

NASA CONTRACT NASW-2171

Final (Annual) Report

Calendar Year 1971

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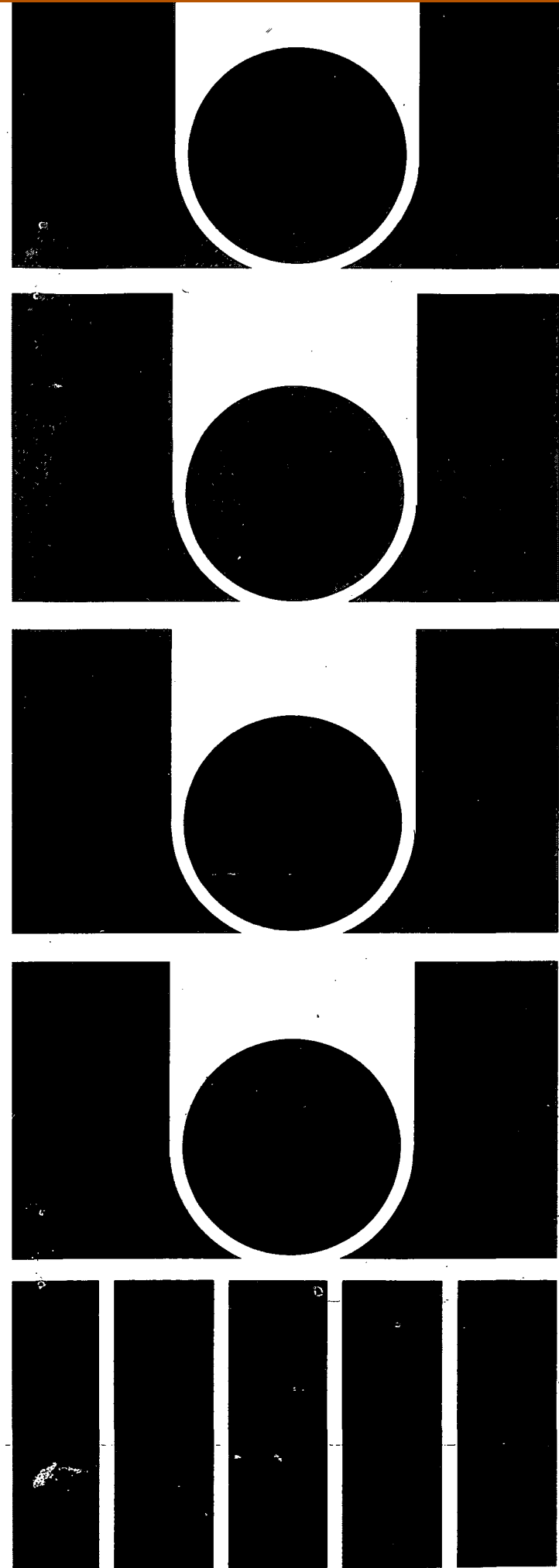
Joseph DiSalvo

Director

January 15, 1972



AEROSPACE RESEARCH APPLICATIONS CENTER



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FINAL (ANNUAL) REPORT

CALENDAR YEAR 1971

NASA CONTRACT NASW-2171

by

Joseph DiSalvo
Director

January 15, 1972

Aerospace Research Applications Center

Indiana University Foundation

Bloomington, Indiana 47401

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This document is the final (annual) report for NASA Contract NASW-2171. The report also includes statistics on ARAC activity for the fourth quarter of 1971. The fourth quarter data are presented in the standardized format using the RDC Statistical Progress Indicator forms. Other fourth quarter information presented in tabular format, in addition to the standardized forms, includes a tabulation of document and other ARAC demand services for each of the various ARAC service elements, a listing of visitors to ARAC which does not include visits by member and prospective member firm people, and a brief listing of recent ARAC promotional activities. The remainder of this report covers significant changes which occurred at ARAC during Calendar Year 1971 and summarizes other annual data.

ARAC DATA

FOURTH QUARTER

CALENDAR YEAR 1971

ARAC DEMAND SERVICES ACTIVITY SUMMARY

| | <u>1st</u> <u>Quarter</u> <u>1971</u> | <u>2nd</u> <u>Quarter</u> <u>1971</u> | <u>3rd</u> <u>Quarter</u> <u>1971</u> | <u>4th</u> <u>Quarter</u> <u>1971</u> |
|--|---|---|---|---|
| Retrospective Search Requests | 74 | 66 | 42 | 31 |
| Computer Information Service Programs | 20 | 14 | 12 | 16 |
| Computer Information Service Documentations | 20 | 30 | 32 | 20 |
| Selective Dissemination Service Documents | 840 | 751 | 431 | 439 |
| Retrospective Search Service Documents | 141 | 55 | 68 | 47 |
| Marketing Information Service Documents | 90 | 82 | 61 | 56 |
| Industrial Applications Service Documents | 712 | 450 | 520 | 509 |
| Other Documents (TSP's, Reports of unknown origin, etc.) | 693 | 501 | 352 | 361 |
| TOTAL DOCUMENTS | 2496 | 1869 | 1476 | 1432 |

ARAC PROMOTIONAL ACTIVITIES*

FOR

FOURTH QUARTER 1971

October, 1971

South Bend Area Firms
Notre Dame, Indiana
Promotional Luncheon

Joseph DiSalvo

Financial Institutions Information Service
New York, New York
Organizational Meeting

Joseph DiSalvo

November, 1971

Annual ARAC Fall Conference
Bloomington, Indiana
See Participant List on Subsequent Pages

ARAC Staff

93 Firms
Midwest
Mail Campaign, RE: Kiplinger Inquiries

Joseph DiSalvo
ARAC Staff

December, 1971

National Association of Manufacturers (Indiana
Members)
Indianapolis, Indiana
Panel Participation

Robert Burdett

Chicago Area Firms
Barrington, Illinois
Promotional Luncheon

Joseph DiSalvo

* Does not include visits to prospective and current clients.

List of Participants
ARAC Fall Conference
November 15 and 16, 1971

Mr. Darrell Lake, Jr.
Products Manager
Incel Corporation
P.O. Box 395
Bluffton, Indiana 46714

Mr. Wake Herriman
ITT Aerospace/Optical
3700 E. Pontiac Street
Mail Station 315
Fort Wayne, Indiana 46803

Mr. John Henry
Owens-Illinois, Inc.
Technical Center
P.O. Box 1035
Toledo, Ohio 43601

Mr. C.P. Gorman
Eli Lilly and Company
740 South Alabama Street
Indianapolis, Indiana 46206

Mr. Charles Redman
Eli Lilly and Company
740 South Alabama Street
Indianapolis, Indiana 46206

Mr. David Burns
Carson Chemical, Inc.
P.O. Box 466
New Castle, Indiana 47362

Mr. Charles W. Woodiwiss
Procter and Gamble Company
Ivorydale Technical Center - Building 104
Cincinnati, Ohio 45217

Miss Jane Rybolt
Research Center
B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141

List of Participants (con't.)

Mr. Donald E. Blanchard
Vice President
Sunbeam Corporation
5400 West Roosevelt Road
Chicago, Illinois 60650

Mr. John Mueller
The Drackett Company
5020 Spring Grove Avenue
Cincinnati, Ohio 45232

Mr. Edmond Howie
Assistant Director
Knowledge Availability Systems Center
University of Pittsburgh
Pittsburgh, Pennsylvania 15213

Dr. D.E. Badertscher, Supervisor
Technical Information Group
Research Department, Paulsboro Lab.
Mobil Research and Development Corporation
Paulsboro, New Jersey 08066

Mr. Rainer Kaiser
Manufacturing Engineer
Mercedes-Benz of North America
158 Linwood Plaza
Fort Lee, New Jersey 07024

Mr. Walker E. Meacham
Superintendent, Engineering Research
Texas Gas Transmission Corporation
P.O. Box 1160
Owensboro, Kentucky 42301

Mr. Robert Hagerman
Texas Gas Transmission Corporation
P.O. Box 1160
Owensboro, Kentucky 42301

Mr. Chuck Mullis
Director, Technical Coordination and Planning
Owens-Illinois
Technical Center
1700 N. Westwood
Toledo, Ohio 43601

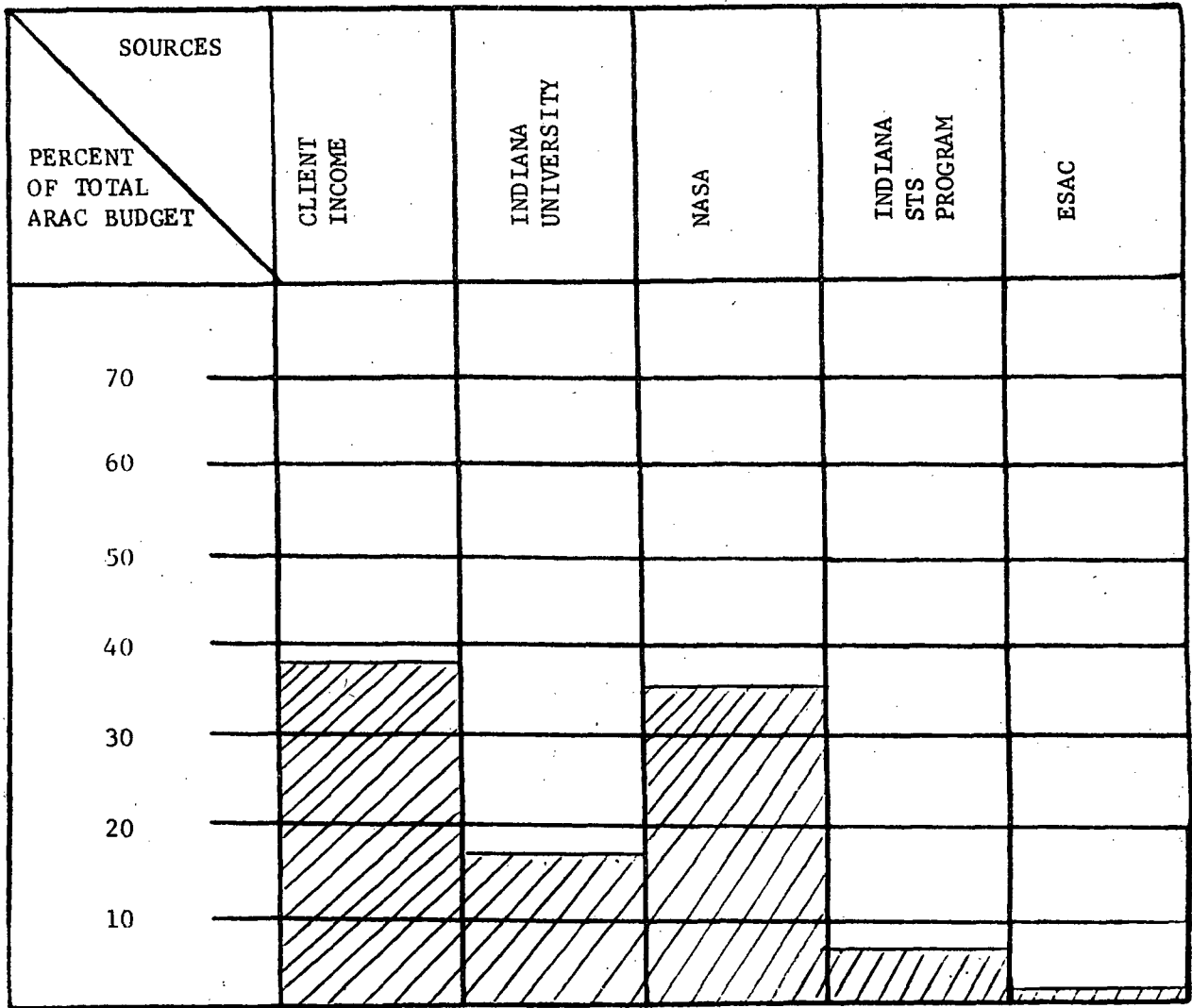
List of Participants (con't.)

Mrs. Elizabeth W. Kraus
Head Librarian
Research Library
Research Labs.
Eastman Kodak Company
Rochester, New York 14650

AEROSPACE RESEARCH APPLICATIONS CENTER
 RDC STATISTICAL PROGRESS INDICATOR FORMS

QUARTER : Fourth 1971

1. ARAC INCOME BY SOURCE



2. ARAC INTERNAL ALLOCATION OF CLIENT INCOME (PERCENTAGES)

| | | | |
|------------------------|----|-------------------------|----|
| COMPUTER OPERATIONS | 12 | MARKETING | 0 |
| ENGINEERING OPERATIONS | 60 | ADMINISTRATION | 16 |
| ACCOUNTING & INVOICING | 12 | NEW PRODUCT DEVELOPMENT | 0 |

AEROSPACE RESEARCH APPLICATIONS CENTER
RDC STATISTICAL PROGRESS INDICATOR FORMS

QUARTER: Fourth 1971

3. MEMBER CLIENTS BY SIC CODE

| | |
|------|----|
| 1311 | 4 |
| 2812 | 1 |
| 2818 | 1 |
| 2819 | 8 |
| 2834 | 1 |
| 2851 | 1 |
| 3069 | 2 |
| 3079 | 3 |
| 3221 | 2 |
| 3291 | 1 |
| 3429 | 1 |
| 3431 | 1 |
| 3442 | 1 |
| 3443 | 1 |
| 3494 | 1 |
| 3499 | 2 |
| 3519 | 1 |
| 3522 | 1 |
| 3531 | 2 |
| 3541 | 1 |
| 3542 | 1 |
| 3548 | 1 |
| 3561 | 3 |
| 3564 | 1 |
| 3573 | 1 |
| 3611 | 3 |
| 3621 | 1 |
| 3622 | 3 |
| 3662 | 1 |
| 3674 | 3 |
| 3679 | 7 |
| 3714 | 6 |
| 3742 | 1 |
| 3821 | 2 |
| 3822 | 1 |
| 3861 | 3 |
| 4811 | 2 |
| 4911 | 2 |
| 4923 | 1 |
| 5092 | 3 |
| 5096 | 2 |
| 7391 | 2 |
| 8911 | 3 |
| N/A | 10 |

TOTAL 99

4. AD HOC USERS BY SIC CODE

| | |
|------|----|
| 1311 | 1 |
| 2812 | |
| 2818 | |
| 2819 | 3 |
| 2834 | |
| 2851 | |
| 3069 | |
| 3079 | |
| 3221 | |
| 3291 | 1 |
| 3429 | |
| 3431 | |
| 3442 | 1 |
| 3443 | |
| 3494 | |
| 3499 | 1 |
| 3519 | |
| 3522 | |
| 3531 | 2 |
| 3541 | |
| 3542 | |
| 3548 | 1 |
| 3561 | |
| 3564 | 1 |
| 3573 | 1 |
| 3611 | |
| 3621 | 6 |
| 3622 | |
| 3662 | |
| 3674 | |
| 3679 | 2 |
| 3714 | 3 |
| 3742 | |
| 3821 | 2 |
| 3822 | 1 |
| 3861 | |
| 4811 | 2 |
| 4911 | |
| 4923 | |
| 5092 | |
| 5096 | |
| 7391 | |
| 8911 | |
| N/A | 10 |

TOTAL 38

AEROSPACE RESEARCH APPLICATIONS CENTER
RDC STATISTICAL PROGRESS INDICATOR FORMS

QUARTER: Fourth 1971

5. ARAC CLIENT COMPOSITION--ANNUAL AND AD HOC USERS

| SIZE* | NO. COMPANIES |
|-------|---------------|
| LARGE | 104 |
| SMALL | 33 |
| TOTAL | 137 |

*Dividing point is 500 employees.

6. ARAC MARKETING APPROACHES (PROSPECTIVE USERS)

| TYPE APPROACH | OCCURRENCES |
|------------------------------------|-------------|
| DIRECT MAIL | 293 |
| PERSONAL PRESENTATIONS | 0 |
| GROUP PRESENTATIONS | 2 |
| PROFESSIONAL MEETING PRESENTATIONS | 0 |
| ADVERTISEMENTS | 1 |
| TELEPHONE | 63 |
| ARTICLES, T.V. INTERVIEWS, ETC. | 1 |

7. MARKET & SERVICE CONTACTS (PRESENT CLIENTS)

| TYPE OF CONTACT | ARAC TECHNICAL STAFF | ARAC MARKETING STAFF |
|-----------------|----------------------|----------------------|
| MAIL | 39 | 12 |
| TELEPHONE | 57 | 29 |
| VISIT | 2 | 6 |

AEROSPACE RESEARCH APPLICATIONS CENTER

RDC STATISTICAL PROGRESS INDICATOR FORMS

QUARTER: Fourth 1971

8. HARD COPY & MICROFICHE ISSUED BY STAR/IAA CATEGORY

| CATEGORY | CATEGORY TITLE | HC | MF | TOTALS |
|----------|--------------------------------------|------|-----|--------|
| 01 | Aerodynamics | 12 | 4 | 16 |
| 02 | Aircraft | 28 | 2 | 30 |
| 03 | Auxiliary Systems | 59 | 7 | 66 |
| 04 | Biosciences | 17 | 4 | 21 |
| 05 | Biotechnology | 44 | 2 | 46 |
| 06 | Chemistry | 46 | 2 | 48 |
| 07 | Communications | 27 | 3 | 30 |
| 08 | Computers | 57 | 6 | 63 |
| 09 | Electronic Equipment | 36 | 3 | 39 |
| 10 | Electronics | 27 | 6 | 33 |
| 11 | Facilities, Research and Support | 26 | 4 | 30 |
| 12 | Fluid Mechanics | 28 | 4 | 32 |
| 13 | Geophysics | 25 | 2 | 27 |
| 14 | Instrumentation and Photography | 92 | 8 | 100 |
| 15 | Machine Elements and Processes | 171 | 8 | 179 |
| 16 | Masers | 36 | 6 | 42 |
| 17 | Materials, Metallic | 134 | 7 | 141 |
| 18 | Materials, Nonmetallic | 86 | 8 | 94 |
| 19 | Mathematics | 51 | 4 | 55 |
| 20 | Meteorology | 10 | 3 | 13 |
| 21 | Navigation | 15 | 5 | 20 |
| 22 | Nuclear Engineering | 22 | 7 | 29 |
| 23 | Physics, General | 21 | 4 | 25 |
| 24 | Physics, Atomic, Molecular & Nuclear | 11 | 2 | 13 |
| 25 | Physics, Plasma | 7 | 3 | 10 |
| 26 | Physics, Solid-State | 55 | 12 | 67 |
| 27 | Propellants | 11 | 4 | 15 |
| 28 | Propulsion Systems | 11 | 3 | 14 |
| 29 | Space Radiation | 5 | 3 | 8 |
| 30 | Space Sciences | 12 | 2 | 14 |
| 31 | Space Vehicles | 3 | 1 | 4 |
| 32 | Structural Mechanics | 52 | 9 | 61 |
| 33 | Thermodynamics and Combustion | 8 | 3 | 11 |
| 34 | General | 32 | 4 | 36 |
| | TOTALS | 1277 | 155 | 1432 |

AEROSPACE RESEARCH APPLICATIONS CENTER
RDC STATISTICAL PROGRESS INDICATOR FORMS

QUARTER: Fourth 1971

9. SUMMARY OF NOTIFICATIONS AND DOCUMENTS DISSEMINATED

| TOTAL NOTIFICATIONS ANNOUNCED* (Includes Tech Briefs, Abstracts, & ARAC-written Summaries) | REPORTS DISSEMINATED (Includes H.C. & M.F. Documents, TSP'S, Reprints, & Articles) |
|--|--|
| 123,000 | 1432 |

*Rounded off to nearest thousand.

SUMMARY OF ARAC OPERATIONS

CALENDAR YEAR 1971

Mix of ARAC Services

The relative proportion of client income generated by the various ARAC service elements continues to remain approximately the same as in previous years. Standard Interest Profiles, Retrospective Searches, Documents and Reprints, and Special Survey (especially in the environmental area) accounted for the majority of ARAC client income in 1971. The complete breakdown is given below.

ARAC Sources of Client Income

Calendar Year 1971

| <u>ARAC Service Element</u> | <u>Percent of Income*</u> |
|---|---------------------------|
| Membership Fee | 5.0 % |
| Weekly Industrial Applications Service | 4.5 % |
| Custom Current Awareness Service | 8.0 % |
| Retrospective Searches | 14.0 % |
| Standard Interest Profiles | 21.0 % |
| Monthly Computer Information Service | 2.5 % |
| Monthly Marketing Information Service | 1.5 % |
| Monthly Management Announcement Service | 1.0 % |
| Documents, Reports, Reprints, Programs | 23.0 % |
| Special Services and Surveys | 19.5 % |

*Rounded to nearest 0.5 %.

COMPOSITE ARAC CLIENT HISTORY

| | <u>1963</u> | <u>1964</u> | <u>1965</u> | <u>1966</u> | <u>1967</u> | <u>1968</u> | <u>1969</u> | <u>1970</u> | <u>1971</u> |
|---------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Client Companies at Beginning of Year | 0 | 29 | 33 | 44 | 48 | 67 | 73 | 109 | 114 |
| New Clients Added | 29 | 7 | 13 | 11 | 22 | 16 | 38 | 17 | 24 |
| Memberships Terminated | 0 | 3 | 2 | 7 | 3 | 10 | 2 | 12 | 12 |
| Member Clients at Year's End | 29 | 33 | 44 | 48 | 67 | 73 | 109 | 114 | 126 |
| Net Gain in Clients | 29 | 4 | 11 | 4 | 19 | 6 | 34 | 5 | 12 |
| Percent of Clients Renewed | N/A | 90% | 94% | 68% | 94% | 85% | 97% | 89% | 90% |

Staffing & Activity Levels

Basically the ARAC operation consists of five different departments. These are Technical Operations, Computer Operations, Production, Marketing, and Accounting. The size of the staff in each department remained approximately constant during 1971 except for Marketing. The marketing staff was cut during 1971, and at the present time consists of only a portion of time for two persons. In spite of this necessary reduction in marketing activity and the economic conditions which prevailed in 1971, ARAC was able to manage a small increase (5%) in client income over the previous calendar year.

One of the reasons for this gain must be attributed to the push in marketing and promotional activity that was made in the latter stages of 1970. Experience indicates that a lag time of approximately six to nine months exists between expenditure of promotional efforts and realization of increased activity. Unfortunately, this probably means that the scaling down of ARAC marketing activity during 1971 will probably show its greatest effects during 1972.

The lack of manpower in the ARAC Marketing Department during 1971 led to a severe shift in the type of marketing approaches used. Individual personal calls on prospective clients were employed only when a relatively strong interest in the use of ARAC services was expressed. The major marketing thrust consisted of use of highly selected lists for mail campaigns followed up by thorough and extensive telephone contact. The lower expense involved in using mail and telephone techniques is offset by the lower percentage of sales closures making the two methods approximately

equal in effectiveness on a cost/benefit basis.

In many instances the quantitative indicators of ARAC activity were lower for 1971 than for 1970. However the revenue level remained approximately the same. The principal explanation for this phenomenon is the wide-spread subscriptions to special survey and monographs. Most of the special surveys done by ARAC during 1971 related to some aspect of the environment. It appears that generation of client income via sales of special survey and monographs will continue to be an important revenue generator for ARAC during 1972.

ARAC Fee Schedule Revision

Arriving at a fair price to ARAC clients for subscription to custom current awareness profiles has remained a thorny issue with ARAC since the time this service was initiated. The internal costs to ARAC for provision of this service are most sensitive to two separate factors. These are (1) the number of items selected by the profile strategy, and (2) the number of different information resources which were consulted (searched) in order to maintain the profile. It would certainly be possible to ascertain an accurate and fair price for any custom profile once it is on-line at ARAC for several months. However potential ARAC clients generally insist on a firm estimate for the profile prior to making the decision about subscribing to the service.

In December of 1971, a decision was made at ARAC to expand the portion of the ARAC fee schedule which delineates the cost for custom current awareness service. It is anticipated that the new pricing philosophy will be put into effect in February of 1972. The new pricing philosophy has the disadvantage that the cost for custom profiles is reached only by consideration of the number of information resources consulted and omits any consideration of volume of material. However the expanded fee schedule has the distinct advantage in that a prospective client may ascertain immediately and in advance the exact cost for a custom profile. A similar situation had also existed for years regarding the ARAC Retrospective Search Service. An expanded fee schedule was also devised in order to rectify this dilemma and likewise will be implemented in February 1972. The expanded fee schedules referred to above are exhibited on the following pages.

ARAC CUSTOM CURRENT AWARENESS SERVICE FEE SCHEDULE

| <u>Information Resource</u> | <u>Single Resource Fee</u> | <u>Multiple Resource Fee (Sum-up for Price)</u> |
|--|----------------------------|---|
| NASA (Scientific and Technical Aerospace Reports (STAR) and International Aerospace Abstracts (IAA)) | \$195 | \$150 |
| GRA (Government Reports Announcements (GRA) (formerly USCRDR) (Unclassified DoD material)) | 195 | 150 |
| AEC (Nuclear Science Abstracts (NSA)) | 195 | 150 |
| Engineering Index COMPENDEX | 150 | 125 |
| Pollution Abstracts | N/A | 75 |
| Air Pollution Abstracts | N/A | 100 |
| Selected Water Resources Abstracts | N/A | 100 |
| Food Science and Technology Abstracts | 195 | 150 |
| Chemical Abstracts CONDENSATES (Abstracts not available from this resource) | | |
| Alternate Issues (Paper) | 95 | 95 |
| Alternate Issues (Cards) | 120 | 120 |
| All Issues (Paper) | 155 | 155 |
| All Issues (Cards) | 195 | 195 |

ARAC MEMBER* COMPANY CUSTOM RETROSPECTIVE SEARCH FEE SCHEDULE

| <u>Information Resource</u> | <u>Single Resource Fee</u> | <u>Multiple Resource Fee (Sum-up for Price)</u> |
|--|----------------------------|---|
| NASA (Scientific and Technical Aerospace Reports (STAR) from 1962) and (International Aerospace Abstracts (IAA) from 1963) | \$ 75 | \$50 |
| GRA (Government Reports Announcements (GRA) (formerly USGRDR) from 1964 - unclassified DoD material) | 65 | 40 |
| NASA TECH BRIEFS (from 1963) | 25 | 15 |
| AEC (Nuclear Science Abstracts (NSA) from 1947) | 100 | 75 |
| Engineering Index COMPENDEX (from 1970) | 100 | 75 |
| Engineering Index CITE (covers Plastics and Electrical/ Electronics Sections only for years of 1968 and 1969) | 75 | 50 |
| Pollution Abstracts (from 1970) | 75 | 50 |
| Air Pollution Abstracts (from 1971) | 75 | 50 |
| Selected Water Resources Abstracts (from 1969) | 100 | 75 |
| ITT Textile File (from 1966) | 75 | 50 |
| Applied Science and Technology Index (from 1960) (Abstracts not available from this resource) | 50 | 25 |
| Chemical Abstracts CONDENSATES (from vol. 69-July 1968) (Abstracts not available from this resource) | 50 plus 5/sec.-vol. | 40 plus 5/sec.-vol. |
| Legal and Special Searches | \$15/eng. hr. | \$15/eng. hr. |

*Users not paying the annual service charge will be charged 20% over prices listed above.

Revised ARAC Standard Interest Profile Offerings

Since January of 1970, ARAC has offered some 130 different and separate Standard Interest Profiles (SIP). A SIP is a form of current awareness service where the ARAC staff defines a technical area which hopefully should be of interest to several users. As updates to the various information resources are received at ARAC, the items relevant to the subject matter of the SIP are selected from the update and then put together as a SIP and sent to any client who may care to subscribe to the topical interest area.

The selling price for a SIP has been established such that the break-even point occurs when seven or eight (depending on whether the ARAC client pays for the SIP at member or non-member rates) subscriptions to a particular SIP are entered. Since the 130 SIPs had been available for two years as of December 31, 1971, it seemed that at least a fair market test had been given and that it was time for a critical review. It was decided for review purposes that any SIP which had at least five subscribers (including those paid at non-member rates, member rates, and those that were on distribution for a free trial evaluation of three months) would probably eventually reach the break-even number of subscriptions required. Those SIPs which had fewer than five subscribers would probably not reach a point of self-sufficiency in the near future. In subjecting the 130 SIPs to this criteria, it was found that 38 SIPs did not have the imposed number of subscribers. Accordingly 37 SIPs will be eliminated as the subscription renewal dates for these SIPs occur. ARAC clients who were subscribing to these SIPs will

be afforded the opportunity to continue receiving coverage of the SIP topical area by starting a custom interest profile. One of the SIPs which did not meet the criteria was combined with another SIP leaving a total of 92 SIPs which are still available. The list of ARAC SIPs still on line may be found on the following pages.

1972 STANDARD INTEREST PROFILES

BY SUBJECT CATEGORY

Chemical Engineering and Chemistry

SIP-02 Crystal Growth
SIP-15 Fluid Flow
SIP-16 Fuels and Combustion for Air Breathing Engines
SIP-17 Air and Water Pollution
SIP-18 Analytical Chemistry
SIP-68 Heat Transfer
SIP-112 Liquid Fuels
SIP-117 Air Pollution, Smoke Abatement, and Dust Control
SIP-125 Water Treatment and Distribution
SIP-153 Chemical Process Engineering
SIP-161 Sanitary Engineering and Waste Disposal
SIP-167 Boilers, Pressure Vessels, and Heat Transfer Equipment
SIP-187 Paper, Pulp, and Cellulose Products
SIP-195 Fluid Flow

Computer & Information Sciences

SIP-23 Fluidics - Included with SIP-15
SIP-27 Logic Circuits
SIP-29 Photography
SIP-46 Information Science
SIP-127 Logic Circuits

Earth Sciences

SIP-17 Air and Water Pollution
SIP-73 Geophysics, Geology and Oceanography
SIP-118 Petroleum Exploration and Production
SIP-144 Water Resources and Pollution Control

Electronics & Electrical Engineering

SIP-10 Non-Destructive Testing
SIP-27 Logic Circuits
SIP-30 Display Systems
SIP-31 Data Transmission
SIP-33 Recording Systems
SIP-34 Semiconductor Devices and Microcircuit Fabrication
SIP-35 Microwave Systems

Electronics & Electrical Engineering - con't.

| | |
|---------|--|
| SIP-36 | Radio Antennas, Transmission, and Propagation |
| SIP-37 | Radio Communications Equipment |
| SIP-38 | Reliability |
| SIP-49 | Control Systems Analysis |
| SIP-69 | Dielectric Materials and Electrical Insulation |
| SIP-70 | Holography |
| SIP-110 | Non-Destructive Testing |
| SIP-127 | Logic Circuits |
| SIP-130 | Display Systems |
| SIP-134 | Semiconductor Devices and Microcircuit Fabrication |
| SIP-149 | Control Systems Analysis |
| SIP-151 | Solders, Soldering and Electronic Assembly |
| SIP-169 | Dielectric Materials and Electrical Insulation |
| SIP-191 | Electrical Power Transmission |

Energy Sources

| | |
|---------|-----------------------------|
| SIP-60 | Space-Age Energy Sources |
| SIP-192 | Internal Combustion Engines |

Life Sciences

| | |
|---------|---|
| SIP-43 | Biomedical Technology |
| SIP-44 | Radiobiology |
| SIP-77 | Neurochemistry and Biochemistry |
| SIP-143 | Biomedical Technology |
| SIP-161 | Sanitary Engineering and Waste Disposal |

Management

| | |
|---------|--|
| SIP-38 | Reliability |
| SIP-39 | Operations Research |
| SIP-41 | Personnel Management and Behavioral Science |
| SIP-59 | Industrial Safety, Fire Protection, and Radiation Protection |
| SIP-63 | Industrial Mathematics |
| SIP-138 | Reliability and Quality Control |
| SIP-139 | Operations Research |
| SIP-159 | Industrial Safety and Fire Protection |
| SIP-176 | Materials Handling and Storage |

Materials

| | |
|--------|---------------------|
| SIP-02 | Crystal Growth |
| SIP-03 | Carbon and Graphite |
| SIP-04 | Physical Metallurgy |
| SIP-05 | Powder Metallurgy |

Materials - con't.

SIP-06 High Temperature Materials
SIP-07 Materials Joining Technology
SIP-08 Material Forming and Machining
SIP-09 Microanalysis and Properties of Engineering Materials
SIP-10 Non-Destructive Testing
SIP-11 Corrosion and Protective Coatings
SIP-19 Reinforced Plastics and Composite Materials
SIP-47 Glass and Ceramics
SIP-108 Material Forming and Machining
SIP-110 Non-Destructive Testing
SIP-147 Glass and Ceramics
SIP-187 Paper, Pulp, and Cellulose Products
SIP-198 Welding and Cutting of Metals

Mechanical Engineering

SIP-07 Materials Joining Technology
SIP-08 Material Forming and Machining
SIP-09 Microanalysis and Properties of Engineering Materials
SIP-10 Non-Destructive Testing
SIP-13 Bearings and Lubrication
SIP-15 Fluid Flow
SIP-16 Fuels and Combustion for Air Breathing Engines
SIP-23 Fluidics - Included with SIP-15
SIP-45 Turbine Technology
SIP-49 Control Systems Analysis
SIP-68 Heat Transfer
SIP-75 Structural Analysis and Design
SIP-108 Material Forming and Machining
SIP-110 Non-Destructive Testing
SIP-112 Liquid Fuels
SIP-113 Bearings and Lubrication
SIP-149 Control Systems Analysis
SIP-167 Boilers, Pressure Vessels, and Heat Transfer Equipment
SIP-176 Materials Handling and Storage
SIP-192 Internal Combustion Engines
SIP-195 Fluid Flow
SIP-198 Welding and Cutting of Metals

Physics

SIP-21 Temperature Measurement
SIP-22 Vacuum Technology
SIP-23 Fluidics - Included with SIP-15
SIP-24 Laser Applications
SIP-25 Laser Research
SIP-28 Infrared Instrumentation

Physics - con't.

SIP-29 Photography
SIP-52 Sensory Devices for Instrumentation
SIP-63 Industrial Mathematics
SIP-70 Holography
SIP-148 Optics
SIP-152 Sensory Devices for Instrumentation
SIP-194 Measurement and Measuring Instruments

Polymers and Plastics

SIP-19 Reinforced Plastics and Composite Materials
SIP-20 Polymer Technology
SIP-115 Paints and Coatings
SIP-116 High Temperature Polymers
SIP-120 Fire Resistant Polymers
SIP-178 Polyvinyl Chloride
SIP-179 Film and Adhesives for Packaging
SIP-180 Polyolefins
SIP-181 Plastics Molding
SIP-182 Adhesives
SIP-183 Foamed Polymers
SIP-184 Reinforced Plastics and Composite Materials
SIP-189 Epoxy Polymers