Garfield, E. "Can the Surgeon Keep Up With New Scientific Information?" June, 1966 . Presented at the Third Annual Alumni Conference of the school of medicine of the University of Pennsylvania, Philadelphia, PA. June 17, 1966.

#### Can the Surgeon Keep up with New Scientific Information?\*

by

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The title of this talk reminds me of the old cliche "When did you stop beating your wife?" If you claim that the surgeon <u>cannot</u> keep up with the growth of knowledge, then you are merely repeating a truism--a state of affairs, I might add, that has been prevalent ever since the invention of movable type. If you claim that the surgeon <u>can</u> keep up, then you are denying, by implication, that the problem is serious.

Undoubtedly the problem of scientific information is a serious one. Most of you have suffered from that special bibliographic disease called "piles"-piles of journals that is. Almost every week I visit a medical colleague who has stacks of unread journals on his office chairs or tables. A few who can afford the luxury of storage space and cost of shelving have (bound) volumes of hundreds of books and journals that have never been cracked.

But don't you find it strange, in this age where information abounds plentifully, that whenever you want to know something, you can't find it?; or whenever you want to find that article you once read, you can't remember exactly where?; or somehow you missed an article only to have one of your friends tell you about it a year too late? This feeling, or situation, which I have described elsewhere as bibliographic poverty in the midst of information plenty (1), is not an isolated one.

\*Presented at the Third Annual Alumni Conference of the School of Medicine of the University of Pennsylvania, Philadelphia, Pa.; June 17, 1966.

However, I hope I can give you cause to feel that the situation is not completely as bad as we feel or are sometimes led to believe. Nevertheless, particularly in the case of clinical scientists, there are real problems which have nothing to do with the growth of scientific knowledge per se but which are, in fact, a function of training and motivation.

Undoubtedly you have heard that there are supposed to be some 50,000 scientific journals published in the world today which contain several million papers per year (2). This is sheer poppycock. The well known <u>Index Medicus</u> now covers about 2,500 medical journals. Truelson recently reported that less than 1/3 of these are ever requested at Yale Medical Library (3). Of these, in my opinion, not more than 200 could be seriously classified as significant.

But even assuming that all 2,500 are of value to someone, somewhere-these journals only account for about 150,000 medical papers per year. This is an order of magnitude lower than the multimillion figure cited. However, let's consider not only medicine but all of science and technology. There are still only a few hundred really significant journals published in the entire world.

Let us use as a major criterion of significance, among others, the number of papers published. In Figure No. 1, you see a table listing the first 90 journals out of 1147 covered in the 1965 <u>Science Citation Index</u>. Less than 20 journals publish more than a 1000 items per year. Less than 100 publish 500 items per year. And this list already includes most of the medical journals that instantly come to mind when preparing an off-the-cuff list of the world's most significant journals.

I don't intend to labor the point with a lot of statistics. However, Figure No. 2 graphically illustrates this information and demonstrates a fundamental characteristic of scientific publication--namely, that a small percentage

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of journals accounts for a large percentage of everything published. Journal statistics are meaningless unless one keeps in mind characteristics such as Lotka's Law (4) or Bradford's Law (5).

Be that as it may, there are only a few hundred significant, and probably about 2,000 important, journals which produce close to 300,000 scientific articles per year--about 1/3 in medicine. This may be small consolation to the individual reader. However, for any specific individual, there is a minute fraction of this information which is of immediate or even potential concern. How does he get at it? Well, there are a number of theories on this, and I want to expose you to a few today.

Several years ago, e.g., Dr. Ethan Allen Brown published a paper in <u>Medical Economics</u> entitled "How to Get the Meat out of 700 Journals." (6) I have taken the liberty of enclosing a copy of this paper in your kits. There are thousands of medical scientists in the world who rely on this method--scanning contents pages--to keep up with the literature. (Figures Nos. 3A and 3B) <u>Current Contents</u> is used by individual surgeons engaged in research, both clinical and experimental. <u>Current Contents</u> is especially used by surgeons who are members of multi-disciplinary research teams who must, of necessity, make a broad sweep of the entire scientific literature--not just the obvious literature of surgery. Indeed, the "pure surgical literature" is a relatively minor problem compared to the "literature of interest to surgeons." The latter has no definable boundaries.

Precisely because the traditional boundaries between medicine, chemistry, electronics, mathematics, etc., have disappeared, the medical scientist today, like most other scientists, needs a means of screening the entire scientific literature, so that he can be informed promptly of those items bearing directly on his interests.

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While <u>Current Contents</u> appeals to the headline reading habits in which we all indulge, a new service called ASCA is a modern computer-based clipping service that seeks out the literature one must know about to perform research effectively. One method, <u>Current Contents</u>, satisfies the browsing instinct. The other, ASCA, is an organized systematic approach. Someone called it ironically "systematic serendipity." (7) One method is broad--the other, more precise and specific. And they complement each other nicely. Very few people want to read the newspaper by starting with the index. On the other hand, only a detailed indexing system can turn up just that item you would have otherwise missed if you cannot afford the luxury of reading every page and column.

The ASCA system I shall describe briefly does just that. In it, you provide a "profile" of your current interests, and the computer system does the rest. If desired, ASCAMATIC service can deliver automatically to you actual clippings or tear sheets of articles listed on a typical weekly report shown in Figure No. 4. In this report, I have shown you what you might have received in 1965 or the first few months of 1966 had you been interested in the specific topic of "shock" which you have been discussing at this conference. In the next figure, No. 5, you see a list of papers you might have received in the same period had you been interested in the highly specific topic of "Atypical Kernicterus, etc." and in the next figure, No. 6, some of the items you might have been alerted to if your profile concerned "Hypoparathyroidism after Thyroidectomy."

In your kits we have included some descriptions of medically oriented literature searches that utilized a new concept known as citation indexing (8). Citation indexing is a method of indexing that is employed both in the ASCA system and in a published index called the Science Citation Index which you can

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examine in most <u>leading</u> medical libraries. You can understand my intolerance if I stipulate that a leading medical library is one which, by definition, receives the SCI. Since the SCI is so generally available, I will not spend time during my talk in discussing its use but would gladly answer questions about it in the discussion period.

The ASCA system is primarily but not exclusively based on the concept of citation indexing. Unlike conventional word indexing systems, in ASCA we can also associate pertinent subject matter through citation links. In short, you define your specific interests by providing a list of older publications on that subject; ISI informs you of all subsequently published works which cite any one of them. This is illustrated in Figures 7 and 8.

Here is a profile on the topic "origin of life." It is a list of publications known to be related to this topic. In Figure No. 8 is shown an ASCA report listing several papers which, during the week of July 30, 1965, cited one or more of these profile items. It is that simple. You can read the ASCA brochure for more details, but the best starting profile is probably the list of papers you cited in your last published paper.

There are two major sociological problems that stand in the way of the surgeon keeping up with scientific information. (The details of particular systems, such as <u>Current Contents</u>, ASCA, <u>Index Medicus</u>, or <u>Medlars</u>, can be tackled in the question period.) In my experience, the major barrier to the effective use of the knowledge available to the medical scientist is motivation and/or training. Anyone who is either overworked or overpaid, or both, is not a good candidate for modern information services. Any professional man must make a decision as to how much time he can devote to his re-education or self-renewal. Some prefer to take refresher courses--others prefer to keep up day by day. Some people

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hate education of any kind and that would include any form of reading. They are obviously not candidates for modern information services no matter how well conceived the service may be and no matter what the cost. More than 50% of doctors wouldn't use a comprehensive medical library even if it were given to them on a silver platter. They just don't communicate or learn that way! One reason for this is training--or lack of it. The average medical man has never learned to use a conventional library--so he is not, by training or disposition, inclined to take the effort to learn how to use the modern information systems which still must frequently lead him to a conventional library. And when I say the physician has not learned to use a library, I not only mean that he is unfamiliar with the bibliographic apparatus--the indexes and catalogs and dictionaries and encyclopedias--I mean that he is not a literature-minded person. A research biochemist gets an idea and, by training, his first instinct is to do a search in the library to see if it is a new idea. When a doctor gets what he thinks is an original idea, he calls a friend. If his friend thinks it is original, then they agree a paper should be written or a paper presented. Both are probably non-library oriented, since birds of a feather travel together, and they are both equally shocked to learn when some journal referee, who is library oriented, can cite a dozen anticipatory references. This agonizing experience produces a vicious circle. Through inadequate training, he thinks he cannot cope with the literature. Otherwise, he would have done a search in the first place. He concludes that his best solution is to see more patients and forget about writing papers. If he is persistent, he may obtain the help of a ghost writer who can do all this "drudge" work but he is usually distrustful of non-medical personnel.

I don't want to labor this point any longer, and I am not absolutely certain that it applies to this audience. If not, I apologize, but these are the facts of library life. They are quite different than I had expected from my idealistic

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library school training. Librarians are trained in the concept of service. They naively assume that when a doctor asks for information, on what he considers to be an original idea, that he is overjoyed to be given a list of 200 references on the same subject. His motivation is to prove his originality. On this occasion, if the doctor uses the library, it is more often than not in obeisance--and in hopes he will find little or nothing. On the occasion when he would like to dispute the findings of a colleague, he is strongly motivated. It is surprising how much he is willing to pay in time, money, or energy especially if he gets results. Unfortunately, literature searching can be an enervating experience and even a strongly motivated searcher may give up early in the game. Fortunately, precisely this kind of search--finding refutations--is ideally done by using the Science Citation Index--because even a secretary can search the Index with minimal assistance or instruction from the doctor. If your secretary has not learned how to use the SCI, then I suggest it would be worth five or ten minutes of her time. Any professional medical librarian can teach her the SCI system. You will be amazed at the results, and I'll be happy to illustrate this for you by concrete examples in our discussion period.

Thank you.

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## 1965 SCIENCE CITATION INDEX

## Source Journal Statistics Ranked by Number of Source Articles (Cumulated)

|     | Source       |         | Cum. %  |     | Source      | Cum. %  |         |  |
|-----|--------------|---------|---------|-----|-------------|---------|---------|--|
|     | Journal      | Sources | Sources |     | Journal     | Sources | Sources |  |
|     |              |         |         |     |             |         |         |  |
| 1.  | NATURE       | 4,389   | 1.92    | 46. | J BIOL CHEM | 751     | 27.65   |  |
| 2.  | BR MED J     | 3,715   | 3.54    | 47. | J DAIRY SCI | 737     | 27.97   |  |
| з.  | COMPT REND   | 3,453   | 5.05    | 48. | KLIN WOCH   | 727     | 28.29   |  |
| 4.  | LANCET       | 3,053   | 6.39    | 49. | J ANIM SCI  | 706     | 28.60   |  |
| 5.  | J AM MED A   | 2,568   | 7.51    | 50. | P ROY S MED | 697     | 28,90   |  |
| 6.  | SCIENCE      | 2,434   | 8.58    | 51. | AM ZOOLOG   | 696     | 29.21   |  |
| 7.  | DAN SSSR     | 2,401   | 9.63    | 52. | J OPT SOC   | 691     | 29.51   |  |
| 8.  | J. CHEM PHYS | 1,758   | 10.40   | 53. | VET REC     | 682     | 29.81   |  |
| 9.  | B S CHIM FR  | 1,576   | 11.08   | 54. | CHEM-ING-T  | 674     | 30.10   |  |
| 10. | J AM CHEM S  | 1,491   | 11.74   | 55. | ANN INT MED | 667     | 30.39   |  |
| 11. | BIOC BIOP A  | 1,481   | 12.38   | 56. | CR SOC BIOL | 662     | 30.68   |  |
| 12. | J CHEM SOC   | 1,375   | 12.99   | 57. | EEG CL NEUR | 661     | 30.97   |  |
| 13. | J. ORG CHEM  | 1,332   | 13.57   | 58. | SOUTH MED J | 650     | 31.26   |  |
| 14. | CHEM IND L   | 1,287   | 14.13   | 59. | J GEOPH RES | 649     | 31.54   |  |
| 15. | CAN MED A J  | 1,271   | 14.69   | 60. | AM CERAM S  | 645     | 31.82   |  |
| 16. | PHYS LETTER  | 1,249   | 15.23   | 61. | AM MATH MO  | 643     | 32.10   |  |
| 17. | J GEN CHE R  | 1,140   | 15.73   | 62. | AIAA J      | 636     | 32.38   |  |
| 18. | MECH ENG     | 1,131   | 16.23   | 63. | J ELCHEM SO | 633     | 32.66   |  |
| 19. | J APPL PHYS  | 1,103   | 16.71   | 64. | CHIM IND M  | 616     | 32.93   |  |
| 20. | PHYS REV A   | 1,079   | 17.66   | 65. | SOV PH JE R | 601     | 33.19   |  |
| 21. | ANN NY ACAD  | 1,079   | 18.13   | 66. | AM J OBST G | 599     | 33.45   |  |
| 22. | N ENG J MED  | 1,057   | 18.59   | 67. | ARCH IN MED | 580     | 33.71   |  |
| 23. | DEUT MED WO  | 1,018   | 19.04   | 68. | REV SCI INS | 578     | 33.96   |  |
| 24. | PATH BIOL    | 1,007   | 19.48   | 69. | AM J MED SC | 578     | 34.21   |  |
| 25. | CIRCULATION  | 939     | 19.89   | 70. | J BACT      | 576     | 34.46   |  |
| 26. | NUCL PHYS    | 932     | 20.30   | 71. | ARCH DERMAT | 576     | 34.72   |  |
| 27. | ANGEW CHEM   | 903     | 20.69   | 72. | PRACTITION  | 571     | 34.97   |  |
| 28. | P IEEE       | 903     | 21.09   | 73. | B CHEM S J  | 569     | 35.21   |  |
| 29. | J PHYS CHEM  | 894     | 21.48   | 74. | AM J OPHTH  | 562     | 35.46   |  |
| 30. | SOV PH SS R  | 889     | 21.87   | 75. | J METALS    | 557     | 35.70   |  |
| 31. | PHYS REV B   | 880     | 22.25   | 76. | P NAS US    | 552     | 35.94   |  |
| 32. | J ACOUST SO  | 876     | 22.63   | 77. | FED PROC    | 548     | 36.18   |  |
| 33. | NUOV CIMENT  | 863     | 23.01   | 78. | PHYS ST SOL | 547     | 36.42   |  |
| 34. | IND LAB R    | 862     | 23.39   | 79. | IEEE SPECTR | 547     | 36.66   |  |
| 35. | ANALYT CHEM  | 859     | 23.76   | 80. | J AM VET ME | 546     | 36,90   |  |
| 36. | P SOC EXP M  | 849     | 24.14   | 81. | J PEDIAT    | 546     | 37.14   |  |
| 37. | BIOCHEM J    | 833     | 24.50   | 82. | J CELL BIOL | 536     | 37.37   |  |
| 38. | TETRAHEDR L  | 832     | 24.86   | 83. | J PHYSL LON | 535     | 37.61   |  |
| 39. | NATURWISSEN  | 823     | 25.22   | 84. | CHEM COMM   | 532     | 37.84   |  |
| 40. | ANAT REC     | 819     | 25.58   | 85. | CHEM BER    | 529     | 38.07   |  |
| 41. | CURRENT SCI  | 813     | 25.94   | 86. | J CHROMAT   | 526     | 38.30   |  |
| 42. | PHYS REV L   | 812     | 26.29   | 87. | SURG GYN OB | 526     | 38.53   |  |
| 43. | SCHW MED WO  | 791     | 26.64   | 88. | AM J PHYS   | 524     | 38.76   |  |
| 44. | ERDOL KOHLE  | 780     | 26.98   | 89  | COLL CZECH  | 515     | 38.99   |  |
| 45. | PHYTOPATHOL  | 778     | 27.32   | 90. | GASTROENTY  | 511     | 39.21   |  |







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FIELD OF INTEREST: METABOLISM OF SHOCK

REPORT FOR 3 JUNE 66 PAGE 1

77,818 citations from current scientific literature and current patents were processed for ASCA this week

THE ITEM BY MCSHAN WHAMER J PHYSIOL1459345CITED BYPAYNE WWACHARYA PTARCH DIS CHILD404366516RN21267523EFFECT OF ABNORMAL BIRTH ON BLOOD CHEMISTRY<br/>DURING THE FIRST 48 HOURS OF LIFE

THE ITEM BY LEPAGE GA AMER J PHYSIOL 146 267 46 CITED BY PANCHENK.LF BOGOLEPO.NH DAN SSSR 160 1401 65 17R N6 62739 VARIATIONS IN METABOLIC ACTIVITY AND IN ULTRASTRUCTURES OF ENCEPHALON MITOCHONDRIA ACCOMPANYING TRAUMATIC SHOCK CONDITION

| THE ITEM BY MCSHAN WH | AMER J       | PHYSIOL        | 145    | 93  | 45 |
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FIGURE 4

FOR OATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( ) AND SEE ORDERING INSTRUCTIONS ON BACK OF FORM. asca

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DR. MARTHA BILLINGS213ACCOUNT NUMBERINSTITUTE OF MEDICAL RESEARCH79UNITS USEDWILKINS, MONTANA920

FIELD OF INTEREST: ATYPICAL KERNICTERUS

**REPORT FOR**3 JUNE 66**PAGE 177,818**citations from current scientific literature and<br/>current patents were processed for ASCA this week

THE ITEM BY SILVERMA. WA PEDIATRICS 614 56 18 CITED BY BLECHER TE EDGAR WM MELLVILLE HA PEEL KR BR MED J 137 27R N5480 71991 1 66 TRANSPLACENTAL PASSAGE OF AMPICILLIN

268 THE ITEM BY ODELL GB J PEDIAT 55 59 CITED BY ODELL GB NATZSCHK.JC PEDIATRICS 37 51 66 28R N1P1 72191 INFLUENCE OF ALBUMIN ON DISTRIBUTION AND EXCRE-TION OF BILIRUBIN IN JAUNDICED RATS

THE ITEM BY ZUELZER WW AM J DIS CHILD 101 87 61 CITED BY KEIDAN SE LOHOAR E MAINWARI.D 179 LANCET 1 66 19R N7430 72068 ACUTE ANURIA IN A HAEMOPHILIAC--DUE TO TRANSFUSION OF INCOMPATIBLE PLASMA CITED BY LAURITZE.C LEHMANN WD Z KINDERHEI 95 143 66 43R N2 74247 DIE BEDEUTUNG DER STEROIDHORMONE FUR DIE ENTSTEHUNG VON HYPERBILIRUBINAMIE UND ICTERUS NEONATORUM

FOR OATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( ) AND, SEE ORDERING INSTRUCTIONS ON BACK OF FORM.

FIGURE 5



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DR. WILLIAM SMITHSON DEPT SURGERY JAMESTOWN HOSPITAL JAMESTOWN, PA. 5841 ACCOUNT NUMBER 82 UNITS USED 917 UNITS REMAINING

### FIELD OF INTEREST: HYPOPARATHYROIDISM AFTER THYROIDECTOMY

REPORT FOR 10 JUNE 66 PAGE 1

**78,904** citations from current scientific literature and current patents were processed for ASCA this week

- THE ITEM BY DAVIS RHLANCET2143261CITED BY ADAMS PHCHALMERS TMCLIN SCI293916512RN270846PARATHYROID FUNCTION AFTER I131THERAPY FORHPERTHYROIDISM
- CITED BY KING LR PORTNOY RM GOLDSMIT.RE CLIN ENDOCR 25 577 65 13R N5 65008 SERUM CALCIUM HOMEOSTASIS FOLLOWING THYROID SURGERY AS MEASURED BY ETHYLENEDIOMINE TETRA-ACETATE INFUSION
- CITED BY HAHNEMAN.S FRIIS T ACT MED SC 177 587 65 10R N5 65368 LATENT PARATHYROID INSUFFICIENCY FOLLOWING THYROIDECTOMY. 2. EFFECT OF INTRAVENOUS INFUSION OF CALCIUM UPON SERUM CALCIUM
- CITED BY WADE JSH FOURMAN P DEANE L BR J SURG 52 493 65 5R N7 66454 RECOVERY OF PARATHYROID FUNCTION IN PATIENTS WITH TRANSIENT HYPOPARATHYROIDISM AFTER THYROIDECTOMY
- CITED BY WADE JSH BR J SURG 52 727
- BR J SURG 52 727 65 M 27R N10 69184 THREE MAJOR COMPLICATIONS OF THYROIDECTOMY CITED BY ANON
- LANCET 1 81 66 20R N7428 71569 THYROID SURGERY AND HYPOPARATHYROIDISM CITED BY MICHIE W STOWERS JN FRAZER SC GUNN A
  - LANCET 1 260 66 L 5R N7431 72231

FIGURE 6

# ASCA (Automatic Subject Citation Alert) PROFILE ENTRY FORM

Institute for Scientific Information 325 Chestnut St., Philadelphia, Pa. 19106

**PROFILE FOR** 

ISI INVOICE # \_\_\_\_\_

Name \_\_\_\_ORIGIN OF LIFE

PLEASE TYPE

| _   |                  | IOUDNUL DOOK MINTED                               | ITEM'S |               |              | 4604 |       |
|-----|------------------|---|--------|---------------|--------------|------|-------|
| _   | OF FIRST AUTHOR  | PATENT OR REPORT NO.                              | VOLUME | FIRST<br>PAGE | LAST<br>PAGE | YEAR | UNITS |
| 1_  | Barghoorn, E.S.  | SCIENCE   | 147    | 563           | 577          | 65   | 1     |
| 2   | Belsky, T.       | NATURE  | 206    | 446           |              | 65   | 1     |
| 3_  | Calvin, M.       | CHEMICAL EVOLUTION<br>(Book)                      |        |               |              | 61   | 1     |
| 4   | Cloud, P.E.      | SCIENCE   | 148    | 27            | 35           | 65   | 1     |
| 5_  | Horowitz, N.H.   | FORTSCHR. CHEM. ORG.<br>NA.                       | 20     | 423           | 459          | 62   | 1     |
| 6   | Lowe, C.U.       | NATURE  | 199    | 219           |              | 63   | 1     |
| 7_  | Miller, S.L.     | SCIENCE   | 130    | 245           |              | 59   | 1     |
| 8_  | Palm, C.         | J. AM. CHEM. SOC.                                 | 84     | 2115          |              | 62   | 1     |
| 9_  | Ponnamperuma, C. | NATURE  | 201    | 337           | 340          | 64   | 1     |
| 10_ | Sneath, P.H.A.   | NATURE  | 195    | 643           | 646          | 62   | 1     |
| 11_ | Silverman, S.R.  | SCIENCE   | 137    | 626           | 628          | 62   | 1     |
| 12_ | Troland, L.T.    | AMER. NATURALIST                                  | 51     | 321           | 350          | 17   | 1     |
| 13_ | Urey, H.E.       | SCIENCE   | 137    | 623           | 628          | 62   | 1     |
| 14_ | Urey, H.E.       | PLANETS (Book)                                    |        |               |              | 52   | 1     |
| 15_ | Calvin, M.       | Reference Author Quest:<br>Source Author Question | ion    |               |              |      | 12    |
| 16_ | Fox, S.W.        | Reference Author Quest:                           | ion    |               |              |      | 10    |
| 17_ | Oparin, A.I.     | Reference Author Quest:                           | lon    |               |              |      | 10    |
| 18_ | Oro, J.          | Reference Author Quest:                           | lon    |               |              |      | 10    |
| 19_ | Ponnamperuma, C. | Reference Author Quest:                           | on     |               |              |      | 10    |

Number of ASCA units this page <u>66</u> Carry over to page 2



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ORIGIN OF LIFE RESEARCH

5 ACCOUNT NUMBER 47 UNITS USED 3 UNITS REMAINING

#### REPORT FOR 30 JUL 65

62,650 citations from current scientific literature and current patents were processed for ASC4 this week

| THE | BOOK BY                               | CALVIN M       | CHE  | MICAL EVOLUT | ION   |       |      | 61 |  |
|-----|---------------------------------------|----------------|------|--------------|-------|-------|------|----|--|
| REF | AUTHOR                                | FOX SW         | SCI  | ENCE         |       | 132   | 200  | 60 |  |
| REF | AUTHOR                                | FOX SW         | ORI  | GIN PREBIOLO | GICAL |       |      | 64 |  |
| THE | ITEM BY                               | HOROWITZ NH    | FOR  | TSCHR CHEM C | RG NA | 20    | 423  | 62 |  |
| THE | ITEM BY                               | MILLER SL      | SCI  | ENCE         |       | 130   | 245  | 59 |  |
| REF | AUTHOR                                | OPARIN AI      | ORI  | GIN OF LIFE  | EARTH |       |      | 57 |  |
| REF | AUTHOR                                | ORO J          | ΡL   | UNAR PLANET  | EXPLO | 3     | 9    | 63 |  |
| THE | ITEM BY                               | PONNAMPERUMA C | NAT  | URE          |       | 201   | 337  | 64 |  |
|     | CITED BY                              | BRIGGS MH      |      |              |       |       |      |    |  |
| (   | )                                     | SPACEFLIGHT    | 7    | 129 65       | 27R   | N4    | 6604 | 7  |  |
|     |                                       | EXPERIMENTS    | ON C | RIGIN OF CEL | LS    |       |      |    |  |
|     |                                       |                |      |              |       |       |      |    |  |
| THE | ITEM BY                               | UREY HC        | SCI  | ENCE         |       | 137   | 623  | 62 |  |
|     | CITED BY                              | MUELLER G CLA  | US G | SUBAC E      | A     |       |      |    |  |
| (   | )                                     | NATURE         | 205  | 1200 65 L    | IOR   | N4977 | 6255 | 8  |  |
|     | INTERPRETATION OF MICRO-STRUCTURES IN |                |      |              |       |       |      |    |  |
|     |                                       | CARBONACEOUS   | MET  | EORITES      |       |       |      |    |  |
|     |                                       |                |      |              |       |       |      |    |  |
| THE | ITEM BY                               | UREY HE        | PLA  | NETS         |       |       |      | 52 |  |
|     | CITED BY                              | WARBURG O GAN  | EHN  | K GEISSL     | ER AW | KAYS  | ER D |    |  |
|     |                                       |                |      | LORENZ S     |       |       |      |    |  |
| (   | )                                     | KLIN WOCH      | 43   | 289 65       | 18R   | N6    | 6255 | 52 |  |
|     |                                       | EXPERIMENTE    | ZUR  | ANAEROBIOSE  | DER   |       |      |    |  |
|     |                                       | KREBSZELLEN    |      |              |       |       |      |    |  |

ACCT NO 5

FIGURE 8

FOR CATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( ) AND SEE ORDERING INSTRUCTIONS ON BACK OF FORM.