----65
END
```

When you depress your Title (T) action key and TR, RECON will display the citations accessed to either BISTABLE CIRCUIT or SWITCHING CIRCUIT. You may call for the viewing of citations by entering T, but only after at least one specification term has been entered. RECON does not automatically display citations without your request.

The presentation of the citations will be in at least two parts, each part containing one or more "pages" or individual displays, of 12 lines per page. Each citation will therefore have at least two pages, but, depending on the length of the citation, may contain more than two.

Each page, except the last, will end with the work "MORE". You may see the following page of a particular citation by entering plus (+). To call for the next citation you should enter T. You may call for another citation at any time while you view citations, by entering T.

All the citations (Max. 167) for the specification terms you have selected will be presented in serial order by accession date within series, so that the first citations you view are the most recent ones accessed.

You may terminate your scanning of citations at any time, either by terminating the search as a whole (depress PERIOD (.) or by entering new

specification terms (entering S, A, C or # and typing out the specification term). This last will put you into a new search cycle.

The information presented in a citation will normally include the following:

- (1) Serial number of citation (first number of first line)
- (2) Accession number (second group of numbers in first line)
- (3) Microfiche availability (# in first line if available)
- (4) NASA support code (*in first line if NASA supported)
- (5) Reference to published index for locating abstract (remainder of first line)
- (6) Title as given in published index (page 1 if possible)
- (7) Author(s) (page 1 if possible)
- (8) Corporate Source (page 1 if possible)
- (9) Date of publication (page 1 if possible)
- (10) Classification notice (page 1 if possible)
- (11) Contract number (starts a new page)
- (12) Report number
- (13) Availability of the report and price
- (14) Distribution limitations
- (15) Document language
- (16) Subject keywords used to index the report

Subject keywords start page 2 and may extend through more than one page. Subject keywords are listed in alphabetical order with all asterisked keywords (major concepts) preceding non-asterisked keywords (minor concepts).

EXAMPLE OF CITATION (PAGE 1)

1. 65N23740/* STAR 65 NO. 13-24
A NEW APPROACH TO THE
HOMOGENIZATION OF HETEROGENEITY
MEDIA FOR NEUTRON DIFFUSION
CALCULATIONS
JACOBS, A. M.
JET PROPULSION LAB., CALIF.
INST. OF TECH., PASADENA
15 APR. 1965 28 P REFS--MORE

(PAGE 2)

CONTRACT NO. NAS7-100
REPORT NO. NASA-CR-62712
JPL-TR-32-686
CFSTI- HC \$2.00/MF \$0.50

(PAGE 3)

*DIFFUSION THEORY
*HETEROGENEITY
*NEUTRON SCATTERING
*TRANSPORT THEORY
ARRAY
DIFFUSION
EQUATION
FORMULATION
FUNCTION
HOLE
HOMOGENIZATION
ISOTROPIC--MORE

(PAGE 4)

MATHEMATICS
MEDIUM
NEUTRON
PLANE
SCATTERING
SYMMETRY
THEORY
TRANSPORT--MORE

ORDERING A DOCUMENT

You may order a document by depressing the Order (O) action key. The following information is printed out on the local library printer: your name and address, the accession number of the document you have ordered, its microfiche availability, first line of the title, first author, first report number (if there is more than one), descriptive material and any comment entered by the user. After ordering, you may continue viewing citations or enter a new specification term in the manner described earlier. If the document being ordered is classified, you must contact your librarian to justify your need to know.

TERMINATING THE SEARCH

The search may be terminated at any time by depressing PERIOD (.). RECON responds to termination by clearing its screen.

SELF-INSTRUCTION

You may secure assistance from RECON if you wish it. You do this by depressing the Self Inst key. If you enter \$\$, (self-instruction in the use of the self-instruction key), RECON will present a series of displays with general instructions for using RECON and detailed instructions for beginning. If you are interested in specific instructions for particular action keys, such as S, RECON will present instructions about S if you first depress \$S. \$ may also be used during a search at any time. The self-instruction display will indicate the alternative open to you, based on RECON's analysis of the history of your search.

ERROR DISPLAYS

It is most important to start any message you send to RECON with the correct action key. If you forget to depress the action key, or depress the wrong action key for the particular specification term you are entering, RECON will respond with an error message. That message will display your transmission so that you can see what is wrong. For example, if you forget to identify yourself at the start of a search by depressing the User key (U), RECON will tell you that the action code is missing or incorrect.

If you transmit the correct action key but the wrong message to RECON (for example, you select an incorrect number from the previous serial listing displayed), you will receive an error display which tells you that your message is incorrect.

If you make a mistake and transmit it, you cannot correct that mistake on RECON's error display that will immediately follow. You must make a new entry or delete the previous entry and re-enter. Because this procedure is cumbersome, you should make every effort to check your message before transmitting it (i.e., before depressing the TR key).

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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