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NOTE

This last annual report, covering FY73, ACME's administrative extension year, was prepared at this time (May 1973) because staff was available to do the work and because NIH requested that the report be made.

An addendum to this last annual report will be prepared sixty to ninety days after the end of the grant period (July 31, 1973).

NATIONAL INSTITUTES OF HEALTH

DIVISION OF RESEARCH RESOURCES

BIOTECHNOLOGY RESOURCES BRANCH

RESOURCE IDENTIFICATION

Report Period: From: August 1, 1972 To: July 31, 1973	Grant No. RR - 311 - 06S1 Date of Report Preparation: May 1973

Name of Resource	Resource Address	Resource Telephone No.
Advanced Computer for Medical Research (ACME)	Stanford University School of Medicine Stanford, California 94305	(415) 321-1200 Ext. 6121
Principal Investigator	**Title**	**Academic Department**
Lederberg, Joshua	Professor	Genetics
Grantee Institution	**Type of Institution**	**Investigator's Telephone No.**
Stanford University	Private Non-Profit University	(415) 321-1200 Ext. 5801

Name of Institution's Biotechnology Resource Advisory Committee:

ACME Policy Committee

Membership of Biotechnology Resource Advisory Committee:

Name	Title	Department	Institution
*Elliott Levinthal	Assoc. Dean for Research	Genetics	SU Med School
Stanley Cohen	Associate Professor	Clin. Pharmacology	"
Joseph DeGrazia	Assistant Professor	Nuclear Medicine	"
Donald Harrison	Professor	Cardiology	"
Sumner Kalman	Professor	Pharmacology	"
Howard Sussman	Assistant Professor	Pathology	"

Name and Title of Principal Investigator:	Signature	Date
Joshua Lederberg, Prof. of Genetics		
Name and Title of Grantee Institution Official	**Signature**	**Date**

I. SUMMARY

A. Brief Evaluation.

The ACME facility is now approaching the end of a six-year grant plus a one-year administrative extension. The ACME experiment has proven highly successful as demonstrated by the following points:

1. Teachability:

Medical researchers have been taught to do their own programming for non-trivial tasks. More than 1700 persons on the Stanford medical scene have been trained in the use of computers.

2. Strong Educational Tool:

This facet of ACME encourages many persons to become involved in computing.

3. Data Acquisition:

The ACME system combines moderate rate data acquisition service with timesharing. A relatively sophisticated group of realtime data acquisition users has been developed.

4. User Community:

More than 210 user projects, exclusive of ACME staff, are current users of the system. They enter the system from 55 terminals spread throughout the Medical Center.

5. Programming Effort:

The ACME disk packs and tapes hold programs representing over 250 man years of programming effort.

6. Publications:

A list of recent publications by ACME users and an index of ACME Notes prepared by ACME staff are presented in Section VIII.

7. Dedicated Systems:

Several groups are now using dedicated computer systems which reflect an outgrowth of pilot projects performed on the ACME facility. We observe a propensity of large or clinical projects to become autonomous from large central facilities.

The ACME experiment was initiated nearly seven years ago to provide a timesharing system on an IBM 360 hardware system concurrent with some realtime data handling. Applying hindsight to the choices made we can now see that our successes noted above are mitigated by some trends which were not predicted by us in 1965. Specifically, technological and price/performance changes have occurred since 1965 which make mini-computing systems dedicated to specific tasks much more competitive with centralized resources than was true in 1965. Based upon our experiences, we at Stanford Medical Center are moving to establish an improved large central computing system while, at the same time, the number of dedicated mini-systems is steadily increasing. In other words, the clear advantages of a large central system for certain applications are offset by other goals in a number of realtime and control situations where dedicated mini-systems offer the only realistic solution.

Some of the more significant changes over the past seven years have included the following:

(1) Both logic and, somewhat later, main memory units have dropped in cost by 1 to 2 orders of magnitude for devices of roughly equal performance.

(2) Disk systems have increased in capacity, speed of access, and reliability while costs have dropped markedly. The figures below demonstrate this trend.

Hardware Devices	Speed	Capacity	MByte/Month
1. Core or semiconductor	200×10^{-9}	8MB	$5,000
2. Fixed Head	2 to 5×10^{-3}	22MB	$500-1,000
3. Moving Head	26 to 30×10^{-3}	800MB	< $10

DISK PERFORMANCE DATA FOR IBM HARDWARE*

Item	1956	1966	1970	1973	Est. 1977-80
1. Capacity	5	233	800	800+	3 x 800
2. Bits/Inch	100	2200	4040	5600	4 x 5600
3. Tracks/Inch	20	100	192	300	600 to 900
4. RPM	1200	2400	3600	3000	
5. Data Rate	9.7KB	312	806	885	4 to 10 x 885
6. Disk Coating in micro inches	1000	100	50	50	
7. Flying Height in micro inches	1200	100	50	50	
8. Gap Width	1000	100	50	50	

* Data received in IBM presentation in San Jose, California held in May, 1973.

(3) The prices for mini-computers have dropped an order of magnitude while capability and level of software support have increased significantly. Also, the variety and flexibility of adding various peripherial devices has risen sharply.

(4) Communications terminals and supporting equipment has improved in terms of speed and reliability.

(5) The user community has grown in numbers and level of sophistication. It also demands increased availability and reliability. Response times must now be measured in fractions of seconds rather than seconds which imposes high overhead costs on large time shared systems.

In 1965 a handful of computer users existed in the Medical Center. Today, there are more than 200 active research projects on the ACME system plus about 25 mini-systems in laboratories. Computers have become accepted for production use in many applications.

The first year and a half of the ACME grant was spent assembling staff and hardware and developing the PL/ACME system. The result was one of the first timesharing systems with concurrent realtime support. The system we mounted is remarkedly easy to learn and use. Since the system has not been exported, we assume that a shift back to the mainstream of software systems as provided by vendors will become necessary. The relative cost of people versus hardware has grown to a point where " home brew" systems cannot be afforded over the long term. This situation is regretted since many of the newly announced systems fail to deliver to the end-user the convenience and power of our existing system. At Stanford, the conversion to vendor-supplied systems might be expected to occur in three or four years.

The series of developments in mini-systems has relieved some burdens but created new needs for small machine support from a central system. Stanford expects to expand upon the currently available intercommunication systems. Since mini-systems are frequently being used as data collection controllers, the development of shared data base systems on the central machine requires inter-machine communication capability.

We have offered graphics services on the ACME system over the past five years. There are now six graphics CRT's plus five hard copy plotters attached to the ACME system. The growth in graphics usage has been slower than one might have expected. We suspect that this reflects a lack of description tools, the relatively high cost of graphics terminals, plus the high cost of running graphics software. Perhaps, the growth spurt will come in a few years after the costs are dropped another factor of 5 or so, and description tools are improved.

Our dependency upon NIH in establishing a user community and developing a financial base with which to support computing services warrants special mention. It is clear to me that the venture capital to establish a system, train users, and form a critical mass of support could not have been raised by incremental growth through charges to individual research grants. A central facility development grant, such as ACME grant, is the only available counterpart to venture capital in a cash-accounted grants system. This investment has now paid off: We have a common language in use by nearly every department in the Medical School, a cadre of trained programmers, and a strong momentum in the direction of shared data bases and shared programs. Some continuing incremental development effort will be needed to prevent atrophy.

The passage of time has brought about needs for realtime support systems which exceed the capabilities of our local ACME system by one or two orders of magnitude. Rather than attempt to build realtime systems which IBM hardware has not been designed to perform, we prefer to rely on alternative systems specifically designed for this use and build improved communications into the central site. Further efforts will therefore constitute another generation of system planning, based on vendor-furnished modules.

We have all heard of TSS, TSC, TORTOS, CPS, CMS, and other time-sharing systems built on IBM hardware systems. It is a credit to the small staff which built PL/ACME that their system can compare so favorably with the other systems which have clearly had far more effort spent on development. The use of PL/ACME as a research tool by so many local groups is a tribute to the system designers and implementers. Gio Wiederhold deserves special credit as the principal creator of the system. He would also be the first to point out some of the design features that might have been improved with the benefit of hindsight. The lists of publications and technical notes appended to this report attest to the productivity of the ACME Facility staff and to the effectiveness of the tools provided to the user community.

J. Lederberg

B. Highlights of FY73.

1. Planning for the Future.

During the past twelve months the ACME computing facility has passed through an identity and existence crisis. The sizeable effort expended by faculty, Hospital staff, and ACME facility staff has led to a decision to maintain the PL/ACME system on new hardware. The computer services for Hospital administration and ACME time sharing and realtime data acquisition services are being merged onto a new facility to be installed in August 1973. Numerous studies and presentations have been required to bring about the decisions which make this possible. This subject is discussed in detail in Part C of this section and in Section II.

2. A Generalized Time Oriented Database System.

Special attention should be focused on the transition which has begun to occur at Stanford with respect to faculty attitude toward the need for sharing of data. The awareness of shared database concepts has increased markedly. Evidence of this can be seen in the teamwork demonstrated in preparation of a health care resources research proposal. Other evidence can be seen in the attendance at seminars concerning the Time Oriented Database system (TOD), developed this year by the ACME staff in conjunction with Dr. James Fries of the Division of Immunology. For more on this subject, see Section V.

3. Software.

System programming development activities during the year resulted in new data compression routines, file system improvements, mounting the COBOL compiler, studies and planning concerning the new VS2 system announced by IBM, support for the small machine multiplexor, and a PDP-11 simulator.

4. Hardware.

The small machine multiplexor was completed, allowing for inter-machine communications. Other hardware projects included work on terminal lightboxes and several new interfaces for users of the 1800 and the multiplexor. ACME acquired several 300 and 1200 baud terminals during the year. In April 1972, we installed a Memorex terminal controller which has performed very well.

5. Core Research.

Support of core research and development effort included programming and computer service support for the DENDRAL project, assistance for the Drug Interaction project, direct support of the initial application of the Time Oriented Data (TOD) system, extension of small machine support to GC/MS activity, a joint development effort on communication hardware development, and a core project to develop new statistical analysis techniques.

6. Utilization.

Utilization of the ACME system in terms of terminal hours has remained relatively constant during the past year. One exception to this is the Drug Interaction project in the Pharmacy which used ACME extensively through February 1973, after which time the system was moved to a dedicated dual mini-computer system.

Since the follow-on to the ACME system was not resolved until March 1973, the rate of new user signups has dropped from normal levels and there have been essentially no new realtime users of the system. This is most understandable since many users felt that ACME might not survive beyond the end of the grant period. It is noteworthy that the user community has continued to use the system in the absence of (prior to March 1973) any Medical Center commitment to retain the PL/ACME system beyond July. Now that such assurance has been made, new users are again expressing interest, evidenced by the number of signups for the introductory classes in use of PL/ACME.

7. Minicomputers.

Other computing activity in the Medical Center includes the acquisition of several minicomputer systems for various research and production projects. Approximately thirty minicomputer systems are currently used within the Medical Center. Some of the applications include data acquisition for mass spectrometers, operation of the Drug Interaction programs, an information system for the Clinical Laboratories, and research support in Nuclear Medicine, Chemistry, Psychiatry, Cardiovascular Surgery, Cardiology, and other divisions and departments. The growth and number of minicomputer systems used for instrumentation control and data collection have pushed the central facility to provide small machine communications and other support activities.

8. Documentation & Conversion.

Throughout Fiscal 73, the staff has spent a great deal of time on documentation of the existing ACME system. Since the decision to move to a merged/158 facility, the conversion effort has been of central importance.

C. Planning and Reorganization.

1. Stanford Center for Information Processing (SCIP).

In the past Stanford operated five major service computing organizations, each of which had its own loyalties to a specific user community. The five were:

Stanford Linear Accelerator Center
University Administrative Computing Facility
Campus Facility
ACME Facility
Hospital Data Processing Facility

Computing at Stanford University was reorganized during the spring of 1973. The new organization, entitled "Stanford Center for Information Processing (SCIP)", provides a unified structure for the five facilities mentioned above. ACME and the Hospital Data Processing Facility will be combined to form the Medical Center Computing Service (MCCS). The heads of all the facilities will report to the director of SCIP. Along with the reorganization of staff involved in managing the various computer facilities, the policy committee structure comprised of faculty members is currently being modified.

2. The Medical Center Planning Effort.

A description of the computer planning activity at the Stanford Medical Center over the past eighteen months would fill many volumes. Several different faculty committees and staff groups have reviewed alternatives ranging from highly distributed interconnected minicomputer systems to highly centralized large computing systems. The issues faced by the various groups were:

1. Should PL/ACME service be continued?
2. Can the ACME users provide a critical mass of dollars required for a stand-alone facility.
3. If a merger is required, who should be the parties to the merger?
4. Are the potential advantages of a shared database between Hospital and Medical School strong enough to outweigh the disadvantages of merging a production system with a research support system?
5. Should realtime computing services continue to be provided from a central computing source?
6. How should computing at Stanford University and the Medical Center in particular be organized?
7. What computing services will be needed over the next several years?
8. How can we relate Medical Center computing planning to broad University goals?

3. The 370/158.

These are among the many issues which have been considered during the past year and a half. The solution selected entails the installation of an IBM 370/158 hardware system using IBM's newly announced VS2 software system. The services to be offered will include batch services in several languages, time-sharing using PL/ACME, realtime data acquisition services using the existing 1800 system, normal consulting and user services, and small machine communications.

The current schedule calls for removal of the 360/50 system from Stanford on July 28, 1973. A number of peripherals will be moved to the new 370/158 site where systems programmers will have approximately 2-1/2 to 4 weeks to bring up the new system. We expect to resume PL/ACME services for terminal users by September 1, 1973; realtime services will hopefully be available approximately one month later.

Funding for use of computers within the Stanford Medical Center is expected to drop over the next eighteen months due to cuts in federal budgets as well as escalation of costs within fixed budgets. A tight dollar economy coupled with multiple options for the users (e.g. outside time sharing service, Campus computing facility, more powerful dedicated mini systems) will force the new Medical Center Computing Service to perform very well to attract the business of the Medical Center commuity.

4. The SUMEX Proposal.

A proposal has been submitted by Dr. Lederberg calling for the formation of a Stanford University Medical Experimental Computing Facility (SUMEX). If approved, this proposal would result in the acquisition of a PDP-10 to support a national facility specializing in tools for the development of artificial intelligence in medicine (AIM). The ACME experience has been invaluable in demonstrating both the opportunities and the problems of community-shared resources. In particular it has given us the technical expertise needed to design realistic specialized instruments to serve geographically dispersed but intellectually convergent users.

D. <u>Overview of ACME Experiment.</u>

The ACME experience indicates that a large central resource can provide a very valuable service for users requiring text editing, numeric calculations, statistical analyses, and realtime data acquisition at relatively low rates. Our experience has also demonstrated that a large central facility should not undertake high data rate realtime data acquisition and closed loop control functions if it intends to service a large number of time sharing users concurrently. In addition we have learned that an extensive amount of "handholding" is needed to serve the research scientists in a medical community. This may change in the future when MD's will routinely receive more training in computer science in the course of their college educations.

ACME's initial proposal included the following paragraph concerning hardware selection and resource allocation:

> "The IBM/360-50 has been selected for the initial realization of ACME (1) as a machine technically appropriate to the immediate tasks in mind and (2) for its system compatibility with the 360-67 already selected for the eventual replacement of the 7090 by the Stanford Computation Center. The 360-50 will be installed in ACME May 1966 and will run on three shifts under Operating System/360, subject to review by the policy committee. These will be dedicated respectively:

(A) A prompt access time-sharing mode - perhaps over most of the working day.

(B) A scheduled, full-use, on line mode - to service development work on high data rate and on line control applications, and for similar systems development.

(C) Job-shop, especially longer runs for which overnight turnaround is acceptable, and which cannot be serviced with comparable effectiveness by SCC."

The following aims were added to the ACME charter at the time of the Renewal Proposal in the Spring of 1969:

1. To improve hardware and software reliability for the benefit of the medical users.

2. To provide small machine assemblers in PL/ACME so that code for small machines can be written from an ACME terminal.

3. To achieve over time a state where income from user charges will match operational costs for the ACME system.

All of the original objectives have been achieved to varying degrees of satisfaction. Of special note is the development of PL/ACME as an interactive time sharing system which can be easily learned and used by medical staff. On the other hand, the realtime support offered is inadequate due to system instabilities and data rate limitations. Access to Campus Facility is inconvenient for ACME users.

In terms of the items added at renewal time, hardware and software reliability have been markedly improved. Small machine assemblers have been added, but the user must write code in the assembly code for whatever satellite he intends to run. At present, assemblers of this type exist for PDP-11, PDP-8, and 1800. The income of the facility has been rising steadily. Economic overlaps with NIH direct support for ACME have blurred the transition to totally non-subsidized use. A major rate increase was initiated in April, 1972. With this change, income over the last 12 months reached roughly 55% of direct operating costs (exclusive of development efforts). From the vantage point of hindsight one could well ask whether the selection of the 360/50 hardware and the decision to promote a large central time sharing and data collection resource were appropriate. Given the availability of new third generation hardware and the promises of IBM or expectations of its customers in 1966, the 360/50 hardware selection is defensible. However, the development of low cost, fast, well-supported minicomputers was not anticipated to proceed at the phenomenal pace that it has. This major technological shift has strongly influenced our present thinking for the future of computing in medicine and related research. The role of a large shared resource has by no means been obviated by the minicomputer revolution. We will continue to need powerful facilities beyond the scene of current mini architecture.

II. STANFORD MEDICAL CENTER COMPUTING PLANS

A. The Current Scene.

Between January and April 1973, the following significant events occurred in the computing environment affecting the Medical Center:

1. The University reorganized the service computing management structure to form the Stanford Center for Information Processing (SCIP). The SCIP organization will manage and operate all major service computing functions for the University.

2. The Board of Trustees authorized acquisition of an IBM 370/158 system to service the needs of the Medical Center.

3. Personnel from the ACME Facility and Hospital Data Processing Facility were assigned the task of converting the current systems to the new hardware systems.

4. Users were notified of the changes scheduled to occur between July and December 1973.

5. Planning of new faculty advisory groups for computing throughout Stanford was done.

PL/ACME users had been warned that the time sharing service might have to be disbanded at the close of the ACME grant. Therefore, the ACME community was elated by the above series of decisions. Medical School faculty and Hospital management were notified of the scheduled changes by a memorandum from Mr. Victor Barber dated April 23, 1973. A copy of this memorandum has been reproduced on the pages which follow.

B. Shared Database Planning.

The need for planning of shared database effort is presented in Appendix A. Given the need to which these memoranda attest, it is likely that the central facility will assign key personnel to work on the problem along with interested researchers. The near term development effort is likely to be based on use of the Time Oriented Database (TOD) system. Further information on TOD is presented in Section V of this report.

C. New Faculty Appointment.

A selection committee has nearly completed its deliberations with respect to a new faculty member in the Medical School who will have considerable responsibility for policies affecting computer services. The new position will be located in the Department of Community and Preventive Medicine. It is hoped that the new appointee will serve as a focus and spearhead for development activity in the shared database area.

DATE: April 23, 1973

TO: Distribution

V. H. Barber

FROM: V. H. Barber, Associate Director, Medical Center Computing Service
Stanford Center for Information Processing

SUBJECT: Computing Services for Medical Center

Stanford University announced in March of 1973 the complete reorganization of its general support computing facilities. The new organization, Stanford Center for Information Processing (SCIP), is described in the attached press release. The result of the reorganization provides a large general support computing facility in the Medical Center environment that merges the services of the medical research community with the business, administrative, and patient care activities.

My role as Associate Director of the Medical Center Computing Service is to serve Medical Center users and represent their interests in the service computing arena. Our goal will be to provide the required computing services at the lowest possible cost. A new hardware system will be available to serve the entire Medical Center in September 1973. The new facility will have more than three times the compute power of existing service facilities and will make available improved services during the year as the power of the system is harnessed with associated software. These will include shorter response or turn-around time and sharing of data bases.

A list of service goals for the MCCS is attached as Appendix A. Additional needs of the medical community will be established through interaction with the Hospital management group, individual users, and faculty committees.

We intend to provide easy communications between you, the user, and the staff of the new facility. We want a highly personalized service that is responsive to the needs of the medical community. Madhu Bhide,x5151, will be the primary liaison and coordination point for Hospital services, especially those oriented toward financial applications. Ms. Karen Richards, R.N., will continue as the Nursing Service Coordinator for computing matters. She is available at x6084. Ron Jamtgaard, x6121, will be the primary contact for users of timesharing services and realtime support; he will respond to needs of the Medical School research and education functions. B. J. Gaul will be Operations Manager of the 370/158 computing facility. He is available at x5880.

Ron Jamtgaard and his staff will be housed in the old ACME offices (TC101, temporary building). All other MCCS computing and management personnel will be located in the Administrative Services Annex, just north of the Medical Center, in the old Hospital Data Processing area.

We plan to serve you in the following manner: The new hardware facility (IBM 370/158) will be available in September 1973 to serve the reasearch and development interests of the Medical Center; by December 1973, the business and finance computing will be merged onto the new system. The services which will be offered when the facility opens include timesharing (using the PL/ACME language) and batch services in those languages for which a user need exists. Initially, batch services will be provided for FORTRAN, COBOL, PL/1, and LISP. Services to the business and finance community will continue as before; however, larger resources will be available, and there will be new opportunities for service.

The transition from PL/ACME on the current Model 50 to the 370/158 will be transparent for the terminal user except possibly in some realtime areas. Our target is to hold service interruption times to a minimum. Standard terminal services will likely be unavailable for about four weeks; realtime services may be disrupted for six to ten weeks. Digital realtime data acquisition services and graphics via the IBM 1800 as well as small machine communications will be provided by the new facility as soon as possible. The transition of Hospital services should be completed by December 1973.

The facility will be operated on income received through user fees. Our goal will be to provide maximum service at the most cost effective rates. Further policy on fees will be developed and released in the near future.

Persons who are new to the Stanford medical computing scene are encouraged to contact me at x5998 so that staff can be assigned to assist in definition and solution of computing needs.

MCCS exists to serve you and your computing needs. We hope to hear from many of you regularly.

cc: Medical School Faculty
Hospital Department Heads
ACME Users
SCIP Associate Director
C. Rich
P. Carpenter
T. Gonda
P. Hofmann
C. Dickens
M. Roberts
R. Jamtgaard

MEDICAL CENTER COMPUTING SERVICE

FUNCTIONS, SERVICES, AND GOALS

1. Patient Accounting. Hospital financial and administrative services and patient accounting services. These services involve chiefly patient accounting, patient billing for Stanford Hospital and Clinics, accounts receivable, third-party allocations, payroll, personnel, general ledger, accounts payable, census, financial and budgetary analyses for the Stanford University Hospital.

   As part of the patient accounting services, MCCS manages a large patient financial data base. It is expected that this will form a nucleus for a comprehensive patient data base in the future. One of the services that the service facility will offer is building on and managing this patient data base for both the Hospital administrative staff and medical research personnel interested in the patient data base.

2. Interactive time-sharing -- PL/ACME. PL/ACME is an easy-to-use time-sharing service. The major user of this service is the medical community at Stanford University. It is expected that the proposed facility will continue to support PL/ACME in its present form and gradually enhance the service to satisfy future requirements.

3. Data reduction and data control services. Currently a well-trained staff of keyboard operators and data control personnel perform these services for the Stanford University Hospital. This service will continue to be performed, and the recipients of this service will expand from Hospital financial data processing users to include other medical personnel.

4. Realtime services. Realtime service is currently provided by an IBM 1800 and ACME-built interfaces in the laboratories. The 1800 is programmed as an integral part of the system and acts as a 360 control unit. These services are currently used routinely by a number of investigators.

5. Small machine communications services. A multiplexor (MUX) for connection of mini-computers to the new 370/158 will be installed in 1973, after more routine services are operational.

6. Data collection. The new facility hopes to collaborate in the development of data collection systems. An example would be the development of an automated Patient Admission, Discharge, and Transfer system. Opportunities in this field will be vigorously pursued.

7. Language support. Other such collaborative efforts are foreseen in the area of language support. One such example is the MUMPS language. This language was developed at the Massachusetts General Hospital. It is used in conjunction with PDP-11 and PDP-15 computers. The Hospital uses a PDP-11 MUMPS system for the Pharmacy Drug Interaction Project. The facility role is not clear; we are open to new ideas here.

8. Liaison with Forms Management. MCCS will work closely with the Hospital Forms Management Section. The responsibility of the Forms Management Section is to coordinate all the forms that are used at the Stanford University Hospital. It takes on the responsibility of designing, printing, ordering, and stocking of forms. This service is expected to continue and will closely interact with the information flow development at the Medical Center.

9. Programming and consulting. The proposed facility will offer programming and consulting service. These programming activities include fee-for-service programming for users, design and development of production systems, and maintenance of public utility programs as well as existing projuction systems. Additionally, the facility will offer services in the areas of procedures analysis and automation of procedures. One of the current analytical services in which we are participating is an automated work-measurement study. It is expected that the proposed facility will continue to participate in such studies and offer services in these areas.

10. Library and grant assistance. Assistance in the identification of funding opportunities, proposal preparation, and management of grants that include the use of computer facilities will be available.

    A library of current reference publications in the area of computer use in the health care field will be maintained.

11. Educational activity. The facility is expected to be very active in continuing its current educational activities, specifically in teaching ACME's interactive and timesharing usage, as well as education of nursing and other Hospital staff in automated procedures. It is further expected that the proposed facility will extend its activities in continuing education of Hospital staff in data processing procedures, systems design, and data base management, and that it will also be active in the area of current awareness and dissemination of information to physicians and other medical personnel. As an adjunct of this, it is expected that the proposed facility will have an internal awareness program to keep its staff abreast of development in health care technology as applied to a computer service facility of a major medical center.

D. Some Observations on Computer Planning.

It took the Medical Center and University eighteen months to perform the planning activity leading to a decision for a course of action. A chronology of this period is attached as Appendix B. By scanning the chronology one can quickly observe that organizational and technical issues involving computing become quite complex and require extended timeframes to complete. Some of the major policy issues addressed by the various study committees included the following:

1. Do we want a highly centralized computing environment or do we choose a distributive minicomputer system with some inter-machine communications? Would some middle ground between these two choices be most appropriate?

2. Can we successfully merge the research support computing of the Medical School with the business and finance data processing of the Hospital?

3. What advantages might be gained by merging with the central Campus Facility of the University?

4. What investment does the PL/ACME user community have in the PL/ACME system and language? How easily could they be converted?

5. How can we fund computing for medical students and researchers on the faculty?

6. What computing needs are likely to dominate over the next five years?

These are some of the questions which the various committees have addressed.

III. ACME FACILITY ACCOMPLISHMENTS - FY73

Accomplishments of ACME staff personnel are described here; core research projects led by faculty members are included in Section V.

The primary accomplishment of the ACME facility during the past year has been to hold its user community largely intact during a period when the future existence of PL/ACME services was highly in doubt. The doubt stemmed from the fact that PL/ACME services had been subsidized by the ACME NIH grant and that the paying users did not constitute a critical mass to afford a facility which could duplicate these services.

A. Planning Studies.

Since October 1971 several members of the ACME staff have been actively involved in planning methods to continue offering PL/ACME services beyond the period of the ACME grant. There follows a list of some of these studies:

1. Merger of Hospital ADP and ACME facilities on a 360/65, PDP-10, or 370/158.
2. Merger of University Administrative Computing Facility, Hospital, and ACME facilities on a 370/158.
3. Merger of Campus Facility and ACME on a 360/67.
4. Conversion effort to mount ACME on various systems.
5. User surveys to determine user plans if PL/ACME services were dropped.
6. Specification of users needs.
7. Review of potential need for time oriented database sub-systems.
8. Consideration of various organizational alternatives. The results of most of these planning studies have been reported in earlier sections of this report.

B. Time Oriented Database Development.

One of the major tasks of the ACME applications staff during FY73 has been the generalization for ACME users of the Time Oriented Database system originally designed by Dr. James Fries of the Division of Immunology. A lengthy description of this system (TOD) is included in Section V of this report.

C. <u>New and Continuing Applications Programs.</u>

1. DENDRAL:

Support for the DENDRAL project during this fiscal year has consisted of machine services both in interactive PL/ACME and batch LISP. Early in the fiscal year an overnight version of batch LISP was mounted so that jobs could be entered from terminals in the daytime and run when the PL/ACME system was not needed. In addition the LISP interactive compiler was markedly improved. The small machine multiplexor and other small machine support has found limited use in the DENDRAL area. In addition the Loma Linda graphic displays have been fully incorporated into the DENDRAL closed loop control problem.

2. Drug Interaction Project.

This has been the year of transition for the Drug Interaction Project from the ACME system to a dedicated dual PDP-11 system. The new software written in MUMPS is now operational. This project has served as a classic example of how a new idea is formulated by faculty, tested under pilot project status on the ACME system, proposed for a research grant, and finally implemented in a production form. Many of the computing applications in the Stanford Medical Center have followed this course of action.

3. Medical Student Admissions.

Programming is now being done to handle medical student admissions needs. The system will assist the Admissions Office in screening applicants and provide administrative support.

4. Time Series Data Analysis.

Last summer ACME helped to support the work of Dr. Will Gersch of the University of Hawaii who used the ACME system to develop an automatic decision procedure to calculate spectral density estimates. The result of this effort is now available to all users in the form of a public program.

5. Radioimmunoassay Programs.

A number of FORTRAN programs written at NIH have been moved to the PL/ACME system to support research in radioimmunoassays.

6. New Realtime Users.

Very few new realtime users were recruited during the past year. This reflects the doubt in the minds of many concerning the future of PL/ACME realtime services. Two projects which were implemented:

Dr. Don Perkel's project involved analog/digital processing of two to four channels of nerve impulses recorded during swimming of the leech. This is a study of nervous control of movement.

The second project, headed by Dr. P. Sokolove was a study of the role of the nervous system in production and maintenance of circadian rhythms (data consisted of nerve spikes and EEG records).

Note: Detailed descriptions of Items 1 and 4 above are presented in Section V.

D. System Software Improvements.

In addition to its considerable planning effort, the systems staff incorporated a number of improvements into the system during 1973. Some of these are listed below:

1. Satellite Machine Support.

The primary effort here involved mounting the small machine multiplexor. This entailed software in the 360/50 as well as small machine code to test the hardware. The new small machine multiplexor can accommodate up to sixteen satellite machines serially passing data to or from ACME (See Appendix C). In addition a PDP-11 simulator was completed. The simulator can be operated in batch or interactively.

2. LISP.

Two tasks were undertaken for LISP users. The first was to mount an overnight LISP batch service to which jobs could be submitted from terminals during the day. The second was to improve the response time of the interactive compiler.

3. File Support.

The primary improvement was a data compression routine which permits users to file their data in a compressed format. For some users, such as those using the time oriented medical record files, this feature permitted a factor of five savings in storage costs. In addition the file system was documented extensively during the last year.

4. Reliability.

A number of bugs were found and fixed. It is a credit to the system staff that we now operate three to four months between system crashes due to software.

5. Other System Tasks.

The number of terminal ports was expanded from 32 to 48. Accounting programs were modified to capture data at hourly intervals. Batch accounting was added to the system. Release 20 of OS was implemented. A COBOL compiler was mounted for batch running. The file system directory was rewritten. A terminal survey was conducted to determine the best terminals for ACME to support in the future. A hardware monitor (called the SUM monitor) was attached to the system by Lee Hundley for a series of system measurements. Special programs were provided for ACME-to-OS dataset conversion.

E. <u>Education and Training</u>.

Over the past six and a half years more than 1700 members of the Stanford Medical community have been trained in the use of PL/ACME. This number includes only those who have enrolled in a formal training class. During the past twelve months, nine introductory classes have been offered with a total enrollment of 84. This is less than the normal annual enrollment, primarily due to the fact that classes were not held during three months of the year when the future of ACME was unresolved. Of the 84 persons enrolled, 23% had a Ph.D. or M.D. degree, another 45% had a Bachelors or Masters degree, and 32% indicated no degree. Two years ago the corresponding percentage of Ph.D. and M.D. participants was 35%. Approximately one-half of those who signed up for the introductory class had no prior programming experience; most of the balance had only slight experience. When asked why they sign up for the course roughly 60% indicate their intent to use the computer for numeric calculations and statistical analyses; approximately 20% plan to handle large data files; 10% indicate an interest in realtime applications; the balance require graphics displays and text editing. More than half plan to participate in a project currently using ACME; about 20% intend to start a new project.

It is interesting to note that 100% of the participants report that they have access to an ACME typewriter terminal. There are currently 55 terminals in our network.

In addition to the introductory course, ACME staff have prepared and offered seminars and advanced classes. The seminars have dealt with general medical computing topics. A special series of seminars was held concerning time oriented database work.

Some persons learned to use ACME without enrolling in the formal classes. One might estimate that 30% or more of the current users did this. An aid to the persons who preferred to learn by doing is a new program on the public file called "TEACHER". This is a question-and-answer course designed to be used from an alphanumeric CRT terminal.

F. Hardware Changes.

1. Multiplexor.

The satellite machine multiplexor is the most complex and costly equipment item designed and fabricated by the engineering group during FY73. The device, which can connect up to 16 satellite machines to the ACME system, provides a data path to and from the 360/150 in a demand-response mode. Data rates of 40,000 bytes per second are available using 4 twisted pair; rates of 250,000 bytes per second are available using coax. The multiplexor is connected to the IBM hardware through a 16-byte parallel data adaptor on the 2701 which in turn is connected to a selector channel (See Appendix C). Only three computers have been connected through the multiplexor. Additional customers will not be urged to connect until the new 370/158 system and its software become operational.

2. Terminal Controller.

All terminals are connected to the ACME system via a Memorex 1270 terminal controller which was installed in April 1972. This device has performed very well. It has 32 ports capable of automatic speed recognition up to 1200 baud.

3. Standard Analog Interface Card.

A new standard analog card has been developed for use in the laboratory. Since the 1800 is being moved to a distance 2000 feet further from most users, we will be encouraging the user community to convert to digital signals at the laboratory end rather than in the 1800. As a result, the new standard analog card is not likely to be used extensively.

4. Lightbox.

The standard ACME lightbox which has been used on IBM 2741 typewriter terminals was designed to operate off the 2741 power supply. Our shift to G.E. Terminet 300 terminals and Beehive CRT's has made the lightbox unusable. A new one has been designed and will be placed in use in June 1973.

5. Interfaces for Users.

The engineering group has designed and maintained a number of interfaces for user instrumentation. In general these are paid for directly by the customer. Some of the devices interfaced during the past year include scintillation counters, a paper tape reader-punch, and a Houston plotter.

G. Operations.

The annual average meantime between failures due to all causes (hardware, software, power, and human) reached a new high in FY73: 87.7 hours. A chart presenting additional information on meantime between failures is on the following page.

ACME's Operations Manager, Charles Class, spent a great deal of effort on planning support for the 370/158 facility, providing assistance in the areas of hardware, physical space and communications. Here at ACME he was active in the work of installing the new 300 baud terminals.

Mr. Class was the ACME representative in Co-op, an organization formed by the operations managers of the University's service computing facilities to increase communication and cooperation among the several operations groups.

ACME 360/50
COMPARISON OF MEAN TIME BETWEEN FAILURES
JULY 17, 1969 - APRIL 30, 1973
(IN HOURS)

HARDWARE

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Annual Average
1969-1970:	113.3	55.3	25.2	31.3	56.0	167.3	47.4	39.5	58.7	59.6	83.0	34.5	64.3
1970-1971:	72.4	34.7	176.0	362.0	704.0	104.0	218.7	364.0	182.0	78.2	103.4	176.0	214.8
1971-1972:	244.7	178.0	368.0	39.4	64.2	60.3	56.2	143.8	175.0	42.3	57.8	51.6	123.4
1972-1973:	24.0	58.3	90.3	232.3	72.4	119.8	163.0	181.0	140.0	120.1*	120.1*	120.1*	120.1

ALL FAILURES INCL. HARDWARE

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Annual Average
1969-1970:	40.0	33.2	17.7	26.5	48.0	44.0	39.0	25.2	27.0	29.8	60.4	22.6	34.4
1970-1971:	29.0	24.3	54.1	181.0	234.7	38.3	54.7	80.9	66.2	37.1	80.4	88.0	80.7
1971-1972:	146.8	142.4	73.6	33.8	54.6	40.2	52.0	79.9	116.7	40.0	39.0	40.2	71.6
1972-1973:	24.0	41.0	80.2	174.2	48.3	55.3	81.5	144.8	140.0	87.7 *	87.7*	87.7*	87.7

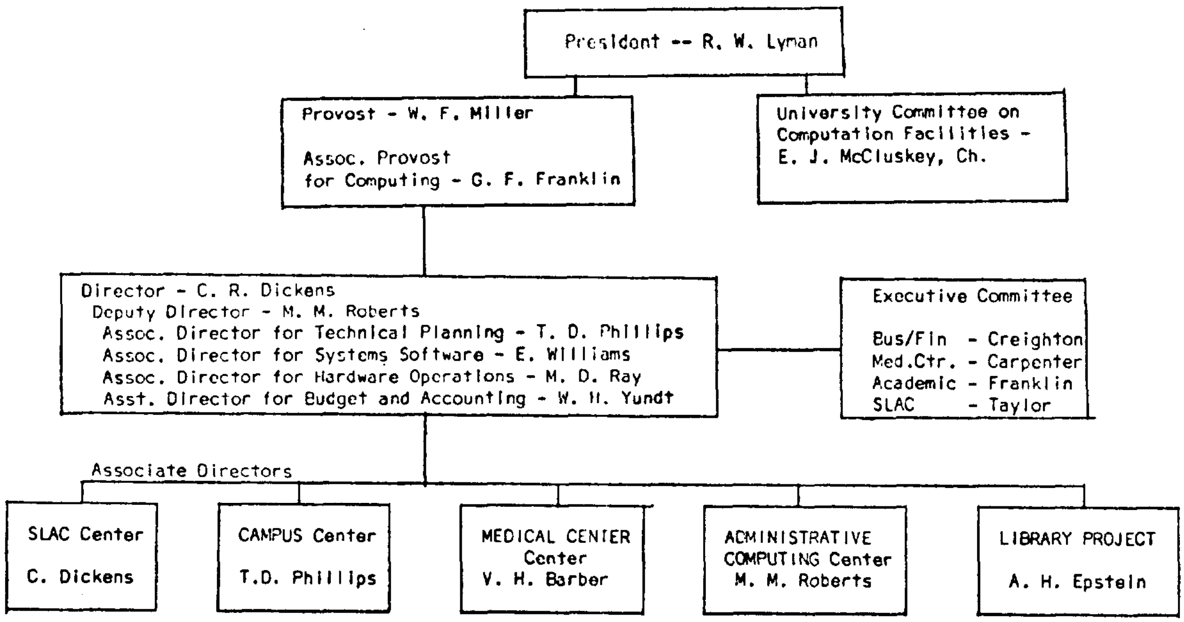
These figures do not reflect failures of 1800, PDP-11, or other systems.

Underlined Figures = Best mean time to failure as compared to same period of each year.

* (May - July, 1973) Projected mean time to failure based upon first nine months, August 1972 through April 1973.

IV. ADMINISTRATIVE ORGANIZATION

The Stanford Center for Information Processing is a new organization for service computing at Stanford University. The SCIP organization is shown schematically below.



STANFORD CENTER FOR INFORMATION PROCESSING

(SCIP)

The ACME computer facility is being merged with the Hospital Data Processing Facility and will now be represented by Mr. Victor Barber as Associate Director of SCIP for Medical Center computing. Until April 1973, the ACME facility was one of three facilities comprising the Computation Center.

The staff of the ACME facility is listed along with the percent of full time equivalent effort on the following page. Major personnel changes which occurred during fiscal year 1973 are as follows:

1. Lee Hundley transferred to the SLAC computing facility where he will be working on realtime applications.

2. Linda Crouse transferred to the Pharmacology Department as a scientific programmer.

3. Rich Cower transferred to the SLAC facility as a computer operator.

4. Jane Whitner and Ying Lew were terminated in view of the end of the ACME grant. The University will consider rehiring them as future needs develop.

5. Chuck Granieri transferred to SLAC as a systems programmer in the spring of 1973.

6. Russell Briggs was assigned full time to the Drug Interaction project.

7. Madeline Aranda, the ACME Secretary, transferred to the Financial Aids Office.

The balance of the staff will likely be assigned either to new computing facilities within the Medical Center or to other service computing facilities on the Stanford campus.

CURRENT ACME PERSONNEL

NAME	% FTE	JOB TITLE
Jamtgaard, R.	100	Director
Wiederhold, G.	40	Consultant
Rindfleisch, T.	100	Systems Analyst
Levinthal, E.	18	Computer Planning Faculty Representative
Frey, R.	100	Systems Programmer
Heathman, M.	60	Systems Programmer
Levitt, R.	50	Systems Programmer
Lipkis, J.	75	Systems Programmer
Miller, S.	100	Systems Programmer
Schroeder, J.	100	Systems Programmer
Stainton, R.	100	Systems Programmer
Williams, E.	50	Associate Director for Systems Software
Bassett, R.	100	Scientific Programmer
Germano, F.	100	Scientific Programmer
Baxter, E.	100	Administrative Asst.
Class, C.	100	Operations Manager
Billger, G.	50	Computer Operator
Sutter, J.	80	Computer Operator
Matous, J.	100	Computer Operator
Rieman, J.	60	Computer Operator
Duffield, A.	80	I.R.L. Support Personnel
Hwang, J.	100	I.R.L. Support Personnel
Pereira, W.	100	I.R.L. Support Personnel
Veizades, N.	100	I.R.L. Support Personnel
Total FTE	19.6	

V. PROJECT DESCRIPTIONS

CORE RESEARCH & DEVELOPMENT

A. DENDRAL

Project: DENDRAL
Realtime

Investigator: Edward Feigenbaum,
Joshua Lederberg, and Carl Djerassi

Dept. of Chemistry, Computer Science,
and Genetics

The DENDRAL project involves collaboration between the Instrumentation Research Laboratory operating under NASA grant NGR-05-020-004, investigators operating under NIH grant RR00612, and ACME.

The emphasis of the DENDRAL-ACME efforts is computer science, while that of IRL-ACME endeavors is data acquisition and computer instrument control.

The DENDRAL project aims at emulating in a computer program the inductive behavior of the scientist in an important but sharply limited area of science; organic chemistry. Most of the work is addressed to the following problem; given analytic data (the mass spectrum) of an unknown compound, infer a workable number of plausible solutions, that is, a small list of candidate molecular structures. In order to complete the task, the DENDRAL program then deduces the mass spectrum predicted by the theory of mass spectrometry for each of the candidates and selects the most productive hypothesis, i.e., the structure whose predicted spectrum must closely matches the data.

The project has designed, engineered, and demonstrated a computer program that manifests many aspects of human problem solving techniques. It also works faster than human intelligence in solving problems chosen from an appropriately limited domain of types of compounds, as illustrated in the cited publications.

Some of the essential features of the DENDRAL program include:

Conceptualizing organic chemistry in terms of topological graph theory, i.e., a general theory of ways of combining atoms.

Embodying this approach in an exhaustive HYPOTHESIS GENERATOR. This is a program which is capable, in principle, of "imagining" every conceivable molecular structure.

Organizing the GENERATOR so that it avoids duplication and irrelevancy, and moves from structure to structure in an orderly and predictable way.

Core Research & Development (Continued)

The key concept is that induction becomes a process of efficient selection from the domain of all possible structures. Heuristic search and evaluation are used to implement this "efficient selection."

Most of the ingenuity in the program is devoted to heuristic modifications of the GENERATOR. Some of these modifications result in early pruning of unproductive or implausible branches of the search tree. Other modifications require that the program consult the data for cues (pattern analysis) that can be used by the GENERATOR as a plan for a more effective order of priorities during hypothesis generation. The program incorporates a memory of solved sub-problems that can be consulted to look up a result rather than compute it over and over again. The program is aimed at facilitating the entry of new ideas by the chemist when discrepancies are perceived between the actual functioning of the program and his expectation of it.

The DENDRAL research effort has continued to develop along several dimensions during Fiscal 1973. The mass spectra of some previously uninvestigated compounds were recorded. The computer program has been extended to analyze the mass spectra of a more complex class of compounds, using new kinds of data. The artificial intelligence work on theory formation and program generality has also progressed.

The techniques of artificial intelligence have been applied successfully for the first time to a problem of direct biological relevance, namely the analysis of the high resolution mass spectra of estrogenic steriods. The performance of this program has been shown to compare favorably with the performance of trained mass spectroscopists. (see Smith, et al. (1972)

Of particular significance in this effort were, in addition to exceptional performance, the potential for analysis of estrogens <u>without prior separation</u>, and for generalization of the programming approach to other classes of molecules.

Because of the structure of the Heuristic DENDRAL program for estrogens, it is immaterial whether the spectrum to be analyzed is derived from a single compound or a mixture of compounds. Each component is analyzed, in terms of molecular structure, in turn, independently of the other components. This facility, if successful in practice, would represent a significant advance of the technique of mass spectrometry. Many problem areas, because of physical characteristics of samples or limited sample quantities, could be successfully approached utilizing the spectra of the unseparated mixtures. Even in combined gas chromatography/mass spectrometry (GC/MS), many mixture components will be unresolved and an analysis program must be capable of dealing with these mixtures.

Core Research & Development (Continued)

We have, in collaboration with Prof. H. Adlercreutz of the University of Helsinki, recently completed a series of analyses of various fractions of estrogens extracted from body fluids and supplied to us by Prof. Adlercreutz. These fractions (analyzed by us as unknowns) were found to contain between one and four major components, and structural analysis of each major component was carried out successfully by the above program. These mixtures were analyzed as unseparated, underivatized compounds. The implications of this success are considerable. Many compounds isolated from body fluids are present in very small amounts and complete separation of the compounds of interest from the many hundreds of other compounds is difficult, time-consuming and prone to result in sample loss and contamination. We have found in this study that mixtures of limited complexity, which are difficult to analyze by conventional GC/MS techniques without derivatization (which frequently makes structural analysis more difficult), can be rationalized even in the presence of significant amounts of impurities. A manuscript on this study has been submitted to the Journal of the American Chemical Society.

In the past year we have extended our library of high resolution mass spectra of estrogens to include 67 compounds. These data represent an important resource and have been included (as low resolution spectra for the moment) in a collection of mass spectra of biologically important molecules being organized by Prof. S. Markey at the University of Colorado.

The Heuristic DENDRAL program for complex molecules has received considerable attention during the last year in order to remove compound class specific information or program strategies. By removing information which is specific to estrogens, the program has become much more general. This effort has resulted in a production version of the program which is designed to allow the chemist to apply the program to the analysis of the high resolution mass spectrum of any molecule with a minimum of effort. Given the spectrum of a known or unknown compound, the chemist can supply the following kinds of information to guide analysis of the mass spectrum: a) Specifications of basic structure (superatom) common to the class of molecules. b) Specification of the Fragmentation rules to be applied to the superatom, in the form of bond cleavages, hydrogen transfers and charge placement. c) Special rules on the relative importance of the various fragments resulting from the above fragmentations. d) Threshold settings to prevent consideration of low intensity ions. e) Available metastable ion data and the way these data are subsequently used -- to establish definitive relationships between fragment ions and their respective molecular ions. f) Available low ionizing voltage data -- to aid the search for molecular ions. g) Results of deuterium exchange of labile hydrogens -- to specify the number of, e.g., -OH groups.

Core Research & Development (Continued)

We have been very successful in testing the generality of the program, with particular emphasis on other classes of biologically important molecules. We have used the program in analysis of high resolution mass spectra of progesterone and some methylated analogs, a small number of androstane/ testosterone related compounds, steroidal sapogenins and n-butyl-trifluoroacetyl derivatives of amino acids.

The Heuristic DENDRAL performance program described above is an automated hypothesis formation program which models "routine", day-to-day work in science. In particular, it models the inferential procedures of scientists identifying components, such as those found in human body fluids. The power of this program clearly lies in its knowledge about various classes of compounds normally found in body fluids, which knowledge allows identification of the compounds.

The Meta-DENDRAL program described in this part is a critical adjunct to the performance program because it is designed to supply the knowledge which the performance program uses. Theory formation is essential in order to carry out the routine analyses - either by hand or by computer. However, the staggering amount of effort required to build a working theory (even for a single class of compounds) holds back the routine analyses. The goal of the Meta-DENDRAL program is to form working theories automatically (from collections of experimental data) and thus reduce the human effort required at this stage. By speeding up the time between collecting data for a class of compounds and understanding the rules underlying the data, the Meta-DENDRAL program will thus provide an improvement in the development of diagnostic procedures.

Detailed accounts of this research are available in the DENDRAL Project annual report to the National Institutes of Health, in several papers already published, and in manuscripts submitted for publication.

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The preceding comments on DENDRAL involve Parts A and C as described in the table below. The balance of this section deals with Part B, instrumentation aspects.

Part A: Applications of Artificial Intelligence to Mass Spectrometry.

Part B(i): Mass Spectrometer Data System Development.

Part B(ii): Analysis of the Chemical Constituents of Body Fluids.

Part C: Extending the Theory of Mass Spectrometry by Computer.

ACME computer support for DENDRAL Part B has been treated as ACME core research activity during FY73. Excerpts from DENDRAL's annual report follow, detailing recent accomplishments.

The large volume of data which must be reduced and interpreted from each GC/MS analysis of a body fluid sample together with the increasing number of samples which must be processed to be responsive to clinical needs, point to more and more highly automated and reliable GC/MS systems. This portion of the proposal addresses the problems of developing and applying such automated systems from several points of view. First, we propose to investigate the integration of sophisticated computer analysis programs into data reduction, data interpretation, and instrument management functions in order to progressively relieve the chemist from manually performing these tasks. Second, we will maintain the daily operation of our GC/MS systems for the on-going investigation of clinical applications and the acquisition of data necessary for the development of automated interpretation programs.

Our overall objectives for automating GC/MS systems comprise a number of specific subgoals including a) implementing highly automated and reliable systems for the acquisition and reduction of low resolution, high resolution, and metastable mass spectral data; b) implementing a data system to support combined gas chromatography/high resolution mass spectrometry; c) automating the location and identification of constituents of body fluid extracts from gas chromatogram and mass spectrum information for the routine application of these techniques to clinical problems; and d) investigating the intelligent closed loop control of mass spectrometer systems in order to optimize the data acquired relative to the task of data interpretation.

Core Research & Development (Continued)

A. Mass Spectrometer Data System Automation

Concentrating initially on the MAT-711 spectrometer, we have made significant progress toward a reliable, automated data acquisition and reduction system for scanned low and high resolution spectra. This system is largely failsafe and requires no operator support or intervention in the calculation procedures. Output and warnings to the operator are provided on a CRT adjacent to the maas spectrometer. The system contains many interactive features which permit the operator to examine selected features of the data at his leisure. The feedback currently provided to the operator to assist in instrument set-up and operation can just as well be routed to hardware control elements for these functions thereby allowing computer maintenance of optimum instrument performance.

Progress in this area is an integration of our efforts in hardware and software improvements:

HARDWARE - The basic system consists of the mass spectrometer interfaced to a PDP-11/20 computer for data acquisition, pre-filtering, and time buffering into the ACME time-shared 360/50. The more complex aspects of data reduction are done in the 360/50 since the PDP-11 has limited memory and arithmetic capabilities. New interfaces for mass spectrometer operation and control have been developed. The interfaces can handle (through an analog multiplexer) several analog inputs and outputs which require that the PDP-11 computer be relatively near the mass spectrometer. We now have the capability for the following kinds of operation through the new interfaces.

i) Computer selection of digitization rate.

ii) Computer selection of data path (interrupt mode or direct memory access (DMA).

iii) Direct memory access for faster operation in the data acquisition mode.

iv) Computer selection of analog input and output channels.

v) Sensing of several analog channels through a multiplexer (e.g., ion signal, total ion current).

vi) Magnet scan control. This control can be exercised manually or set by the computer. It controls both time of scan and flyback time. Coupled with selection of scan rate, any desired mass range can be scanned at any desired scan rate.

vii) The computer can monitor the mass spectrometer's mass marker output as additional information which will be used to effect calibration.

Core Research & Development (Continued)

SOFTWARE - Automatic instrument calibration and data reduction programs have been developed to a high degree of sophistication. We can now accurately model the behavior of the MAT-711 mass spectrometer over a variety of scan rates and resolving powers. Our instrument diagnostic routines are depended upon by the spectrometer operator to indicate successful operation or to help point to instrument malfunctions or set-up errors. Some features of these programs are described below.

i) Data Acquisition. Programs have been written which permit acquisition of peak profile data at high data rates using the PDP-11 as an intermediate data filter and buffer store between the mass spectrometer and ACME. This allows data acquisition to proceed even under the time constraints of the time-sharing system. Storage of peak profiles rather than all data collected has greatly reduced the storage requirements of the program and saves time as the background data (below threshold) are removed in realtime. An automatic thresholding program is in operation which statistically evaluates background noise and thresholds subsequent data accordingly. Amplifier drift can thus be compensated. We have developed some theoretical models of the data acquisition process which suggest that high data acquisition rates are not necessary to maintain the integrity of the data. Demonstration of this fact with actual data has helped relieve the burden of high data rates on the computer system, particularly as imposed by GC/MS operation, and permits more data reduction to be accomplished in realtime or alternatively reduces the required data acquisition computer capacity.

ii) Instrument Evaluation. A high resolution mass spectrometer operating in a dynamic scanning mode is a complex instrument and many things can go wrong which are difficult for the operator to detect in realtime. In order for the computer to assist in maintaining data quality, it must have a model of spectrometer operation on the basis of which data quality can be assessed and processing suitably adapted as well as instrument performance optimized. We have developed a program which monitors the state of the mass spectrometer.

iii) Data Reduction. A program has been written which allows automatic reduction of high resolution data based on the results of the prior instrument evaluation data. Conversion of peak positions in time to the corresponding mass values is effected by mapping each spectrum into the calibration model developed previously. The interpolation algorithm between reference calibration points incorporates

Core Research & Development (Continued)

a quadratically varying exponential time constant to account for the second order character of a magnet discharging through a resistance and a capacitance as well as an offset at infinite time to account for residual magnetization affecting accuracy at low masses.

Perfluorokerosene (PFK) peaks, introduced into high resolution mass spectra for internal mass calibration, are distinguished from unknown peaks by a pattern recognition algorithm which compares the relationships between sequences of reference peaks in the calibration run with the set of possible corresponding sequences in the sample run. The candidate sequence is selected which best approximates calibrated performance within constraints of internally consistent scan model variations. This approach minimizes the need for selection criteria such as greatest negative mass defect for reference peaks, the validity of which cannot be guaranteed. Excellent performance results from using sequences containing 10 reference peaks.

Unresolved peaks are separated by a new analytical algorithm, the operation of which is based on a calculated model peak derived from known singlet peaks rather than the assumption of a particular parametric shape (e.g., triangular, Gaussian, etc.) This alogorithm provides an effective increase in system resolution by a factor of three thereby effectively increasing system sensitivity. By measuring and comparing successive moments of the sample and model peaks, a series of hypotheses are tested to establish the multiplicity of the peak, minimizing computing requirements for the usually encountered simple peaks. Analytic expressions for the amplitudes and positions of component peaks have been derived in the doublet case in terms of the first four moments of the peak complex. This eliminates time consuming iteration procedures for this important multiplet case. Iteration is still required for more complex multiplets.

Elemental compositions are calculated from high resolution mass values with a new, efficient table look-up algorithm developed by Lederberg.

Future work will extend these ideas to a system for the acquisition of selected metastable information as well as to include the quadrupole system used in the routine low resolution clinical work.

B. GAS Chromatography/High Resolution Mass Spectrometry.

We have recently verified the feasibility of combined gas chromatography/high resolution mass spectrometry (GC/HRMS). Using the programs described above we can acquire selected scans and reduce them automatically,

Core Research & Development (Continued)

although the procedures are slow compared to "realtime" due to the limitations of the time-shared ACME facility. We have recorded sufficient spectra of standard compounds to show that the system is performing well.

We have begun to exercise the GC/HRMS system on urine fractions containing significant components whose structures have not been elucidated on the basis of low resolution spectra alone. Whereas more work is required to establish system performance capabilities, two things have become clear: 1) GC/HRMS will be a useful analytical adjunct to our low resolution GC/MS clinical studies to assist in the identification of significant components whose structures are not elucidated on the basis of low resolution spectra alone, and 2) the sensitivity of the present system limits analysis to relatively intense GC peaks.

Recent experiments in operation of the mass spectrometer in conjunction with the gas chromatograph have also shown that the present ACME computer facility cannot provide the rapid service required to acquire repetitive scans at either high or low resolving powers. We can, however, acquire scans on a periodic basis, meaning most GC peaks in a run can be scanned once at high resolving power. We are presently implementing a disk on the PDP-11 to act as a temporary data buffer between the mass spectrometer and ACME. This disk will allow acquisition of repetitive scans, while data reduction must be deferred to completion of the GC run.

C. Automated GC/MS Data Reduction

The application of GC/MS techniques to clinical problems as described in Part B(ii) of this proposal has made clear the need for automating the analysis of the results of a GC/MS experiment. Previous paragraphs dealt with the problems of reducing raw data in preparation for analysis. At this point the data must be analyzed with a minimum of human interaction in terms of locating and identifying specific constituents of the GC effluent. The problem of identification is addressed by the library search and DENDRAL mass spectrum interpretation programs discussed in Part A of this proposal. The problem of locating effluent components in the GC/MS output involves extracting from the approximately 700 spectra collected during a GC run, the 50 or so representing components of the body fluid sample. The raw spectra are in part contaminated with background "column bleed" and in part composited with adjacent constituent spectra unresolved by the GC.

We have begun to develop a solution to this problem with very promising results.

Core Research & Development

D. Closed-Loop Instrument Control.

The task of collection of different types of mass spectral information (e.g., high resolution spectra, low ionizing voltage spectra snd selected metastable information) under closed loop control during a GC/MS experiment is extremely difficult and may not be realizable with current technology. We are studying this problem in a manner which will allow the system to be used for important research problems (e.g., routine analysis of urine fractions without fully closed loop control) while aspects of instrument control strategy are developed in an incremental fashion.

Core Research & Development (Continued)

B. Time Oriented Database System (TOD)

Investigator:	Dr. James Fries and the ACME Staff	Project: J_FRIES_.DATABANK F_GERMAN.TOD DATABANK.TODD

Dept. of Medicine - Immunology and ACME

In 1970 and 1971, Dr. James Fries in the Division of Immunology of the Department of Medicine developed concepts and implemented programs which he labeled "Time Oriented Database". One of the first steps was the development of standard forms for use in the medical record. These forms are completed manually and require no computer intervention or interaction. Use of the new medical record forms has proved highly desirable in several clinics at Stanford since that time, with or without the associated computer programs. The relationship of the computer to the project makes possible rapid comparison and statistical analysis of various data items covering multiple visits for one patient or for many patients.

In the summer of 1972, a design study was completed which would generalize the use of the TOD programs on the ACME system so that several divisions could use a common set of programs. The design effort was handled primarily by Stephen Weyl with assistance from Gio Wiederhold and Frank Germano. Implementation of the new generalized TOD programs was managed by Frank Germano with Stephen Weyl, Rick Giusti, Bob Bassett, and Jane Whitner handling the programming.

As of May 1, 1973, several TOD databanks had been implemented and several more had been planned. The table below reflects the progress to that date.

TOD Implementation Progress Report (May 1, 1973)

PRESENT TOD DATABANKS

User	Medical Speciality	Comments
Dr. Jim Fries	Immunology	Operational on TOD 3 months
Dr. S. Rosenberg Dr. L. William	Oncology	Operational on TOD 3 months
Dr. M. Stern	Metabolic Disease Clinic	Databank defined. Time-Oriented Medical Record forms being printed. Data entry will begin when forms are ready.

TOD DATABANKS GOING THROUGH DEFINITION PROCESS

Dr. K. Brodie Dr. M. Rosenzweig	Psychiatry Alcohol & Violence Prevention Clinic	
F. Germano	TOD Group	TOD group mailing list
D. Lombardi	Student Affairs Office	Part of the TOD System will be used to set up a Medical Student Record System
Dr. Bleck	Childrens Hospital Orthopedic Service	TOMR forms designed. Waiting to define databank.
Dr. J. Gamel	Ophthalmology Clinic	Databank defined. Presently collecting input data.

GROUPS CONSIDERING A TOD DATABANK DEFINITION

Dr. Wilbur	Childrens Hospital
Dr. Miller	Childrens Hospital
Dr. V. Johnson Dr. A. Hackel	Pediatrics
Dr. M. Bagshaw	Radiology

The system which was announced in January 1973 is but a first step in development of database systems at Stanford. Clearly more development effort will follow which will improve the data entry techniques to be employed, enhance quality control of data entered, and increase the amount of shared data in the files.

The following pages contain four ACME Notes written to document the TOD system, along with explanatory remarks. The four ACME Notes are:

TODI - Introduction to TOD System
TODREF - Index to TOD ACME Notes
TODDDL - TOD Databank Description Language
TODCST - Analyzing the Costs of Running a TOD Databank

ACME Note

TODI-3
Frank Germano/Steve Weyl
April 5, 1973

Introduction to TOD (Time-Oriented Databank) System

The TOD system is a set of programs available from ACME designed to aid users in the creation, maintenance, and use of computer "databanks" which store patient-related information over time. These programs are available as TOD public programs on the PL/ACME system. If a user can conceptually view his patient data in the form of a three-dimensional array, indexed by patient, parameter, and time, he can use the TOD system. A recently conducted database review of medical data stored on the ACME computer system and other Stanford computers revealed that many of these databanks have this form. The results of this survey are summarized in ACME Note DBS.

Flexibility and Independence

In order to offer a system of programs which support most patient-related databases implemented on the ACME facility, a large degree of flexibility and independence had to be built into the system. The TOD approach is a decentralized one, in which each division maintains a separate databank, whose inter-relation to all databanks is well defined. Each TOD databank is set up and used under one ACME name and project. The databank planner is the administrator of that databank, not ACME. To provide for user definition, an extra file is added to the databank. This file is called a SCHEMA file; it describes the form of the databank. It stores that information which makes each TOD databank unique for its user. Public programs which act on a TOD databank look to this file for descriptive information about the databank. This information is then used by the various programs which act on the databank during their operation.

Advantages of TOD for A User

Use of the TOD system can offer several advantages to the user. Some of the direct advantages are discussed below.

1. Less Effort to Utilize a Patient-Related Databank:

Prior to TOD each user essentially had to write programs to set up, maintain, and use a databank. This represented a great duplication of effort. The databanks tended to be implemented according to different, rather arbitrary conventions. Moreover, because of the diversity of form for the various databanks, sharing of information could only be done on a case-by-case basis and with special programming. Use of TOD will reduce programming effort for users who store patient-related data.

2. Data Sharing

Because of the existence of the SCHEMA file, all the information required to allow sharing of data is in one place and in computer-readable form. This will allow data sharing between TOD users to occur more easily in the future.

3. High-Level Documentation

Aside from providing information to programs which operate on the TOD system, the SCHEMA file provides information to programmers and users of a databank. This information, describing individual items in the databank, is defined by a Schema Language called DDL (Database Description Language) which uses a PL/ACME-like syntax for its declarations. This common language forms the basis for unambiguous communication among TOD databank groups. This communication process is strengthened by the fact that the different groups share a common general core set of programs and a common general file structure. Details of an individual databank are described using the Schema Language.

4. Operational Statistics

   All the TOD programs store statistics which describe the operation of the databank. Careful review of these statistics in conjunction with the monthly summary of ACME charges will give the user a much clearer picture of what his computer dollar is buying.

5. Common Improvements

   As ACME and users find ways to improve the TOD system programs and procedures in terms of capabilities and cost-effectiveness, these improvements will be passed along to TOD users by changes in the TOD programs and systems documentation to be implemented by means of monthly "releases" of the system. These releases will be upwards compatible. If a user writes a specialized program which he feels is worthy of sharing with the TOD group, this program can easily be generalized and made available as part of the TOD system.

<u>Overview of the TOD System</u>

The programs comprising the TOD system fall into four groups: data entry, data update, data retrieval and analysis, and TOD System Utility Programs. Figure I summarizes these groups.

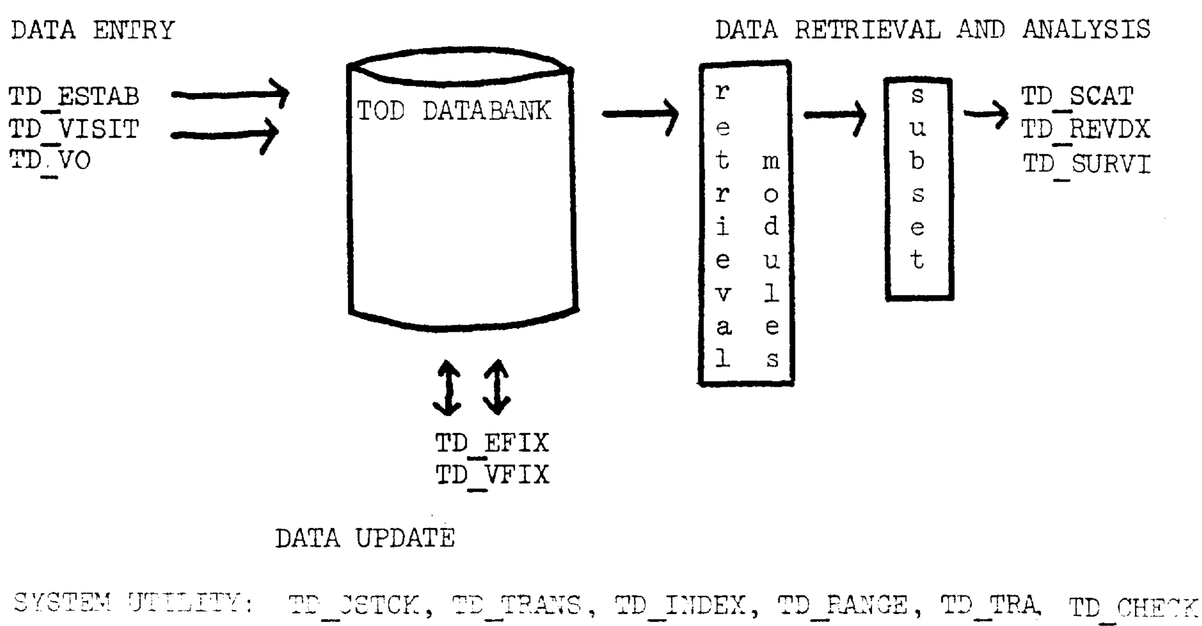


Figure I. TOD System Overview

TOD Programs

The programs named in Figure I are representative of the programs that will comprise the initial TOD system. Most of these are main programs, although a few are subprograms which can be included in a user-written program. Table I below summarizes the purpose of these programs.

Table I. TOD System Programs

Program	Class	Purpose
TD_ESTAB	entry	enter demographic (one-time) information associated with a patient.
TD_VISIT	entry	enter information measured at a point in time, e.g. at a patient clinic visit.
TD_EFIX	update	correct/change a patient demographic (one-time) data element.
TD_VFIX	update	correct/change information measured at a point in time.
TD_GCOL TD_GROW TD_GEXT TD_GROWX	retrieval sub-programs	routines to extract information from the TOD data files. These modules will be used by TOD programs and are available to the user for use in special purpose analysis programs.
TD_SALL TD_SAND TD_SOR TD_SSUPR	retrieval	create a library of subsets of patients and patient-visits based on the values of demographic, physiological, and general descriptive variables.
TD_GTDES	sub-program	extract schema information for a specific TOD databank.
TD_SUBST	sub-program	a routine used by all programs and available to extract those patients or patient-visits which satisfy certain criteria. The calling program then does its analysis on the reduced set.
TD_SCAT	analysis	construct scatter graph of two parameters
TD_REVDX	analysis	simple statistical review.
TD_QLIST	analysis	multi-optioned list databank contents program.
TD_SURVI	analysis	survival calculations. 4 methods. PUBLIC version of B. Brown's "Survival Kit".
TD_STENT	analysis	program to extract data from a TOD databank and write data file or pass array elements for the more common ACME statistical programs. (Not implemented.)

Program	Class	Purpose
TD_CHECK	utility	check data item values and file structure for inconsistencies.
TD_CSTCK	utility	operational statistics summary.
TD_TPOSE TD_RANGE TD_INDEX	utility	construct the indicated auxiliary file. Programs best run during times of low ACME utilization.
TD_DLIST	utility	Once the databank is defined, the schema is translated to a form more appropriate for computer processing.
TD_RECOM	utility	Periodically, users will wish to modify the form of their databanks by means of a major reorganization. This process, using an old and new schema (Database Definition), loads the new database from the old.

TOD Files

A TOD databank contains a number of inter-related files. Four of these files are required: td_schem, td_desc, td_head, and td_parm. In addition to these files, several auxiliary files can be added to the system to make retrieval of certain information faster. These files are td_index, td_range, td_htpse, and td_ptpse. Table II summarizes the purposes of these files.

Table II. TOD Files

File	Information Content
td_schem	Description of the databank in PL/ACME DECLARE-type statements.
td_desc	Internal form of the databank description.
td_head	Demographic patient information. One record per patient.
td_parm	Information measured at a point in time. One record per time per patient.
td_index	(HEADER item value, KEY to HEADER file) pairs sorted on header values. One such group for each header element that is indexed.
td_range	For each patient, the hi and lo ranged parameter values across all parameter records associated with the patient over time. Only those parameters which are ranged are included.
td_htpse td_ptpse	For TRANSPCSED data items these files contain the same information as the HEADER and PARAMETER files except that the ordering is such that all values for a particular item are contiguous, making questions which relate to specific items much faster to answer.

The Purpose of the Present TOD Effort

The present TOD implementation is not to be the system to end all information retrieval systems. Its capabilities have been limited in order to assure that a demonstratable working system can be swiftly implemented. Nevertheless, a full set of capabilities are provided to handle most of the users who are following patients over time. Once a number of TOD users exist, who speak a common language, further extensions to the system can be planned in a meaningful manner.

ACME views the TOD system as a set of programs which allows users who follow patients over time to set up, maintain, and use a databank in a simple and efficient manner. The present TOD effort is a study of the patient databank question in the Stanford Medical Center.

Further Reading

A reference to all ACME notes describing the operation and use of various portions of the TOD system and its implementation is given in ACME Note TODREF.

Revision of TODI-2 dated March 16, 1973.
Dist: Staff/TOD/All

ACME Note

Index to TOD ACME Notes

TODREF-1
Steve Weyl
April 4, 1973

This note is a comprehensive index to the set of ACME Notes describing the TOD (Time-Oriented Databank) system. The index is given in three parts: Part I references the notes that all planners and users should be familiar with. Part II references the file structure and system implementation notes, which are primarily of interest to systems analysts and programmers. Part III references historical notes, notes describing administrative procedures for the TOD system, and notes associated with individual TOD databanks.

The TOD system is a set of programs available from ACME designed to aid users in the creation, maintenance, and use of computer "databanks" which store patient-related information over time.

ACME notes TODI and TDOV give an overview of the TOD system. ACME note TODD is the original design document for TOD and is primarily of historical interest, since many of the conventions suggested there have been modified in the course of implementation.

* Notes marked with an asterisk (*) had not yet been published at the time this issue of TODREF went to press.

PART I - USE OF THE TOD SYSTEM

A. General Introduction and Overview

TODI	Introduction to the TOD (Time Oriented Databank) System -- F. Germano, S. Weyl
TDOV	TOD System Overview -- F. Germano

B. Planning and Defining a Databank

*TDPLAN	Planning a TOD-based Databank -- F. Germano, S. Weyl
*TDUA	How to Make a Schema for TOD -- V. Wiederhold
TODATA	Stanford Medical Center TOD Data Descriptor Dictionary -- F. Germano
TODDDL	The TOD Databank Description Language -- S. Weyl
TDPT	Definition of a TOD Databank Using PUBLIC Program TD_TRA -- S. Weyl
TDPDT	Detranslation of a Databank Schema Using PUBLIC Program TD_DTRA -- S. Weyl

TODPDN Obtaining a Proof Listing of the Schema File Using TD_DLIST -- F. Germano

TDPRE Redefinition of a TOD Databank Using TD_RECOM -- S. Weyl

C. Entering and Correcting Data

*TDUB How to Enter Data on TOD -- V. Wiederhold

TODPDG Checking Data Values and File Linkage Using Program TD_CHECK -- R. Giusti

D. Report Generating Programs

TODPDF Patient Chart Listing Program TD_PLIST -- R. Giusti

TODPDL Listing of TOD Header & Parameter Files Using TD_QLIST -- B. Bassett

TODPDN Obtaining a Proof Listing of the Schema File Using TD_DLIST -- F. Germano

E. Retrieval and Analysis Programs

TODPDD TOD Retrieval Module Summary Sheet -- F. Germano

TODPDO Definition of Patient Subsets for Analysis Using Programs TD_SALL, TD_SAND, TD_SOR, and TD_SSUPR -- S. Weyl

TODPDB TOD Scatterplot Program -- F. Germano

TODPDC TOD Reviewdx Program -- F. Germano

TODPDE TOD Survival Kit - User Instructions -- J. Whitner

TODPDJ TOD Debug Lister Program TD_QKLST -- R. Giusti

TODPDM Using TOD Retrieval Modules as Debug Programs -- R. Giusti

*TODSUR TOD Survival Kit - Computational Methods -- M. Hu

F. TOD Utility Programs

TODPDG Checking Data Values and File Linkage Using Program TD_CHECK -- S. Weyl, R. Giusti

TIDG	Record 1 in the TOD Descriptor File, td_desc -- F. Germano
TIDH	Structure of the Subset Library File, td_subs -- S. Weyl

PART III - OTHER ACME NOTES

A. Historical

TODD	Definition of the PL/ACME Time-Oriented Databank Protocol -- S. Weyl
DBT	ACME Data Base for Cancer Virus Tumor Samples (Medical Microbiology - Dr. Hayflick) -- S. Weyl
DBD	ACME Data Bases for Drs. Eugene Dong and Phillip Caves - Cardiovasular Surgery Research -- S. Weyl
MOP	Comment on Medical Applications Oriented Preliminary Data Base -- S. Weyl
PMOD	Need for a Medical Applications Oriented Data Base Protocol and Support Facility -- S. Weyl
BSPD	Sharing Patient Data Files -- G. Wiederhold
DBS	Present and Potential Patient-Related Databanks at the Stanford Medical Center -- F. Germano, G. Wiederhold
HTP	Preliminary Data Base for Heart Transplant Pilot Research on Dogs -- S. Weyl

B. TOD Administrative Procedures

TODADM	Administrative Procedures for the PL/ACME Time-Oriented Databank (TOD) -- F. Germano, S. Weyl

C. Notes on Individual TOD Databanks

TDUONA	Programs PRELET - ONCOLET: Oncology Letter Writing Programs -- J. Whitner
*TDUONB	Time-Oriented Databank for the Oncology Clinic -- S. Weyl

D. Keyword Index to TOD Notes

*TODIDX Keyword Index to TOD Notes -- F. Germano, S. Weyl

OTHER REFERENCES

1. Wiederhold, Gio, An Advanced Computer System for Medical Research, PROCEEDINGS OF THE IBM JAPAN COMPUTER SCIENCE SYMPOSIUM--Research and Development and Computer Systems

2. Frey, Girardi, Wiederhold, A Filing System for Medical Research, BIOMEDICAL COMPUTING, (2) (1971).

3. Wiederhold, Gio, Database Structures and Schemas (to be published)

4. Fries, James, Time Oriented Medical Research and a Computer Data Bank, JAMA, vol. 222, no. 12, Dec. 18, 1972, pp. 1536-1542.

Dist: Staff/TOD/All

Core Research & Development (Continued)

The TOD Databank Description Language

The TOD Databank Description Language is a means to define medical data in a less ambiguous form than has been used in the past. ACME Note TODDDL describes this defining capability.

In order to make the task of defining a patient databank easier, forms were designed which contained spaces for the same information required by the TOD Databank Description Language. A sample TOD Databank Element Definition form appears on the next page.

Once several databanks were defined using the TOD Databank Description Language, the concept of the TOD Data Descriptor Dictionary came into being. The Stanford Medical Center Data Descriptor Dictionary is a listing of the data elements in all the TOD databanks. This listing is arranged in order by the symbolic (short 8-character) name assigned to TOD data elements by individual databank planners. To each symbolic name a two-character suffix has been appended to indicate which TOD databank the data element resides in. When several databanks have the same symbolic name for a data item (which should only occur when the elements are indeed the same data variable in each of the individual databanks), they appear together in the listing, each with its own unique suffix.

The data dictionary pulls together in one place the variables stored in all the TOD databanks. It enables new databank planners to see what data already exists in other TOD databanks, but more importantly, it shows what conventions, such as data checking or units, were assigned to the data items.

A sample page for the TOD Data Descriptor Dictionary follows.

TOD DATABANK SAMPLE ELEMENT DEFINITON FORM

STANFORD TOD DATABANK ELEMENT DEFINITION
(TIME ORIENTED DATA)

Name: ______
Project: ______
Date: ______

H or P	ELEMENT NUMBER	LONG NAME	SHORT NAME	UNITS	DATA TYPE (a)	CHARACTER LENGTH	CHECKING: DATA LIMITS Lo	CHECKING: DATA LIMITS Hi	SPECIAL (b)	OFFLINE (b)	INDEX (b)	AUX. FILES: RANGE (b)	AUX. FILES: TRANSPOSE (b)	INITIALIZE To (c)	SAME (b)	ELEMENTS ( ) TO ( ) / COMMENTS

NOTE:

(a) Data Types:
1 – Value
2 – + Range
3 – Discrete
4 – Character
5 – Date
6 – Code
7 – Confidential
8 – Pointer

(b) Enter X if desired

(c) If header element character string does not fit into space, use attached sheet.

TOD-001 (4/73)

ELEMENT NO.	LONG NAME	SHORT NAME and SUFFIX	UNITS	A	F	DATA TYPE	LIMIT CHECKING		INITIALIZATION	
P311	Guaiac (stool occult blood)	GUAIAC _ON	+range			+RNG				
H 28	G I Sx Character	GUTCHAR _IM	none			CHAR				
H 27	G I Sx Date	GUTDATE _IM	date			DATE				
P 84	Gynecologic symptom review	GYN _ON	+range			+RNG				
P 84	Hallucinations	HALLUCE _IM	+			+RNG			0	SAME
P413	Hand X-Rays	HANDX _IM	+		BT	+RNG				
P 17	Frontal Head Pain	HD_FRONT_IM	+		BT	+RNG			0	SAME
P 22	Frontal headache	HD_FRONT_ON	+range			+RNG				SAME
P 16	Occipital Head Pain	HD_OCCIP_IM	+		BT	+RNG			0	SAME
P 21	Occipital headache	HD_OCCIP_ON	+range			+RNG				SAME
P 15	Temporal Head Pain	HD_TEMP _IM	+		BT	+RNG			0	SAME
P 20	Temporal headache	HD_TEMP _ON	+range			+RNG				SAME
P 19	Headache symptom review	HEADACHE_ON	+range			+RNG				
H 30	Neuropsych Sx character	HEADCHAR_IM	none			CHAR				
H 29	Neuropsychiatric Sx date	HEADDATE_IM	date			DATE				
P 51	Heart symptom review	HEART _ON	+range			+RNG				SAME
P386	Heel Pain	HEELPAIN_IM	+			+RNG			0	SAME
P 94	Height	HEIGHT _IM	cm	L	BT	VALU	10	200		
P115	height	HEIGHT _ON	cm	L		VALU	20	250		
P132	Heliotrope eyelids	HELI_EYE_IM	+			+RNG			0	SAME
P 55	Hematemesis	HEMATEM _IM	+		BT	+RNG			0	SAME
P 67	Hematemesis	HEMATEM _ON	+range			+RNG				SAME
P 78	Hematuria,gross	HEMATUR _ON	+range			+RNG				SAME
P227	Hemoglobin	HEMOGLOB_IM	gm %	L	BT	VALU	2	20		
P391	Hemoglobin	HEMOGLOB_ON	gms%	L	T	VALU	2	20		
P 38	Hemoptysis	HEMOPTY _IM	+		BT	+RNG			0	SAME
P 45	Hemoptysis	HEMOPTY _ON	+range			+RNG				SAME
P137	Hepatomegaly	HEPATO _IM	+		BT	+RNG			0	SAME
P156	Hepatomegaly	HEPATO _ON	cm	L	T	VALU	5	50	10	SAME
P187	Hip joints	HIPS _IM	+	L	BT	VALU	0	5	0	SAME
P402	HISTO	HISTO _IM	mm	L		VALU	0	40		
P478	Hospitalization	HOSPITAL_IM	none			+RNG			0	SAME
H 10	Height	HOW_TALL_IM	cm	L		VALU	20	400		
P 51	Heartburn	HT_BURN _IM	+		BT	+RNG			0	SAME
P 63	Heartburn	HT_BURN _ON	+range			+RNG				SAME
P126	Enlarged heart	HT_LARGE_IM	+		BT	+RNG			0	SAME
P142	Enlarged heart	HT_LARGE_ON	+range			+RNG				SAME
P141	Heart physical exam	HT_PHY _ON	+range			+RNG				
P384	Low Back Sx	HXLOBACK_IM	+			+RNG			0	SAME
P383	Neck Sx	HXNECK _IM	+			+RNG			0	SAME
P378	Nodules, Hx	HXNODULE_IM	+			+RNG			0	SAME
P385	Temporomandibular Sx	HXTMARTH_IM	+			+RNG			0	SAME
P379	Tophi, Hx	HXTOPHI _IM	+			+RNG			0	SAME
P190	Infra Clav. left lymphadenopathy	ICL_LYM _ON	cm	L		VALU	0	20		SAME
P189	Infra Clav. right lymphadenopathy	ICR_LYM _ON	cm	L		VALU	0	20		SAME
P 29	Icterus	ICTERUS _ON	+range			+RNG				SAME
P255	IGA	IGA _IM	mgm %	L	BT	VALU	0	1000		
P256	IGG	IGG _IM	mgm %	L	BT	VALU	0	3000		
P257	IGM	IGM _IM	mgm %	L	BT	VALU	0	1000		
P196	Iliac left lymphadenopathy	ILL_LYM _ON	cm	L		VALU	0	20		SAME
P195	Iliac right lymphadenopathy	ILR_LYM _ON	cm	L		VALU	0	20		SAME
P312	Azathioprine	IMURAN _IM	mg/day	L	BT	VALU	0	300		
P265	Immune Electrophoresis	IM_ELECT_IM	none	L		VALU	0	10		
H 16	Index number	INDEXNUM_IM	none	L		VALU	0	2000		

SAMPLE PAGE FROM
TOD DATA DESCRIPTOR DICTIONARY

ACME Note

TODDDL-1

Steve Weyl
April 3, 1973

The TOD Databank Description Language

A. The TOD Schema and DDL:

A TOD databank is constructed and accessed according to a carefully defined databank description called a schema. The schema is specified by a set of "high level" language statements which are stored on a textfile, much like a PL/ACME program. These statements are translated into an internal form by the schema translation program, TD_TRA (ACME Note TDPT).

The high level schema language will henceforth be referred to as the databank description language, DDL. The syntax of DDL resembles PL/ACME syntax, except that it only provides for declarations. DDL is designed to require accuracy and completeness of definition, since these are essential for effective databank operation.

The schema serves two important functions: First, its DDL representation gives an explicit documentation of the content, unit of measurement, reference name, and type of each data item; and it indicates the data initialization, range checking, encoding, and retrieval file maintenance which must be performed. Second, the internal form of the schema provides generalized TOD programs with information about the structure of a specific user's databank (see example in ACME Note TODD, Part III, Section A.2.d.i.).

The necessary information for writing a DDL schema can be accumulated and proofed on a convenient printed form, copies of which may be obtained at the ACME office.

B. Basic Semantics of DDL:

A "single piece" of information is stored in a data item or just item. The information stored in an item is referred to as the value of that item.

The items of a databank can be partitioned into two general categories. Items in the first category are recorded only once and they store demographic information or background information associated with a patient. Items in the second category store the numeric values of several time-dependent parameters recorded for each patient-visit. A "visit" corresponds to a physician interview, or any other point in time at which information about a patient is logged.

DDL represents the two categories of data items as formal arrays. Each formal array element corresponds to a single data item, so that an array of elements is a list of related items. The category of demographic items is represented by the HEADER formal array. The category of time-dependent items is represented by the PARAMETER formal array.

The size of each formal array, and thus the size of each category of items, is established with a declaration statement. Then each formal array element may be assigned a 5-tuple of attributes. These attributes describe the data item associated with a formal array element. The attributes define content, a measurement unit, name, data type, and retrieval type for an item. Unassigned formal array elements are place-holders expediting the introduction of new data items into the databank.

The INITIAL statement allows a user to define the initial (i.e. default) value of each item prior to data entry. Careful assignment of default values can result in major savings of secretarial and processing time. Also, by reducing the amount of data which must be entered per patient-visit, the data entry error rate will be lowered.

C. Formal Syntax for DDL:

DDL sentences

```
/*  comments  */

DECLARE  { HEADER    }  (array_size);
         { PARAMETER }
         { H         }
         { P         }

{ HEADER    }  (array_elt_no)=(content,unit,name,  { VALUE                            }  [LIMIT(min,max)][CHECK][FIX],  { [INDEX][RANGE][TRANSPOSED][PRIVATE] }  )
{ PARAMETER }                                      { +RANGE                           }                                 { NONE                                }
{ H         }                                      { DISCRETE.                        }
{ P         }                                      { CHAR(string_length)              }
                                                   { DATE                             }
                                                   { CODE                             }
                                                   { CONFIDENTIAL(string_length)      }
                                                   { POINTER                          }

INITIAL name [VALUE(initial_value)][SAME];
```

For explanation of formal syntactic conventions, see ACME Note WAA.

Explanation of Terms:

Capitalized words are keywords recognized independently of capitalization. Lower case words are explained below.

"comments" is a string of any characters.
"array_size", "array_elt_no"(array element number), "string_length","min", & "max"are numbers.
"content" and "unit" are literal strings enclosed in single quotes.
"name" is a PL/ACME variable name.
"initial_value" may be literal string (enclosed in single quotes) or a number.

Textfile Format:

Multiple sentences may occur on a single textfile line. Extra non-imbedded blanks are ignored. (Note: Comments are not permitted inside of sentences.)

Note on Semantics:

Some syntactically correct sentences are not semantically acceptable, and will be rejected by the translator. See ACME Note TDPT for these exceptions.

D. Detailed Semantics for DDL Statements:

Comments, enclosed in the PL-conventional "/*" and "*/" are ignored by the schema translator and serve only as documentation.

A declaration statement specifies the number of elements in each formal array. Before data items can be assigned attributes, their associated formal arrays must be declared of adequate size. "H" and "P" are recognized abbreviations for "HEADER" and "PARAMETER".

The formal assignment statement defines for formal array elements the attributes of their associated data items. There are five attributes which must all be specified. We will consider each separately.

The first attribute of a data item is a character string of length ≤ 40 describing the content of that data item. For example, if a HEADER item stores the address of the referring physician for each patient, its content might be described as 'ADDRESS OF REFERRING PHYSICIAN'. The content attribute is included in the schema for documentation purposes. It may eventually be used for computer composition of Time Oriented Record forms.

The second attribute of a data item is a character string of length ≤ 10 describing a standard unit of measurement. For example, if a PARAMETER item stores the white blood cell count for each patient-visit, its units might be described as 'x1000'. A unit must always be specified and a null response will not be accepted. For the HEADER item suggested in the first example, its unit would have to be specified as 'address' or 'none'. The reason for always requiring units is to assure that databank planners fully specify the meaning of each data value, so that data can be shared.

The third attribute of a data item is a (short) name by which the data item may be uniquely identified. This name must be a valid PL/ACME variable name. Names will always be recognized irrespective of capitalization. In the second example above, "WBC" might name "white blood cell count".

Names are an important symbolic attribute of data items, and the use of standard names will greatly simplify communication of information between two data banks and merging of data banks. To assist in the standardization of data item names, a sorted list of names and the attributes of their associated data items will be maintained by the TOD manager.

Public databank procedures will make use of certain standard names for automatic update of data values. For example, the data item named "age" will automatically have the current age of a patient stored in it (as computed from the "date" for this visit and the "birthdat" item for this patient). These standard items are defined in Section E.

In the INITIAL statement, HEADER or PARAMETER elements are identified by their names.

Names will be used in tabular output programs for column headings.

The fourth attribute of a data item specifies the data type of information stored in this item. The following types are available:

1) VALUE data items can meaningfully assume continuous numeric values with six significant figures. They are stored as ACME single precision floating point numbers. VALUE data items are assumed by analysis programs to be measured on an interval scale.

2) +RANGE data items can assume the values 0, 1, 2, 3, 4 (of the "+RANGE scale"), which is treated by analysis programs as an ordinal scale.

3) DISCRETE data items can only meaningfully assume discrete numeric values. Analysis programs consider them to be measured on a nominal scale.

4) CHAR(string_length) specifies that a data item has as its value a string of variable length ≤ "string_length".

5) DATE data items store dates in an internal form. Dates are entered in a standard format, DDMONYY. DD=two digits specifying the day, MON=first three letters of the month (irrespective of capitalization), and YY=last two digits of the year. There are no spaces. The standard form is automatically encoded into an internal "arithmetic date" for storage and numerical manipulation. Stored dates are converted back to external form by TOD retrieval modules.

6) CODE data items are stored as numeric values related by encoding-decoding procedures to a more legible representation. For example, the item "sex" might be coded as 0, 1 for F, M.

7) CONFIDENTIAL data items are encoded and decoded by private procedures providing keyword-protected scrambling. Only HEADER information can be confidential.

8) POINTER data items store pointers to information contained in an auxiliary data file, defined for a specific TOD databank. What gets pointed to by a POINTER items is determined when an individual TOD databank is defined. As an example, a HEADER element of type POINTER might point to the first of a group of textfile lines comprising a reference letter for each patient.

There are three data type qualifiers. At data entry time an item for which LIMIT(min,max) is specified will have its value checked. If the entered value falls outside of the specified limits, an error message will be given.

At data entry time an item for which CHECK is specified will have its value checked for validity by the user-provided encoding-decoding data check procedures (see ACME Note [illegible]). Items for which FIX is specified will have their values checked by a big data checking program run incrementally against the databank asynchronously with data entry.

The fifth attribute of a data item specifies the retrieval type for information stored in this item. Retrieval files will be maintained by a public UPDATE program facilitating the retrieval of data items in accordance with their retrieval types. Like the other attributes, retrieval type cannot be omitted from the formal assignment statement. Any subset of the types INDEX, RANGE, TRANSPOSED, or PRIVATE may be given for retrieval type, or else the user must specify the type NONE. PRIVATE indicates that a user maintains private files to expedite retrieval for this parameter.

Leaving several formal array elements unassigned with attributes greatly decreases the cost of adding new data items at databank recompilation time, and is highly recommended. Assignment of previously unassigned formal array elements is a relatively inexpensive way of expanding a data bank, whereas redeclaration of formal arrays leads to costly reformatting of the entire databank.

The INITIAL statement causes the data items corresponding to a named formal array element to be set to an initial value given as "initial_value" prior to data entry, checking and encoding. If "SAME" is specified for a HEADER element, it has no effect. If "SAME" is specified for a PARAMETER element, then it has the following effect: On the first visit for each patient, this parameter element is set to UNDEFINED, or to its initial value if VALUE (initial_value) was indicated. Then for each successive visit this item's value is initialized to its value on the previous visit for this patient. If no initialization is specified, numeric values are automatically set to "UNDEFINED" = -0.0 and string values are set to null as a default.

Formal array elements must be assigned attributes before they can be assigned initial values.

Declarations of formal arrays must precede use of formal array elements, and an assignment of attributes to a formal array element must precede its initialization. If several assignments or initializations are specified for one formal array element, only the last will be effective.

E. Required Items:

The following three HEADER and two PARAMETER element assignments must be included in every databank definition if a user wishes to take advantage of public data entry and retrieval programs. The assignments are written in DDL with explanatory comments. Data type qualifiers and retrieval types other than NONE are acceptable throughout.

```
HEADER(1) = ('Name: last,first,middle initial','none',NAME,CHAR(30),NONE);
HEADER(2) = ('Stanford medical record number','none',MEDREC,VALUE,NONE);
            /*  Stored as a six digit number. */
HEADER(3) = ('Birthdate','none',BIRTHDAT,DATE,NONE);
PARAMETER(1) = ('Date of visit','none',DATE,DATE,TRANSPOSED);
PARAMETER(2) = ('Age of patient to date','years',AGE,VALUE,NONE);
               /* The value of age will be automatically computed from
                  BIRTHDAT as a decimal number of years when the value
                  of DATE is entered. */
```

F. Restrictions on Databank Schemas:

See ACME Note TDPT, Section 6.

G. Example of a DDL Schema, subset of the Oncology Databank (ACME Note TDUONS):

-text-td_schem

```
/*    ******    */
DECLARE HEADER(15);
DECLARE PARAMETER(50);
HEADER(1) = ('Name: last, first,middle initial', 'none', NAME, CHAR(40), INDEX );
HEADER(2) = ('Stanford medical record number', 'none', MEDREC, VALUE, INDEX );
HEADER(3) = ('Birthdate', 'none', BIRTHDAT, DATE, NONE );
HEADER(4) = ('Sex: M male, F female', 'sex', SEX, CODE, INDEX );
HEADER(5) = ('Patient address', 'none', ADDRESS, CHAR(100), NONE );
HEADER(6) = ('Zip code', 'none', ZIP_CODE, CHAR(5), NONE );
HEADER(7) = ('Phone number', 'none', PHONE, CHAR(10), NONE );
HEADER(8) = ('Diagnostic code 1', 'none', DCODE1, CHAR(11) CHECK, INDEX );
HEADER(9) = ('Diagnostic code 2', 'none', DCODE2, CHAR(11) CHECK, INDEX );
HEADER(10) = ('Diagnostic code 3', 'none', DCODE3, CHAR(11) CHECK, INDEX );
HEADER(11) = ('Diagnostic code 4', 'none', DCODE4, CHAR(11) CHECK, INDEX );
HEADER(12) = ('Diagnostic code 5', 'none', DCODE5, CHAR(11) CHECK, INDEX );
HEADER(15) = ('Race:1w,2b,3o', 'none', RACE, DISCRETE LIMIT(1, 3), INDEX );
PARAMETER(1) = ('Date of visit', 'date', DATE, DATE,TRANSPOSED );
PARAMETER(2) = ('Age of patient to date', 'years', AGE, VALUE, TRANSPOSED );
PARAMETER(3) = ('fatigue', '+range', FATIGUE, +RANGE, NONE );
INITIAL FATIGUE SAME;
PARAMETER(4) = ('fever', '+range', FEVER, +RANGE, NONE );
INITIAL FEVER SAME;
PARAMETER(5) = ('chills', '+range', CHILLS, +RANGE, NONE );
INITIAL CHILLS SAME;
PARAMETER(6) = ('nightsweats', '+range', SWEATS, +RANGE, NONE );
INITIAL SWEATS SAME;
PARAMETER(7) = ('weight loss', '+range', WT_LOSS, +RANGE, NONE );
INITIAL WT_LOSS SAME;
PARAMETER(8) = ('pain', '+range', PAIN, +RANGE, NONE );
INITIAL PAIN SAME;
PARAMETER(9) = ('Pruritis', '+range', PRURIT, +RANGE, NONE );
INITIAL PRURIT SAME;
PARAMETER(10) = ('Karnofsky status%', 'none', KARNOF, VALUE LIMIT(0, 100), TRANSPOSED );
INITIAL KARNOF SAME;
PARAMETER(15) = ('height', 'cm', HEIGHT, VALUE LIMIT(20, 250), NONE );
PARAMETER(16) = ('weight', 'kilograms', WEIGHT, VALUE LIMIT(5, 150), NONE );
PARAMETER(17) = ('BP-systolic', 'mm Hg', BP_SYST, VALUE LIMIT(60, 300), NONE );
PARAMETER(18) = ('BP-diastolic', 'mm Hg', BP_DIAS, VALUE LIMIT(0, 180), NONE );
PARAMETER(19) = ('Temperature', 'deg C', TEMPERAT, VALUE LIMIT(35, 45), NONE );
PARAMETER(20) = ('respiration', 'per min', RESPIR, VALUE LIMIT(5, 60), NONE );
PARAMETER(40) = ('Absolute lymphoctyes (computed)', 'x1000/mmcu', LYMPH_AB, VALUE, TRANSPOSED );
/* Absolute lymphocyte count is computed at data entry time as wbc * lymphs in percent of wbc.  */
PARAMETER(41) = ('Absolute neutrophils (computed)', 'x1000/mmcu', NEUT_AB, VALUE, TRANSPOSED );
/* Absolute neutrophils are computed at data entry time as wbc * neut in percent of wbc.  */
```

Dist: Staff/TOD/All

Core Research & Development (Continued)

Analyzing TOD Operational Costs

Early during the TOD project we found that physicians did not have the tools available to get an adequate picture of the operational costs of a databank. They knew their total costs and what they did, but the task of allocating costs to individual transactions had become complex. An attempt was made during the project to set up a cost analysis framework to aid the researcher in determining where his computer dollar went. ACME Note TODCST outlines a study underway; ACME Note TODPDA outlines the method of trapping basic cost and transaction data for the TOD system. Note TODCST follows.

ACME Note

TODCST-1
Frank Germano
March 22, 1973

Analyzing the Costs of Running a TOD Databank

This note outlines a study to analyze the costs of running a TOD databank. Components of costs and procedures to compare them are identified, both for comparisons of cost components within individual databanks and among several databanks.

The outline described in this note will be used to compare TOD costs in Immunology and Oncology, two operational TOD databanks. In the future, as the number of TOD databanks grows, the benefits of cross-databank cost comparison, as outlined here, will increase. In any event, cost comparisons among components of a single databank are always useful.

Raw Data Sources:

The raw data for analyzing costs of a TOD databank can come from several sources:

(1) ACME end-of-billing period accounting detail which shows LOGON-LOGOFF pageminute charges by account.

(2) TOD program TD_CSTCK output.

(3) Independent logs kept by TOD users.

Each source yields information on some aspects of the cost picture. All have certain biases which should be understood.

ACME End-of-Billing Period Accounting Data:

The ACME end-of-billing period accounting data is the most critical because the monthly bill is developed from it. This is the number we are trying to analyze and justify. At present, an ACME user only gets a monthly bill showing totals for disk blocks, pageminutes, and terminal connect charges for the month. The logon-logoff detail is only provided on special request.

Since this detail is only identified by date, time, terminal, and pageminutes used during a session, and since a user can run many different programs during the time he is logged on, it is difficult to break down the costs of individual sessions to component operations. A component operation can be a program or some transaction(s) within a program.

The availability in ACME of a "pageminute used so far" function would be helpful in breaking down session costs. Even with this function, the responsibility of trapping the data and analyzing it falls to the application program. The availability of this command would eleminate the major error in accounting estimates made by the TD_CSTCK program described below.

TOD TD_CSTCK Program:

This program was designed to analyze the data generated by the TODOPEN-TODCLOSE procedures present in most TOD programs. These procedures estimated the pageminutes used by individual TOD programs and logged the appropriate data. The pageminute function described above would turn these estimates into actual data.

The bulk of TD_CSTCK is a TOD cost analysis system. Attempts are made to allocate costs by program, but more important, by transactions done by the programs. See ACME Note TODPDA for a discussion of the TD_CSTCK program.

TD_CSTCK is the first step in the data analysis because it is designed to allow the user to purge the data once a month coinciding with the accounting cycle. Data over time, for which an analysis framework will be developed later in this note, is not presently kept in computer form. Later as the kinds of analysis become more stable, TD_CSTCK can be modified to keep data month-to-month and appropriately analyze it.

Presently there exists a program TD_COMPR, which is a modified TD_CSTCK. TD_COMPR will summarize costs for <u>any</u> TOD databank whereas TD_CSTCK can only access data from the name and project with which a user logged onto ACME. TD_COMPR is only to be used by the TOD Manager.

<u>Individual Logs</u>:

Individual logs suffer from several disadvantages. They require <u>everyone</u> who operates the terminal to use it, a requirement which in practive is never adhered to. To get the detail provided by the method above would require an amount of time most users of the system would not be willing to spend. Individual logs are useful to keep data unrelated to the programs and transactions. For example, keeping a log of the names of people using a databank would allow better distribution of documentation to the people who need it.

<u>COST Components for Individual TOD Databanks:</u>

There are three major areas of cost in the operation of a TOD Databank. They are: personnel costs, computer run charges (including terminal rental), and computer disk storage. Personnel costs will not be directly studied here.

<u>Computer Run Charges</u>:

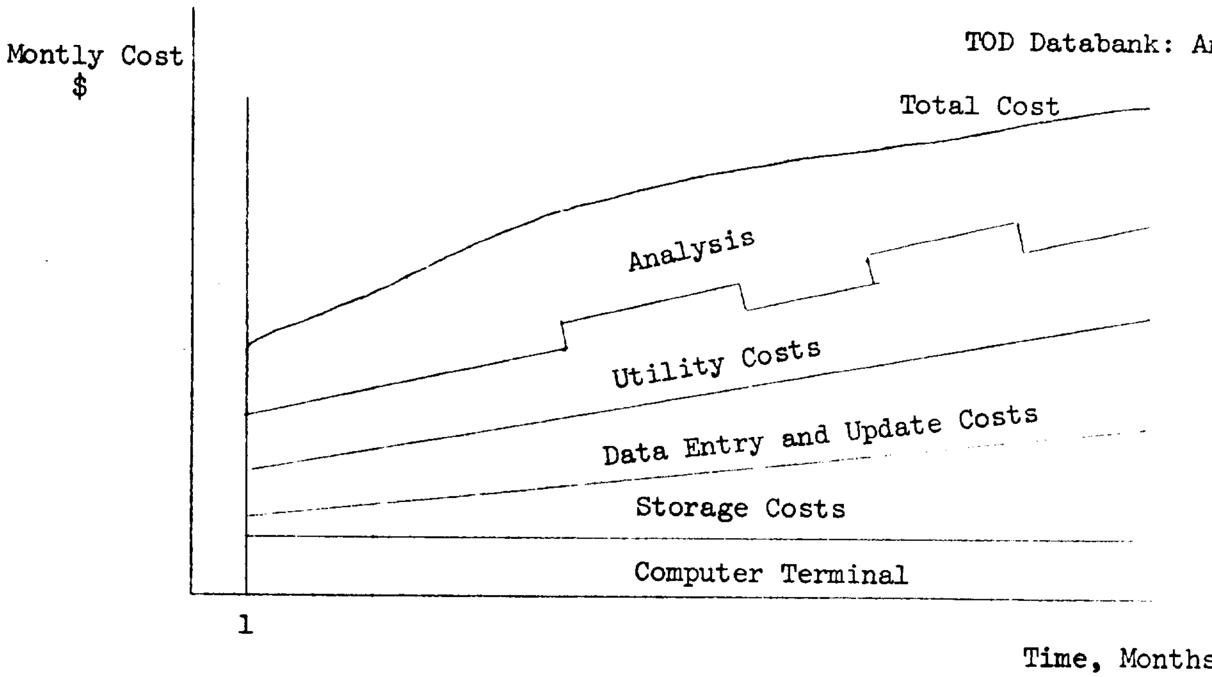
Computer run charges are composed of many components:

- The terminal rental per month is presently $190 per month.
- The actual program charges for running a TOD databank can be broken down into several functional area: data entry and update; subset; analysis; and utility procedures. Many TOD programs can be found in each area. ACME Note TODI indicates this partitioning.
- The bulk of the computer run costs for a TOD databank fall into the data entry and update area. Dr. Jim Fries has estimated data entry and update charges to be 75% of the run time costs.

Individual Aggregate Analysis:

A useful analysis for an individual databank would be to follow the individual group mentioned above over time. Graph I illustrates this analysis. "Costs" can be measured in dollars, pageminutes, or time-units.

Graph I. Individual Aggregate Analysis



Note: Figure not necessarily to scale.

Graph I illustrates an aggregate analysis and includes all the factors that influence costs, such as more people using the databank, more patients in the databank, higher activity than normal in a functional area, etc.

In order to begin to understand the reasons why these aggregates change, a more detailed analysis is required. Data entry and update costs will be used as an illustration because they are the most critical. A similar analysis could be developed for the other functional areas.

In TOD, a patient's demographic information can be entered; this data can be updated; a patient-visit can be entered; and this visit data can be updated. These operations are done by the four programs TD_ESTAB, TD_EFIX, TD_VISIT, TD_VFIX, respectively. Costs in each of these programs are influenced by the same variables. The major variables are: the number of patients or visits entered or fixed at one use of the program; the number of elements per patient which were entered or fixed; and the complexity of the data entered. These variables influence computer charges for data entry. They also influence disk charges because the files increase in size as more data is entered.

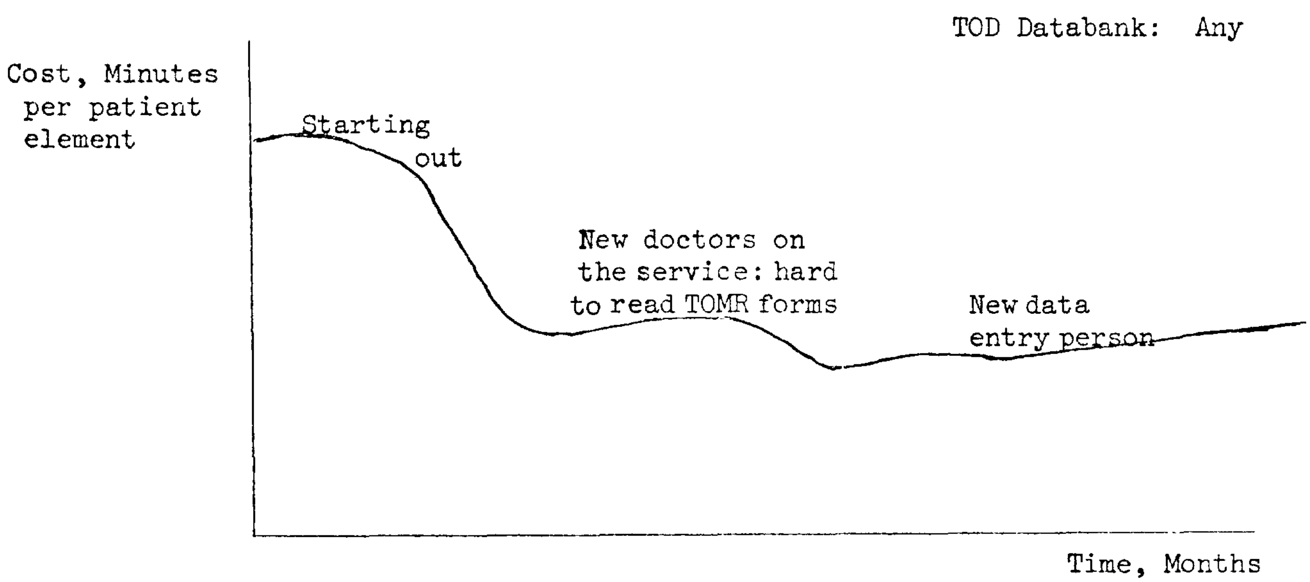
In looking at the costs of using these programs, the example of entering a patient's demographic information using program TD_ESTAB will be studied. Similar statements can be made for the other programs. In TD_ESTAB, the cost (time, dollars, or pageminutes) per patient entered is useful because it removes the direct effect of the number of patients entered to yield a more basic cost coefficient. For the same reason, the cost per patient element entered is taken as the elementary cost unit. One could argue that the complexity of the element measured in key-strokes to enter would be the true basic cost unit. At present we are only analyzing down to the element level.

Watching the cost per patient and the cost per element provides useful insight into the data entry costs. If the number of elements added per patient was always about the same, then we wouldn't have to use the cost per element; the cost per patient would do. In Oncology and Immunology, the number of elements entered per patient does vary widely. TD_CSTCK does not presently include compile time.

One must remember that the cost of compiling a program is finite and could shadow the effect of entering data. The effects are relative in the sense that 20 elements for a patient might be comparable to one quarter of compile time. In this case, ignoring compile time, which is not accounted for by TD_CSTCK, introduces a sizable error. If 200 elements were entered, the error of not counting compile time becomes negligible.

Having picked cost per element as the elementary item, Graph II illustrates a method of studying it over time. Cost will be measured in minutes per patient element.

Graph II. Elementary Cost Components Vs. Time



One would expect variability in this elementary item for several reasons. A badly written TOMR chart with items improperly marked will slow down the data entry operation. Interruptions of the data entry person such as phone calls, visitors, etc., will increase the data entry cost. A new data entry person will take more time until he or she has learned the system. Assuming a consistent chart, no interruptions, and the same data entry person, the costs still will vary (e.g. data entry person can become bored or fatigued).

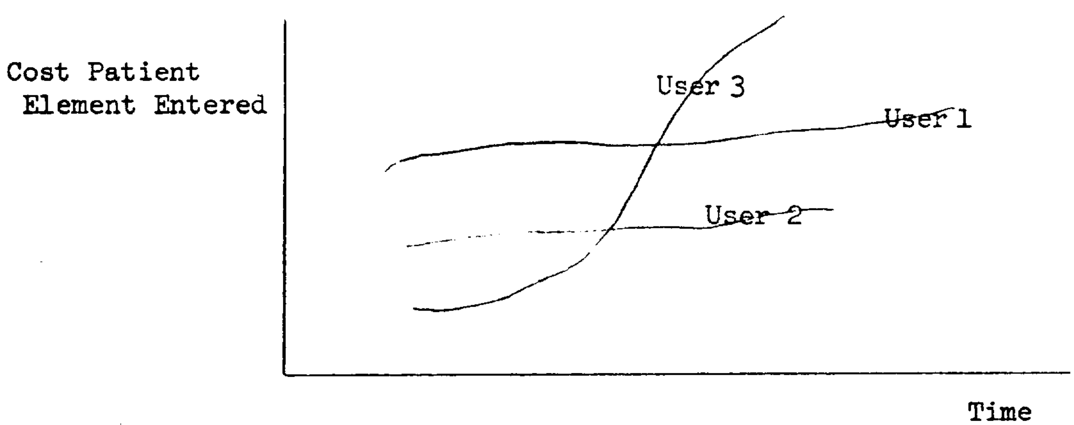
Cost Comparisons Among Databanks:

Aside from intra-databank comparisons discussed earlier, inter-databank comparisons can be made.

Studying the costs of running databanks using the same programs allows us to establish norms or standards for the operations involved in running a databank. The data is also useful in estimating future costs of planned databanks. A better understanding of costs will allow the detection of high cost areas and, hopefully, the subsequent improvement of these areas. For example, if a databank has an elementary cost component twice that of another databank, that tells us something about the first databank's operation. Moreover, if we can determine what the second databank is "doing right" and can teach the first databank the same procedures, it too can lower its costs.

Each month, elementary cost items can be tabulated and summarized for all the operational TOD databanks. Graph III illustrates a data entry cost comparison for several users.

Graph III. TOD Data Entry Cost Comparison



Aggregate items can also be compared among TOD users. Some of the more important items are listed in Table I. All items are per month.

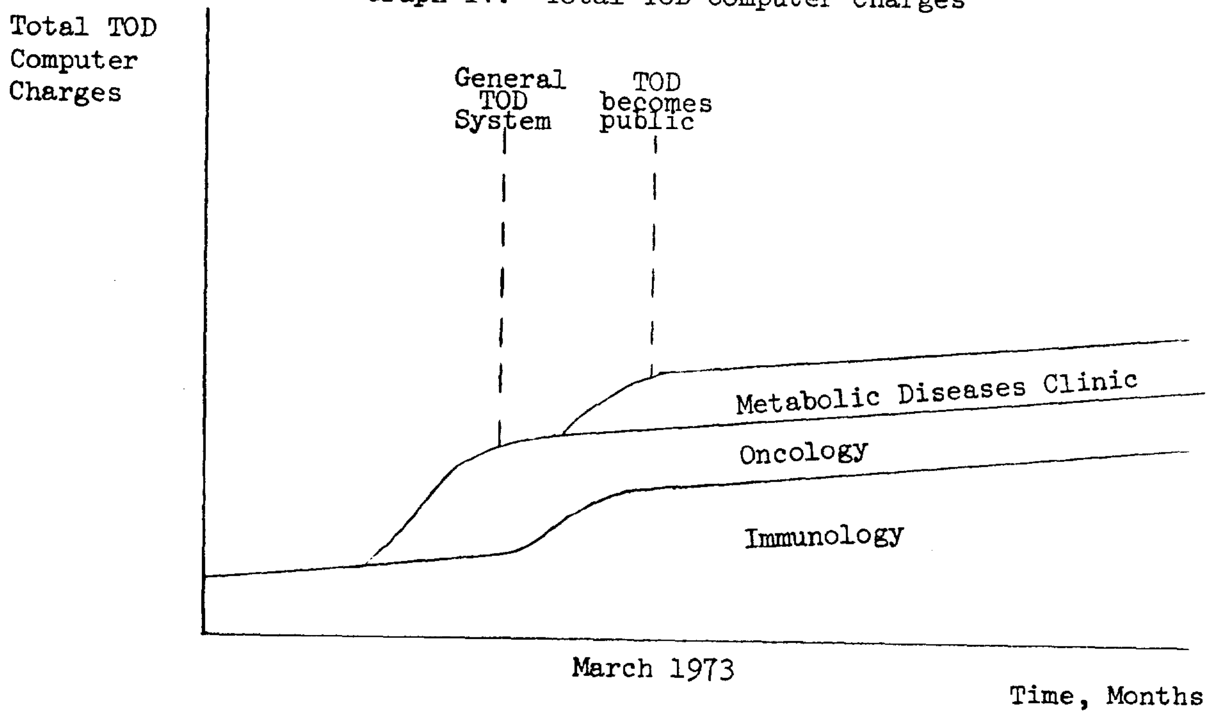
Table I. TOD Costs Comparison for all TOD Users

Month of: x x x x x x x

ITEM	USER 1	USER 2	USER 3	. . .
From ACME Accounting:				
Terminal Cost.				
Computer Cost.				
Number of Pageminutes.				
Number of Minutes.				
Number of Blocks.				
From TD_CSTCK:				
Minutes.				
$ Estimated.				
Pageminutes Estimated.				
Cost per Program.				
Cost per Functional area.				
Miscellaneous:				
Ratio($ from ACME to $ from TD_CSTCK).				
Ratio(Time from ACME to time from TD_CSTCK).				
Ratio(Pageminutes from ACME to page. from TD_CSTCK).				
% of cost falling in each functional area.				
Number of patients in file.				
Number of patients entered.				
Number of patient-visits in file.				
Number of patient-visits entered.				

A final analysis which would illustrate the use of TOD is shown in Graph IV.

Graph IV. Total TOD Computer Charges



Dist: Staff/TOD/All

Core Research & Development (Continued)

C. New Analysis Programs for Time Series Data

Project: ACME Realtime

Investigator: Will Gersch

Dept. of Neurology

1. Description

ARSPEC is an interactive research tool for automatic spectral density analysis of time series data. The program performs four interrelated tasks: (1) display of time series data; (2) filter design and application to data; (3) data reduction; and (4) spectral density computation. The user instructs ARSPEC to perform tasks in a desired order by issuing supervisory commands.

Unlike PUBLIC program TIMESER, ARSPEC uses an automatic decision procedure to produce accurate spectral estimates. This technique is applicable to all time series data.

The computational procedures are defined in ACME Note EARSPE-2.

2. Historical Note

The recursive procedure for computing autoregressive coefficients is due to Levinson (A)(1947). This procedure was "re-discovered" by Durbin (B)(1960). The automatic decision procedure for deciding the order of the autoregressive model is due to Akaike (C,E)(1970). An alternate statistical procedure based on earlier statistical procedures for deciding autoregressive model order appears in Gersch (D)(1970).

3. A Short Explanation of Spectral Analysis by Autoregressive Model Technique

Conventional spectral analysis procedures compute spectral density estimates using a weighted Fourier transform of the empirical autocorrelation function of observed time series. The use of conventional techniques is complicated by the requirement that a user assign the values of parameters determining statistical tradeoffs in the spectral representation. This requires expertise with spectral estimation theory. As a case in point, conventional spectral analysis techniques are employed by ACME PUBLIC program TIMESER.

The autoregressive model technique fits a model to be observed data. This model is autoregressive in that each observation of the time series is expressed as a linear combination of its own past (hence it is regressive on itself) plus a term drawn from an uncorrelated sequence (Equation 1). The coefficients of the model are determined by a least squares fit to the empirical autocorrelation function. The order of the model is determined by the Akaike (E) final predictor error criterion.

Core Research & Development (Continued)

Spectral density estimates are calculated from the coefficients of the autoregressive model (Equation 2).

The statistical performance of spectral estimation using the autoregressive technique has the properties that (i) the spectral estimates are unbiased, and (ii) the variance of the spectral estimates is approximately given by

$$\text{var } \hat{S}(f) = \frac{2p}{N} \hat{S}^2(f)$$

where p = the order of the autoregressive model. The statistical performance of this procedure is at least as good as the performance of the best conventional spectral estimate. Finally, the fact that the procedure is unbiased eliminates the need for expert determination of the statistical trade-offs, and hence the procedure can be made automatic.

4. <u>References</u>

A. Levinson, N. (1947). The Wiener RMS (Root Mean Square) Error Criterion in Filter Design and Prediction. J. Math. Physics, <u>XXV</u>, pp. 261-278.

B. Durbin, J. (1960). The fitting of time-series models. Rev. Int. Stat. Inst. <u>28</u>, pp. 233-244.

C. Akaike, H., Information theory and an extension of the maximum likelihood principle, presented at the Second International Symposium on Information Theory, Tsahkadsor, Armenian SSR, 2-8 of September, 1971. (To be published in <u>Problems of Control and Information Theory</u>, USSR 1972.)

D. Gersch, W. (1970), "Spectral Analysis of EEG's by Autoregressive Decomposition of Time Series", <u>Mathematical Biosciences</u>, 7, 1970, pp. 205-222.

E. Akaike, H., Statistical Predictor Identification, Ann. Inst. Stat. Math., <u>21</u>, 1970.

5. <u>Sample Runs</u>

Raw data is a sine wave imbedded in noise. Noise is Gaussian noise with mean zero and standard deviation an order of magnitude greater than the sine wave amplitude. Noise has been passed through a high pass filter before addition to the sine wave.

Core Research & Development (Continued)

```
Data set number of graphics device=?13
Ψ YOU ARE NOW PERMITTED 01 LINES ON THE 1800
Number of raw data samples=?1000
Name of raw data file =?TEST
Key of record containing raw data=?1
Enter a command =?display
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
```

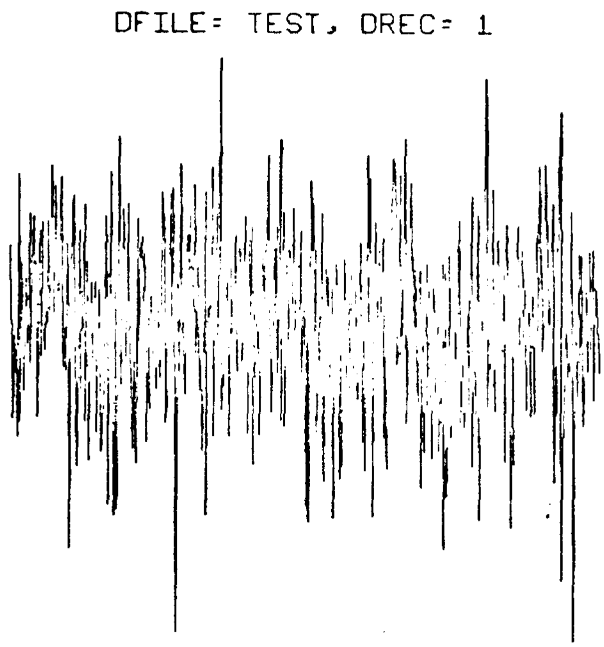


FIGURE 1

```
Enter a command =?spectrum
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
 ='Autoregressive model is of order',=     40;
Optional description of spectrum =?sine wave in filtered noise
Enter 0 if done, nonzero to save spectrum on data file.=?0
```

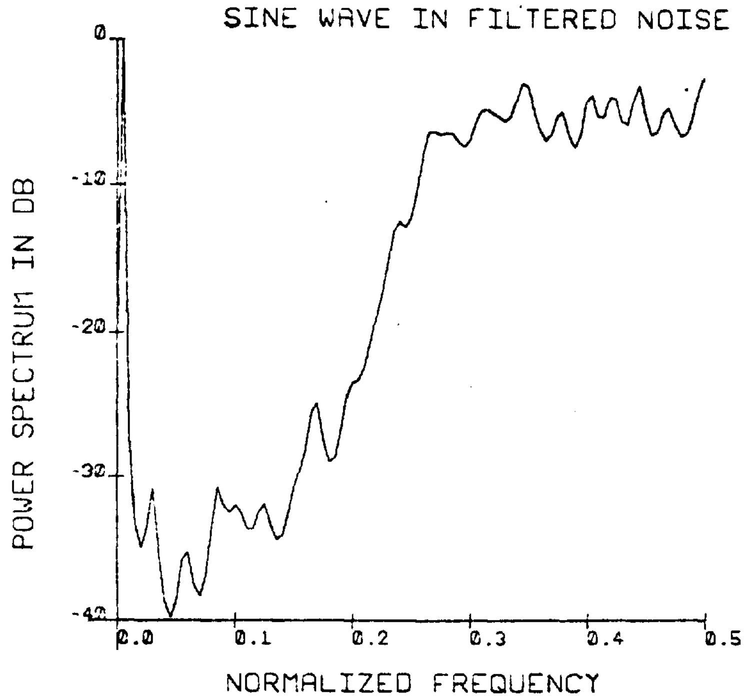


Figure 2

```
Enter a command =?filter
High frequency cutoff point=?0.1
Low frequency cutoff=?0.05
Enter 0 for low pass, nonzero for high pass filter=?0
Enter 0 for unsmoothed, nonzero for smoothed filter=?1
Enter 0 to display, nonzero to apply filter=?0
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
```

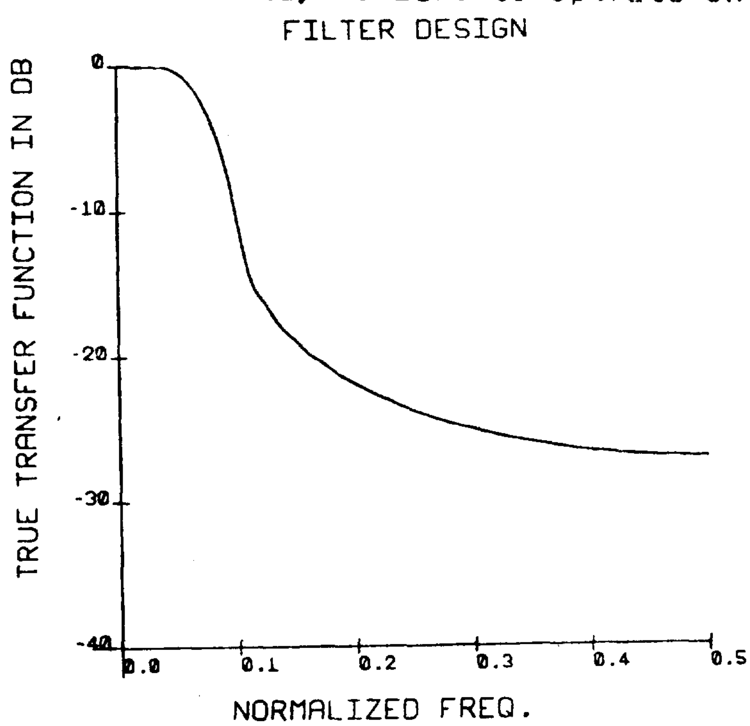


FIGURE 3

After filtering, we can see the original sine wave.

```
Enter a command =?display
Enter 0 to operate on raw data, nonzero to operate on processed data=?1
```

PROCESSED DATA

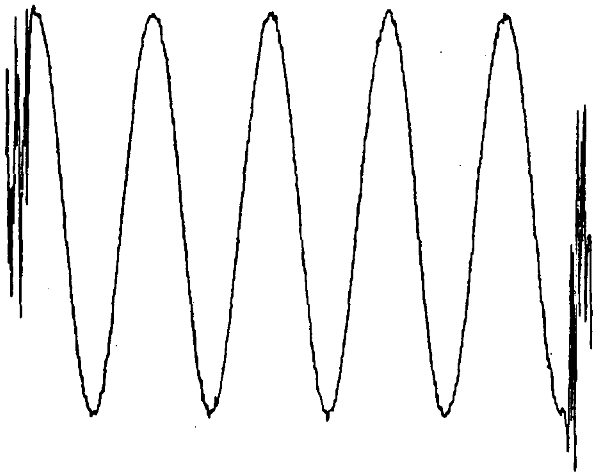


FIGURE 4

Note the end effects caused by filtering

2. The second example is a spectral analysis of actual EEG data.

```
Data set number of graphics device=?91
Number of raw data samples=?2000
Name of raw data file =?EEGDATA
Key of record containing raw data=?100
Enter a command =?display
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
```

DFILE= EEGDATA, DREC= 100

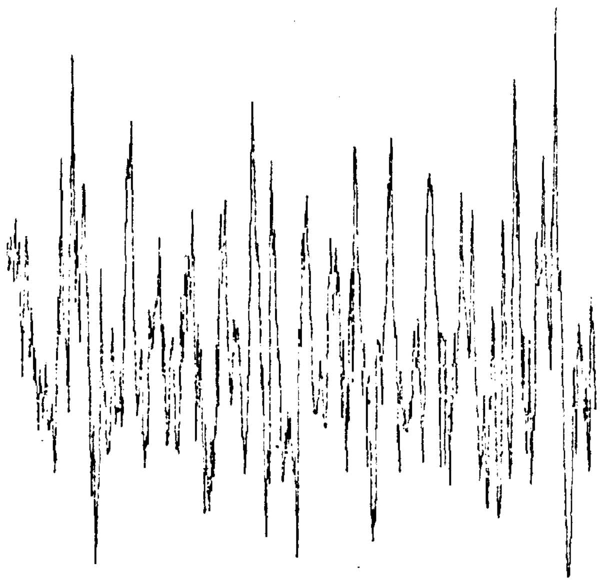


Figure 5

```
Enter a command =?spectrum
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
 ='Autoregressive model is of order',=     22;
Optional description of spectrum =?EEG SPECTRUM
Enter 0 if done, nonzero to save spectrum on data file.=?0
```

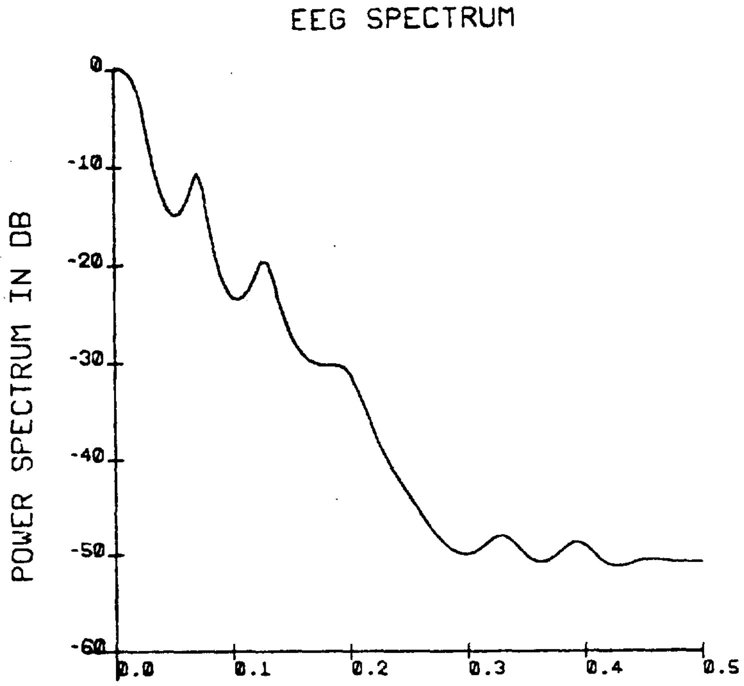


Figure 6

A low pass filter is now applied; then data is reduced to 1000 points.

```
Enter a command =?filter
High frequency cutoff point=?0.25
Low frequency cutoff=?0.2
Enter 0 for low pass, nonzero for high pass filter=?0
Enter 0 for unsmoothed, nonzero for smoothed filter=?1
Enter 0 to display, nonzero to apply filter=?1
Enter 0 to operate on raw data, nonzero to operate on processed data=?0
Enter a command =?reduce
Enter 0 to operate on raw data, nonzero to operate on processed data=?1
Number of reduced data samples=?1000
Enter a command =?spectrum
Enter 0 to operate on raw data, nonzero to operate on processed data=?1
 ='Autoregressive model is of order',=     21;
Optional description of spectrum =?
Enter 0 if done, nonzero to save spectrum on data file.=?0
Enter a command =?done
● 127: RUN STOPPED
   AT LINE    3.100 IN PROCEDURE ARSPEC
```

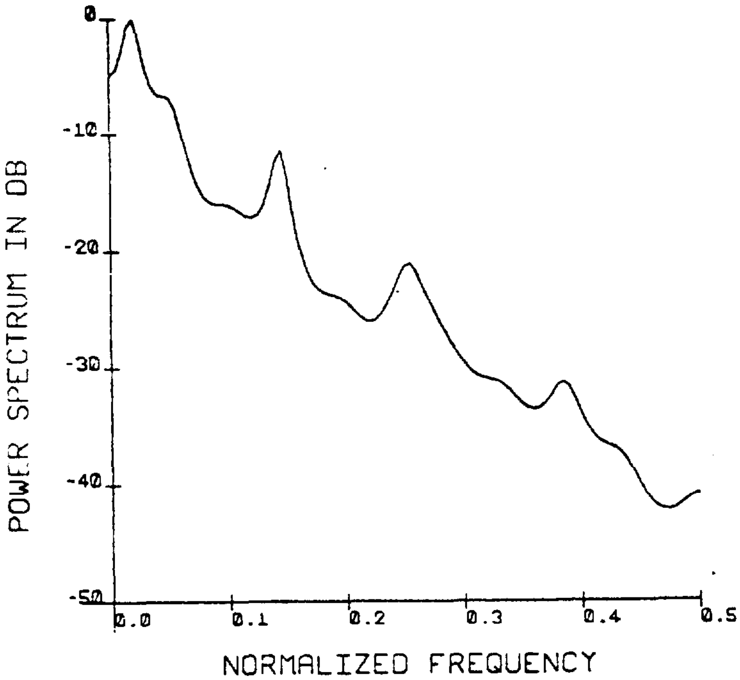
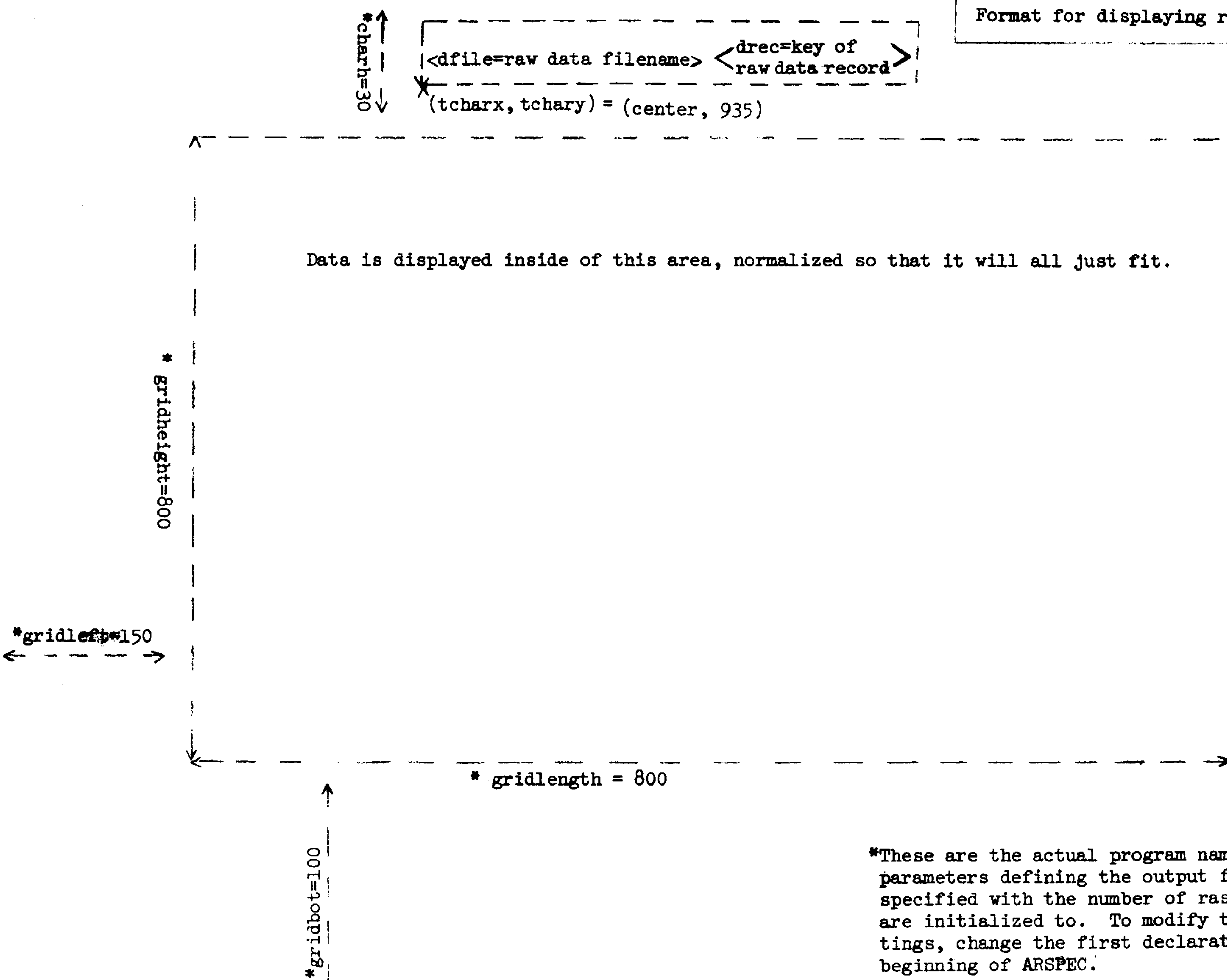


Figure 7

The spectral outline of the reduced and filtered data has characteristics parallel to the original data. Note that 50% reduction of data causes the normalized frequency scale to double.

Format for displaying raw data

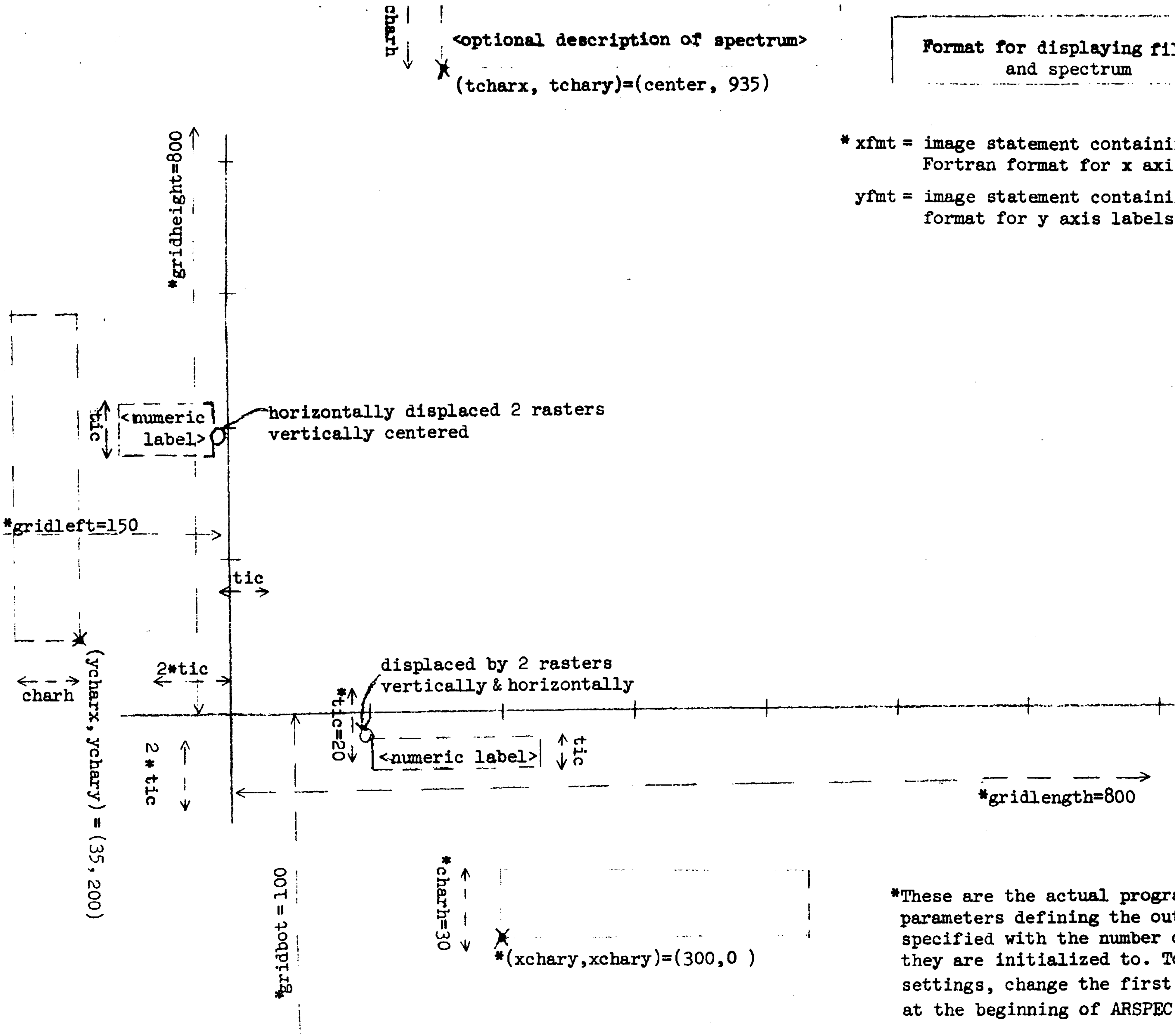


*These are the actual program names of parameters defining the output format, specified with the number of rasters they are initialized to. To modify these settings, change the first declaration at the beginning of ARSPEC.

Format for displaying filter and spectrum

* xfmt = image statement containing Fortran format for x axis labels

yfmt = image statement containing Fortran format for y axis labels



*These are the actual program names of parameters defining the output format, specified with the number of rasters they are initialized to. To modify these settings, change the first declaration at the beginning of ARSPEC.

D. Miscellaneous Core Projects

For descriptions of the other projects which had core research status during FY73, see the Summary of Computer Resource Usage, Categories 5 and 6, in Section VII of this report.

VI. BUDGET

The budget section of this annual report is divided into the following topics:

A. Resource Expenditures

B. Expenditure Details

C. Summary of Resource Funding

D. Resource Equipment List

E. Income Statement for 12-Month Period Ending April 1973

Fiscal year 1973 direct costs will be $800,000. This will be offset by approximately $260,000 in income from service fees. These figures exclude costs associated with providing terminal services to users and the income received through terminal service fees.

Section E indicates that income of $289,000 was received from users in the 12-month period ending April 1973, compared to prior year income of $230,000. The terminal service fees accounted for approximately $100,000 in additional income during each of these two years; roughly one-half of this sum was spent for terminal rentals while the balance has been used to provide services best offered from a central point and to support new communications gear for use of the 370/158 facility.

A. Resource Expenditures

SUMMARY

	Total Resource Expenditures 05 year (8/1/70-7/31/71) Budget Period	06 year (8/1/71-7/31/72) Budget Period	06S year* (8/1/72-7/31/73) Budget Period
1. Personnel:			
a. Salaries & Wages	239,329	244,023	278,422
b. Staff Benefits	32,851	36,814	44,377
Subtotal	272,180	280,837	322,799
2. Consultant Services	912	508	--
3. Equipment			
a. Main Resource-Rented	384,542	385,926	383,862
b. Main Resource-Purchased	40,843	61,218	36,371
c. Supporting Equipment	1,951	1,259	1,260
d. Equipment Maintenance	6,145	14,764	14,500
Subtotal	433,486	463,167	435,993
4. Supplies	15,873	9,251	5,800
5. Travel	3,047	2,138	4,000
6. Engineering Services	11,818	25,236	12,700
7. Publications Costs	3,031	4,608	6,000
8. Other			
a. Computer Services (1)	8,272	3,250	5,900
b. Other	9,531	11,243	12,100
Subtotal	17,803	14,493	18,000
9. Subtotal - Direct Costs	758,150	800,238	805,292
10. Indirect Costs	141,205	103,120	65,196 (2)
11. Total Costs	899,355	903,358	870,488

(1) Includes education courses

(2) Assumes $403,561 exempt equipment costs and user income of $260,000

* 06S refers to one year extension

B. Expenditure Details

DIRECT COSTS ONLY

	06 year August 1, 1971- July 31, 1972	06S year August 1, 1972- July 31, 1973
1. Personnel		
Director's Office	32,928	28,391
Systems Analysis	2,758	7,748
Systems Programmers	91,263	86,907
Applications Programmers	37,631	50,428
Research Assistants	9,094	5,227
Operations	56,588	59,185
Secretarial & Administrative	13,761	14,674
I.R.L. Support Personnel		25,862
Subtotal, Salaries	244,023	278,422
Staff Benefits	36,814	44,377
TOTAL PERSONNEL	280,837	322,799
2. Consultant Services	508	---

B. Expenditure Details

DIRECT COSTS ONLY

		August 1, 1971- July 31, 1972	August 1, 1972- July 31, 1973
3. Equipment			
Major Equipment			
1052	Console Typewriter	635	635
1403	Printer 600 LPM	8,397	8,397
2050	Additional CPU (F)	99,955	101,297
2314 #1	Dir. Acess Storage	21,466	---
2314 #2	Dir. Acess Storage	19,988	---
2361	Core Storage	27,291	---
2401	Mag. Tape Unit	3,377	3,377
2403	Mag Tape Unit Control	8,971	8,971
2540	Card Reader Punch	6,947	7,157
2701	Data Adapter Unit	10,561	10,728
2702	Transmission Control	13,162	---
2821	Control Unit	10,937	10,937
	Ampex DC 314	20,068	38,642
1	Ampex DC 314	22,243	36,304
	Ampex ECM-50	77,949	119,922
	Memorex 1270	2,967	16,248
Subtotal		354,914	362,615
	Disk Pack Rentals (25/25)	2,333	2,434
	Terminals Rentals (10/6)	10,767	7,900
	IBM 1800 add. units		
1442		2,638	2,671
1826		7,691	7,691
1856		1,701	1,701
Subtotal, 1800		12,030	12,063
	Unit Record 029	1,259	1,260
	Data Set and Line Rentals	5,882	< 1,200 >*
TOTAL, MAIN RESOURCES AND SUPPORTING EQUIPMENT RENTALS		381,303	386,322

* Reflects corrections of charges mistakingly placed on Grant account for graphics communication services.

B. Expenditure Details

DIRECT COSTS ONLY

	August 1, 1971- July 31, 1972	August 1, 1972- July 31, 1973
Purchased Equipment		
RPQ's for Beehive Terminals	381	
PDP-11 System	38,237	
DEC Dual Tape Systems	7,450	
Computer Terminals (4)	15,150	
1200 Baud modems (2 + power supply)		438
Sale of Beehive Terminals & Interfacing		< 8,975 >
Printer for Beehive CRT/PDP-11		3,570
Computer Terminals (5)		16,013
Equipment for PL/ACME follow on system*		25,325
Subtotal Purchased	61,218	36,371
Maintenance (Under outside contract)	14,764	14,500
Total Equipment	463,167	435,993

* Some money has been shifted from other budget categories to permit purchase of equipment needed to provide follow-on PL/ACME services. More detail is presented on separate correspondence to NIH.

B. Expenditure Details
DIRECT COSTS ONLY

		August 1, 1971- July 31, 1972	August 1, 1972- July 31, 1973
4. Consumable Supplies			
Office		2,220	1,600
Computer		7,031	4,200
Subtotal, Consumable Supplies		9,251	5,800
5. Travel			
BREITBARD	Philadelphia to Stanford for job interviews, 10/3		336
CLASS	FJCC, Anaheim, 10/5-7		68
FREY	SHARE Interim Meeting, San Diego, 12/3-6		135
	SHARE XXXIX Conference, Toronto, 8/7-11		531
	IBM Course, San Francisco 8/28-9/1		24
	SHARE XL, Denver 3/6-9		315
GERMANO	IBM Course, San Francisco, 12/18-19		18
GRANIERI	IBM Course, San Francisco, 11/28-30		29
HEATHMAN	IBM Course, San Francisco, 11/28-30		23
HU	Visit Computer Transmission Corp, Los Angeles, 3/15		39
JAMTGAARD	ACM SIGBIO and SIGGRAPH and FJCC, Anaheim, 12/3-5		192
	Univac Corp. for "Exec 8" demo., San Francisco, 11/9		9
	Visit NIH/BRB and DRG, Washington, D.C., 1/31-2/2		427
MILLER	IBM Course, San Francisco, 11/13		7
	IBM Courses, San Francisco, 9/26-27, 10/3-5		35
STAINTON	FJCC, Anaheim, 12/3-5		153
	IBM Class, Portland, Ore., 10/16-20		208
	Assist in display at International Transplant Conference, San Francisco, 9/25-29		19
	Visit Computer Transmission Corp., Los Angeles, 3/15		33
WHITNER	Sixth Annual Symposium on the Interface Workshop, Berkeley, 10/16-17		25
WIEDERHOLD	SHARE, San Diego, FJCC, Anaheim, 12/3-6		248
	ACM National Conference, Boston, 8/11-16		242
	Visit U.C. Med. Ctr., San Francisco, 8/17		10
	All Other Travel		874
Subtotal, Travel		2,138	4,000

	August 1, 1971-July 31, 1972	August 1, 1972-July 31, 1973
6. Engineering Services	25,236	12,700
7. Publication Costs	4,608	6,000
8. Computer Services		
360/67 & Tymshare Services	2,615	2,000
Staff Training	635	3,900
Subtotal, Computer Services	3,250	5,900
9. Other Expenditures		
Books and Periodicals	407	200
Postage and Freight	1,698	2,000
Telephone	6,673	6,400
Physical Plant	115	300
Technical Services	1,322	3,000
Misc	1,028	200
Subtotal, Other	11,243	12,100
GRAND TOTAL -- DIRECT COSTS	800,238	805,292

C. Summary of Resource Funding

	BUDGET PERIODS		
	05 Budget Period	06 Budget Period	06S Budget Period
Source of Funds			
Computer Service Fees	170,596	266,805	260,000
Biotech, Resources Branch Support			
Amount of Current Award: Line (5) of Award Statement	675,747	633,379	475,158
Adjustment from Prior Periods: 1. Balance from prior budget periods	76,459	3,174	87,857
2. Balance of 270 x/y Proceeds	< 27,275 >		5,292
Additional Funding Required*			42,181
Total BR Support	724,931	636,553	610,488
TOTAL FUNDING	895,527	903,358	870,488

* A request for additional funding support has been forwarded to NIH.

D. Resource Equipment List

RENTAL EQUIPMENT

360/50 Configuration

TYPE-SERIAL	DESCRIPTION	RENTAL START DATE	MONTHLY RATE	E/A%	EDUCATIONAL ALLOWANCE	TAX	NET RENTAL
IBM:							
1052-50618	Console Typewriter	12-13-66	63.00	20	12.60	2.52	52.92
1403-14708	Printer 600 LPM	"	833.00	20	166.60	33.32	699.72
2050-11047	Additional CPU (F)	"	1,660.00	25	415.00	62.25	1,307.25
2050-11047	CPU	"	10,453.00	35	3,658.55	339.72	7,134.17
2401-10877	Mag. Tape Unit	"	335.00	20	67.00	13.40	281.40
2403-70738	Mag. Tape Unit Control	"	890.00	20	178.00	35.60	747.60
2540-12531	Card Reader Punch	"	710.00	20	142.00	28.40	596.40
2701-11144	Data Adapter Unit	"	1,025.00	20	205.00	41.00	861.00
2821-12464	Control Unit	"	1,085.00	20	217.00	43.40	911.40
MEMOREX:							
1270-10378	Control Unit	5-23-72	1,290.00	--	--	64.50	1,354.50
AMPEX:							
DC 314-034	Dir. Acess. Stge.	12-20-71	3,127.80	--	--	123.39	3,251.21
DC 314-037	Dir. Acess. Stge.	1-13-72	2,907.00	--	--	118.35	3,025.35
ECM 50-1222	Core Storage	12-08-71	9,545.00	--	--	448.50	9,993.50
360/50 Configuration Total			33,958.82		5,065.25	1,355.93	30,249.50

D. Resource Equipment List

RENTAL EQUIPMENT (Cont.)

Supporting Equipment Rentals

TYPE-SERIAL	DESCRIPTION	RENTAL START DATE	MONTHLY RATE	E/A%	EDUCATIONAL ALLOWANCE	TAX	NET RENTAL
25 units 911	Disk Pack (3M)	5-17-71(@ 7.88)	197.00	--	--	9.85	206.85
3 units	IBM 2741 Communication Terminal	various	319.50	20	63.90	12.78	268.38
3 units	G.E. Terminet Communication Terminal	various	354.00	--	--	17.70	371.70

1800 Rental Equipment

1826-10152	Data Adapter Unit	9-22-66	763.00	20	152.60	30.52	640.92
1442-70295	Card Read Punch	"	265.00	20	53.00	10.60	222.60
1856-10607	Analog Output Terminal	6-24-70	150.00	10	15.00	6.75	141.75

Other Rented Equipment

Card Punch	IBM (Model 029/P4202)	9-21-70	111.00	10	11.10	5.00	104.90

E. Resource Equipment List

PURCHASED EQUIPMENT

Period Covered -- 8/1/67-4/30/73

DESCRIPTION/IDENTIFICATION	MANUFACTURER	MODEL NO.	PURCHASE PRICE	SOURCE OF FU
1800 System				Genetics I.R.L
Process Controller	IBM	1801		
Printer Keyboard	"	1816		
Enclosure	"	1828		
Analog Input Terminal	"	1851	2,908.00	
Digital Display	ACME			SRR
Oscilloscope	Hewlett-Packard		1,500.00	Macy Grant
Pulse Generator	E.H. Research Labs	139B	1,275.00	Macy Grant
Conversion 1801	IBM	2B	18,753.00	
PDP-11 System	Digital Equipment	PDP-11	17,891.00	
Oscilloscope	Tektronix	547	3,253.00	
Printer	Litton Industries	30	4,053.00	
Module/Packs	Prentice	800/LDA-1	2,972.00	
Oscillator/Generator	Wavetek	130	309.00	
Couplers (2)	Prentice	d22	939.00	
Module	Prentice	LDA 1	383.00	
Cabinet	Prentice		4,182.00	
Disk Drive System	Digital Equipment	RK11 CA/RK03AA	15,332.00	
Sampling Unit	Tektronix	Type 152	1,767.00	
PDP-11 System	Digital Equipment	PDP-11	38,446.00	
DEC Dual Tape System	Digital Equipment		7,450.00	
Computer Terminal (2)	Computer Transceiver Corp.	311	7,645.00	
Computer Terminal (2)	General Electric	Terminet	7,505.00	
Modems (2)	Prentice	LDA-1 with power supply	438.00	

VII. UTILIZATION DATA

A. Interpreting Utilization Charts.

The terms used to discuss ACME utilization involve charging units and categories of users.

1. Charging Units

Last year, the computer service charge units were:

pageminutes
terminal connect time
blocks of disk storage
terminal service charge

A pageminute is defined as occupancy of 4096 bytes of core for one minute. Terminal connect time is the total number of minutes that a terminal is connected to the system in a logged-on condition. A block of disk storage is a fixed-length block of 2000 bytes of 2314-type disk storage. The terminal service charge covers monthly terminal rent plus other services offered by the ACME staff. This service charge is handled by the University independent of the ACME grant.

2. User Categories

The table below shows the category identifier, definition, and rate of each user category. The rate charged per pageminute varies by user category, and some categories are subsidized 100% by the ACME grant. An asterisk next to the category identifier designates those so subsidized. All other categories are paying. There is a distinction between realtime and non-realtime users. Realtime users use the 1800 processor or 2701 data adapter for data collection or process control functions.

PAGE-MINUTE CHARGE TABLE

	Category	cents/pageminute
1.	Realtime User - Sponsored Research	1.00
2.	Non-Realtime User - Sponsored Research	1.70
3.	Non-Stanford Medical	2.50
*4.	Medical Students	2.00
*5.	Realtime User - Core Research	2.00
*6.	Non-Realtime User - Core Research	2.00
*7.	ACME Staff - Excluding Operations	2.00
8.	Hospital Data Processing	1.70
9.	Non-Medical - Stanford and Non-Stanford	2.00

Page-Minute Charge Table (Continued)

*10.	Realtime - Pilot and Pending Proposal	2.00
*11.	Non-Realtime - Pilot and Pending Proposal	2.00
*12.	Realtime - Extended Non-Funded	2.00
*13.	Non-Realtime - Extended Non-Funded	2.00
16.	Negotiated Rates - Combination of Core Research and Medical Administration	1.20
*17.	ACME Operations	2.00

*No cash charges, i.e., absorbed by the ACME project budget.

B. Patterns of Use.

Approximately 2/3 to 3/4 of the terminals logged-on to the system are in execution at any point in time. This is consistent with a level achieved one year ago. Somewhat fewer terminals are logged-on each day in recent months. This reflects the fact that more people are being charged for their utilization. It also reflects the fact that fewer new users have been recruited this year due to the uncertainty of PL/ACME's future. The number of terminal hours did not decrease significantly despite the increase in the number of 30-character-per-second terminals. Subjectively, it appears to the facility director that much of the utilization today is based upon programs written during the past three or four years. Perhaps as many as 50% of the users rarely write new programs for data entry and data analysis.

During the past year approximately 85% to 90% of the available disk storage for users has been used. Frequently we have run out of space on individual disk packs during the normal operating hours. This has caused considerable inconvenience to all users. One additional disk drive was added to the system this year to alleviate the problem.

The Utilization by Department table indicates considerable usage by the Computer Science Department. The DENDRAL project accounts for essentially all of this usage.

The final table in this section presents a summary of all utilization by all users during the year. On this table, the designation "C" (collaborative) indicates that the project (1) received programming services greater than normal consulting, (2) was accommodated by special changes to the system by the ACME staff, or (3) was involved in a normal research collaboration relationship with ACME.

ACME UTILIZATION BY DEPARTMENT

Twelve-Month Period May 1972 - April 1973

*Distribution is that of April 1973.

Department/Division	# of Terminals*	PAGEMINUTES students	PAGEMINUTES non-chargeable	PAGEMINUTES chargeable	BLOCKS students	BLOCKS non-chargeable	BLOCKS chargeable	TOTAL CHARGE students	TOTAL CHARGE non-chargeable	TOTAL CHARGE chargeable	
MEDICAL SCHOOL											
Anesthesia	1.25	-0-	43,149	402,931	10	608	43,272	$ 1.00	$ 944.09	$10,178.89	
Biochemistry	1.00	957		111,589	425		4,398	61.94		2,365.24	
Community and Prev Med				8,031			42			143.74	
Biostatistics	.62			58,718			7,105			1,747.89	
Dermatology				-0-			60			6.00	
Genetics	5.00	129,117	732,695	1,215,539	5,542	45,707	51,038	3,208.95	18,770.02	16,215.71	
Gyn/Ob				162,529			4,892			3,319.74	
Medical Microbiology	1.00	88,933		114,292	3,613		6,280	2,163.16		2,493.08	
Medicine				33,372			10,086			1,601.00	
Cardiology		14,126		101,502	1,337		8,362	420.24		2,163.16	
Clinical Pharmacology	1.00		293,856	461,248		12,352	55,888		5,368.90	11,269.21	
Gastroenterology				36,633			587			689.30	
Hematology				66,612			6,151			1,785.04	
Immunology	1.00			208,632			27,512			6,427.23	$43,540.57
Infectious Diseases		14,512		3,892	1,927		2,778	488.16		344.80	
Metabolism	4.63	-0-		796,240	38		49,494	3.80		17,090.32	
Nephrology				38,035			1,380			794.98	
Oncology	.50	-0-		59,931	840		4,498	84.00		1,375.53	
Respiratory Medicine		2,554			114			62.97			
Neurology	1.00		501,650	7,794		16,669	889		8,119.55	175.08	
Pathology	1.00			304,649			5,872			3,755.28	
Pediatrics		162,081	-0-	161,296	6,903	540	22,893	3,975.98	54.00	5,201.63	
Pharmacology	2.00	9,152		413,687	85		24,019	194.85		9,742.58	
Physiology		25,459			377			551.01			
Psychiatry	2.00	92,722	2,004	371,611	12,362	1,796	24,743	3,138.59	220.91	8,379.40	
Radiology	.50		279,446	343,890		7,773	10,602		4,476.48	6,707.58	
Diagnostic Radiology	1.00			169,336			28,819			4,631.99	
Nuclear Medicine	1.00			186,635			5,130			2,880.46	$31,079.60
Radiation Therapy	.50			716,344			40,761			14,651.02	
Radiobiology	1.00			117,219			1,846			2,208.55	
Surgery				7,385			2,482			377.95	
Cardiovascular		52,166		143,852	4,188		16,530	1,534.51		3,134.24	
Ophthalmology				47,432			451			863.90	$ 7,132.73
Otolaryngology		-0-	-0-	49,681	138	72	3,841	13.80	7.20	1,247.87	
Urology			127,314	114,387		1,173	3,472		2,688.91	1,508.77	
Admissions Committee				63,375			6,197			1,837.26	
Fleischmann Labs				267,793			7,930			4,911.61	
Joint Teaching and Research	.50			171,070			6,937			3,322.80	
Regional Medical Program	1.00			29,945			17,500			2,267.34	
MEDICAL SCHOOL TOTALS	27.50	591,779	1,980,114	7,567,107	37,899	86,690	514,737	$15,902.96	$40,650.06	$157,816.17	

Department/Division	# of Terminals*	PAGEMINUTES students	PAGEMINUTES non-chargeable	PAGEMINUTES chargeable	BLOCKS students	BLOCKS non-chargeable	BLOCKS chargeable	TOTAL CHARGE students	TOTAL CHARGE non-chargeable	TOTAL CHARGE chargeable
HOSPITAL										
Cardiology	1.00									
Clin Lab - Immunology				6,219			72			$ 114.16
Clin Lab - Infec Diseases	1.00			1,119,523			88,324			24,323.66
Clin Lab - Pathology	1.00			511,269			7,404			5,787.34
Data Processing	1.00			501,615			32,962			9,046.46
Pharmacy				8,006,546			95,581			26,957.57
HOSPITAL TOTAL	4.00			10,145,172			224,343			$66,229.19
CLINICS	1.00			515,400			23,350			$ 7,828.71
OTHER CLINICS AND HOSP	1.00			680,358			18,919			$15,874.73
CAMPUS										
Aero and Astro				-0-			624			$ 62.40
Biosciences	2.00	3,035		286,747	135		6,343	$ 76.15		3,617.73
Chemistry	1.00		176,223	199,075		15,697	14,478		$ 4,846.90	4,827.51
Computer Science**	3.00		4,597,329	1,606,744		176,473	62,854		41,210.20	20,025.17
Law				-0-			696			69.60
Math	1.00			5,267			70			98.36
Physics				7,723			2,954			428.00
Psychology		867		28,093	51		978	22.81		662.08
Statistics	.50			5,886			363			148.20
CAMPUS TOTAL	7.50	3,902	4,773,552	2,139,515	186	192,170	89,360	$ 98.96	$46,057.10	$29,939.05
UNKNOWN SCRATCH***		216,629			161			$4,450.82		
OTHER		20,736	3,139	474,996	126	53	24,992	$ 436.24	$ 69.41	$11,396.27
USER TOTALS	41.00	833,046	6,756,805	21,522,568	38,372	278,913	895,701	$20,888.98	$86,776.57	$289,084.12
ACME	10.00		8,928,799****			198,823			$105,581.53	
GRAND TOTALS	51.00	833,046	15,685,604	21,522,568	38,372	477,736	895,701	$20,888.98	$192,358.10	$289,084.12

*Distribution is that of April 1973.
**Primarily the DENDRAL project, serving Genetics, Chemistry, and Computer Science Departments.
***Unknown users, mostly medical students.
****Of this total, 5,927,711 pageminutes were used by Operations to run the system.

GRAND TOTAL PAGEMINUTES: 38,041,218
GRAND TOTAL BLOCKS: 1,411,809

April 26, 1973

Number of User Projects
By Department and Category at April 16, 1973

Department/Division	Category 1	2	3	4	5	6	7	8	9	10	11	12	13	16	17	Total
MEDICAL SCHOOL																
Anesthesia	2	5	0	0	0	0	0	0	0	0	1	0	0	0	0	8
Biochemistry	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0	6
Community and Prev Med	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biostatistics	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Dermatology	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Genetics	2	6	0	4	1	2	0	0	0	0	0	0	0	0	0	15
Gyn/OB	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Medical Microbiology	0	2	0	8	0	0	0	0	0	0	0	0	0	0	0	10
Medicine	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cardiology	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Clinical Pharmacology	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hematology	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Immunology	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Infectious Diseases	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Metabolism	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Nephrology	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Oncology	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Neurology	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Pathology	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Pediatrics	0	2	0	2	0	1	0	0	0	0	0	0	0	0	0	5
Pharmacology	0	7	0	1	0	0	0	0	0	0	0	0	0	0	0	8
Physiology	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Psychiatry	2	13	0	4	0	0	0	0	0	0	0	0	0	0	0	19
Radiology	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diagnostic Radiology	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Nuclear Medicine	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Radiation Therapy	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Radiobiology	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Surgery	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cardiovascular	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Ophthalmology	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Otolaryngology	1	5	0	0	0	0	0	0	0	0	1	0	0	0	0	6
Urology	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Admissions Committee	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Fleischmann Labs	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Joint Teaching and Research	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Regional Medical Program	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
MEDICAL SCHOOL TOTALS	15	107	0	25	2	3	0	0	0	0	2	0	0	0	0	153

1. Realtime, sponsored resch.
2. Non-realtime, sponsored resch.
3. Non-Stanford medical
* 4. Student education
* 5. Realtime, core resch.
* 6. Non-realtime, core resch.
* 7. ACME staff, excl. operations
8. Stanford Univ. Hospital
9. Stanford non-medical
*10. Realtime, pilot and pending proposal
*11. Non-realtime, " "
*12. Realtime, extended non-funded
*13. Non-realtime, extended non-funded
16. Negotiated rate, combination of core research and application
*17. ACME operations

HOSPITAL	Category 1	2	3	4	5	6	7	8	9	10	11	12	13	16	17	Total
Clin Lab - Immunology	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Clin Lab - Inf Dis	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Clin Lab Pathology	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Data Processing	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Pharmacy	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
HOSPITAL TOTAL	0	0	0	0	0	0	0	7	0	0	0	0	0	1	0	8
CLINICS	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
OTHER CLINICS AND HOSP																
PAVAH	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
State Univ. of NY	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Univ of Calif. at SF	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Palo Alto Med Rsch.	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5
OTHER CLINICS AND HOSP TOTAL	0	2	7	0	0	0	0	0	0	0	0	0	0	0	0	9
CAMPUS																
Aero and Astro	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Biosciences	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	6
Chemistry	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	4
Computer Science	0	2	0	0	9	0	0	0	0	0	0	0	0	0	0	11
Physics	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Psychology	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	7
Statistics	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	3
CAMPUS TOTAL	5	7	0	2	11	0	0	0	9	0	0	0	0	0	0	34
UNKNOWN SCRATCH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
OTHER																
Prentice Electronics	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Jung Institute	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Youth Opportunities Program	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
SLAC	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
Carnegie	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
OTHER TOTALS	0	0	2	1	0	0	0	0	6	0	0	0	0	0	0	9
USER TOTALS	21	116	9	29	13	3	0	8	15	0	2	0	0	1	0	217
ACME	0	0	0	0	0	0	46	0	0	0	0	0	0	0	6	52
GRAND TOTALS	21	116	9	29	13	3	46	8	15	0	2	0	0	1	6	269

ACME INCOME

April 17, 1972 to April 16, 1973

360/50 Income from Chargeable Users	May	June	July	August	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	Total
1 - Realtime, sponsored research	$ 6,739	$ 7,798	$ 7,018	$ 5,362	$ 4,712	$ 4,133	$ 2,996	$ 2,336	$ 1,970	$ 2,582	$ 2,385	$ 2,337	$ 50,368
2 - Non-realtime, sponsored research	14,973	14,574	13,118	13,259	11,663	12,801	14,524	11,430	10,119	12,074	11,596	11,214	151,345
3 - Non-Stanford, medical	2,127	1,413	1,547	2,262	1,719	1,513	500	1,445	398	459	477	391	14,251
8 - Stanford University Hospital and Clinics	1,686	1,769	1,682	2,102	2,079	2,224	2,592	4,436	3,830	4,700	4,304	4,219	35,623
9 - Stanford, non-medical	1,489	1,017	688	1,168	1,161	382	779	759	774	505	988	825	10,535
16 - Combination Core Research and Application	2,390	2,796	2,747	2,544	2,594	2,535	3,075	2,992	2,688	2,524	71	1	26,957
TOTAL	$29,404	$29,367	$26,800	$26,697	$23,928	$23,588	$24,466	$23,398	$19,779	$22,844	$19,821	$18,987	$289,079
Income from Terminal and Misc Charges*	$ 7,790	$ 8,180	$ 7,790	$ 7,695	$ 8,265	$ 8,275	$ 9,055	$ 8,760	$ 8,550	$ 8,265	$ 8,170	$ 7,695	$ 98,490

*This income is not associated with the ACME Grant. It is an offset to cost incurred by the University for terminal rental, engineering services, and other miscellaneous services provided to the ACME community.

ACME INCOME

FY69 through FY73

	360/50 Income to Grant	Clearing Account Income
FY69 *	$ 37,277	$118,377
FY70	178,252	95,973
FY71	170,596	100,809
FY72	267,558	110,979
FY73 (est.)	260,000	100,000

*User charges instituted in March of 1969.

ACME UTILIZATION DATA

FY70 - FY73

As measured by number of accounts (staff and operations accounts excluded):

	# of accounts	% change
March 1970:	198	
March 1971	210	+6.0%
March 1972	224	+6.6%
March 1973	214	-4.4%

As measured by income:

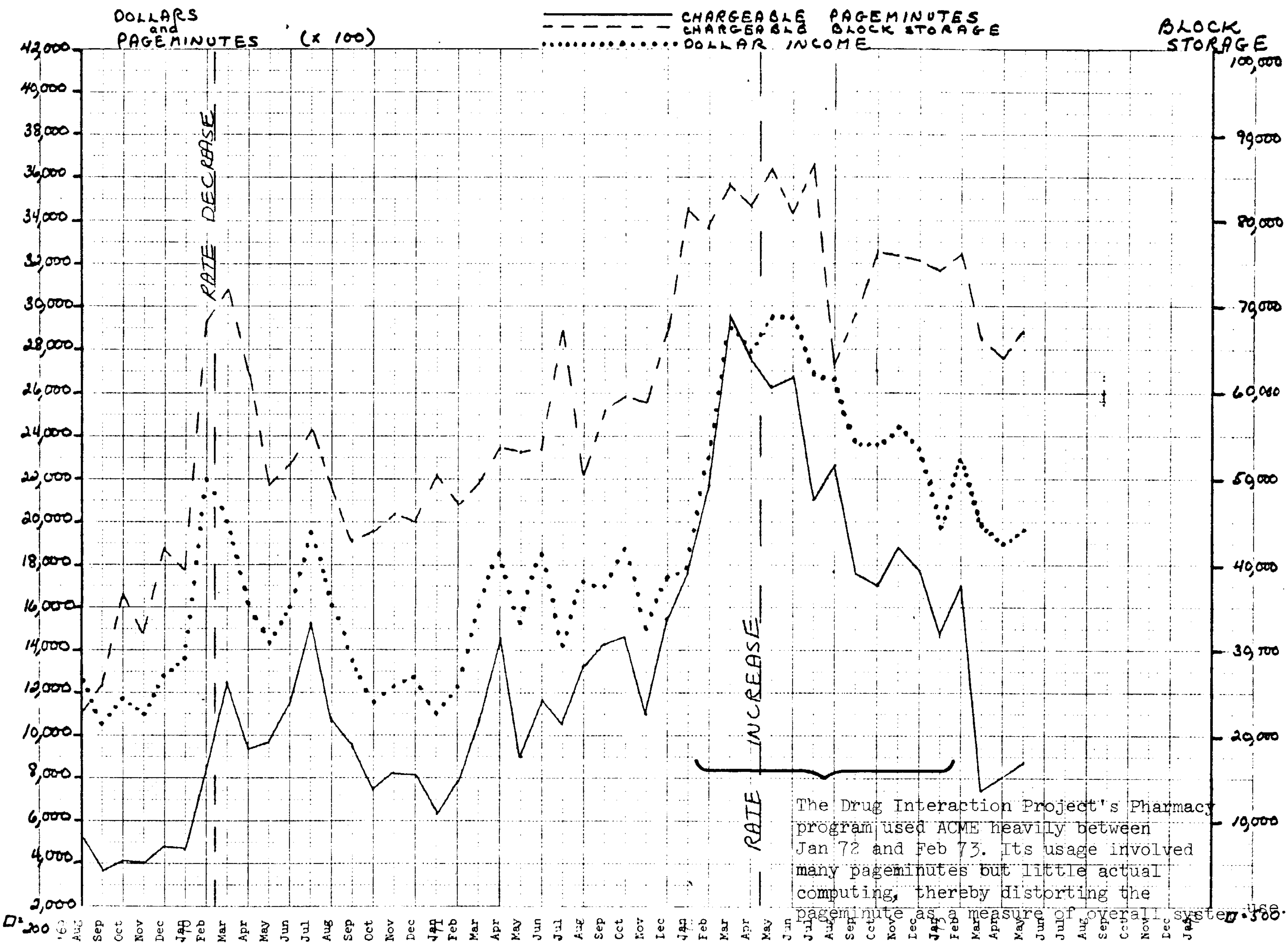
	FY70[b]	FY71	FY72[c]	FY73 9 mo. Actual	FY73 Total Estimated
360/50 services	$178,252	$170,596	$267,558	$203,508	$260,000
% change		-4.3%	+56.8%		-2.9%
terminal rental[a]	98,973	100,809	110,979	74,730	100,000
% change		+1.8%	+10.0%		-9.9%
total	$277,225	$271,405	$378,537	$278,238	$360,000
% change		-2.1%	+39.4%		-4.9%

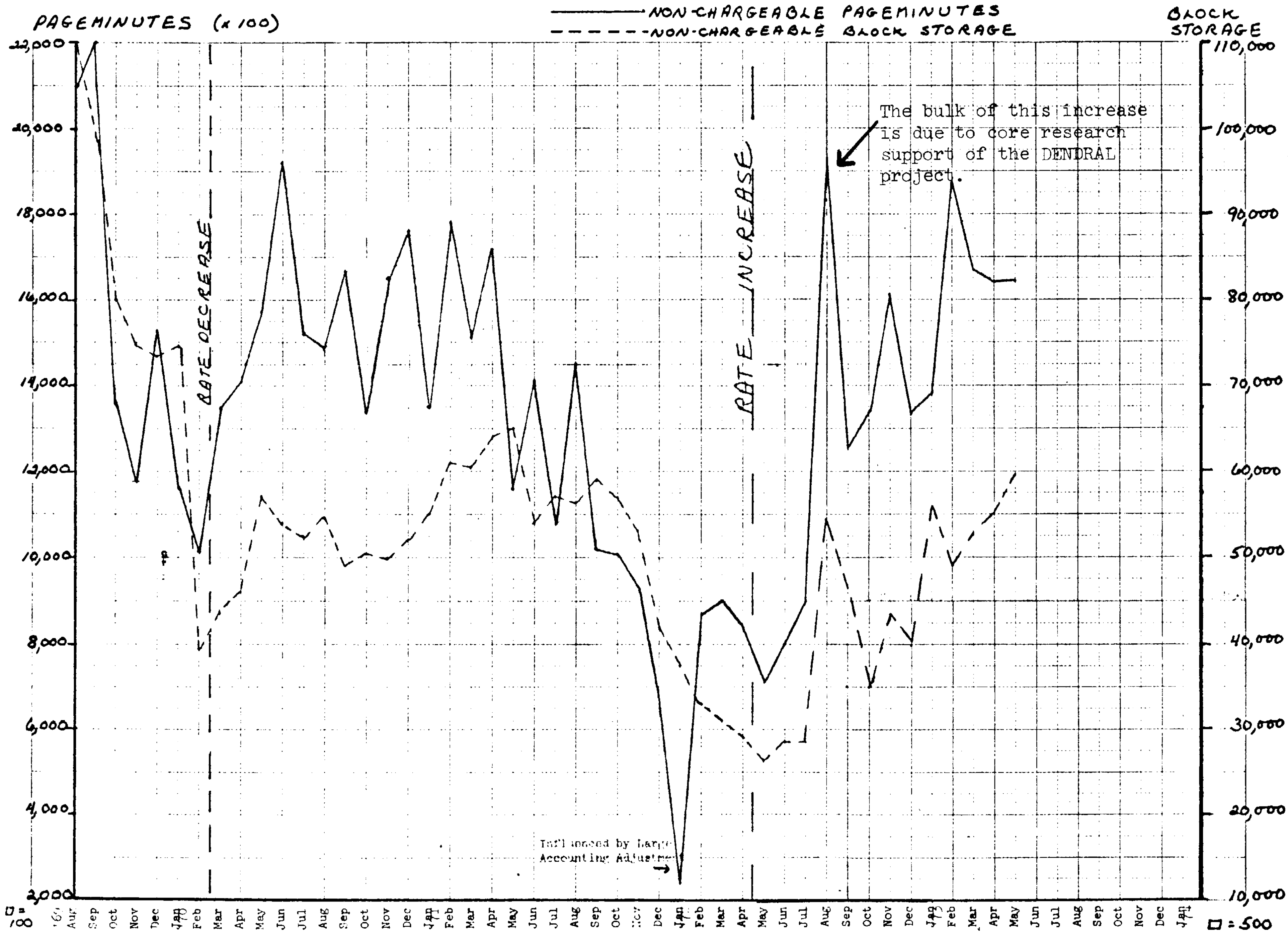
[a]Income provides for terminal rental, services best provided by a central facility, and some recharges for engineering services.
[b]Rate reduction introduced in February 1970.
[c]Rate increase introduced in May 1972.

As measured by timesharing units:

Six-Month Period Ending:	Pageminutes x 10^6 Adjusted to Reflect Impact of Faster Memories after Nov. 1971[d]	% Change
January 1971	1.50	
July 1971	1.45	-3.4%
January 1972	1.29	-1.1%
July 1972	1.95	+51.1%
January 1973	1.69	-1.3%

[d]One pageminute represents occupancy of 4k bytes of memory for one minute.


DOLLARS and PAGEMINUTES (x 100)
CHARGEABLE PAGEMINUTES
CHARGEABLE BLOCK STORAGE
DOLLAR INCOME
BLOCK STORAGE
RATE DECREASE
RATE INCREASE
The Drug Interaction Project's Pharmacy program used ACME heavily between Jan 72 and Feb 73. Its usage involved many pageminutes but little actual computing, thereby distorting the pageminute as a measure of overall system use.



PAGEMINUTES (x 100)
NON-CHARGEABLE PAGEMINUTES
NON-CHARGEABLE BLOCK STORAGE
BLOCK STORAGE
RATE DECREASE
RATE INCREASE
The bulk of this increase is due to core research support of the DENDRAL project.
Influenced by Large Accounting Adjustment
12,000
10,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
□ = 100
□ = 500

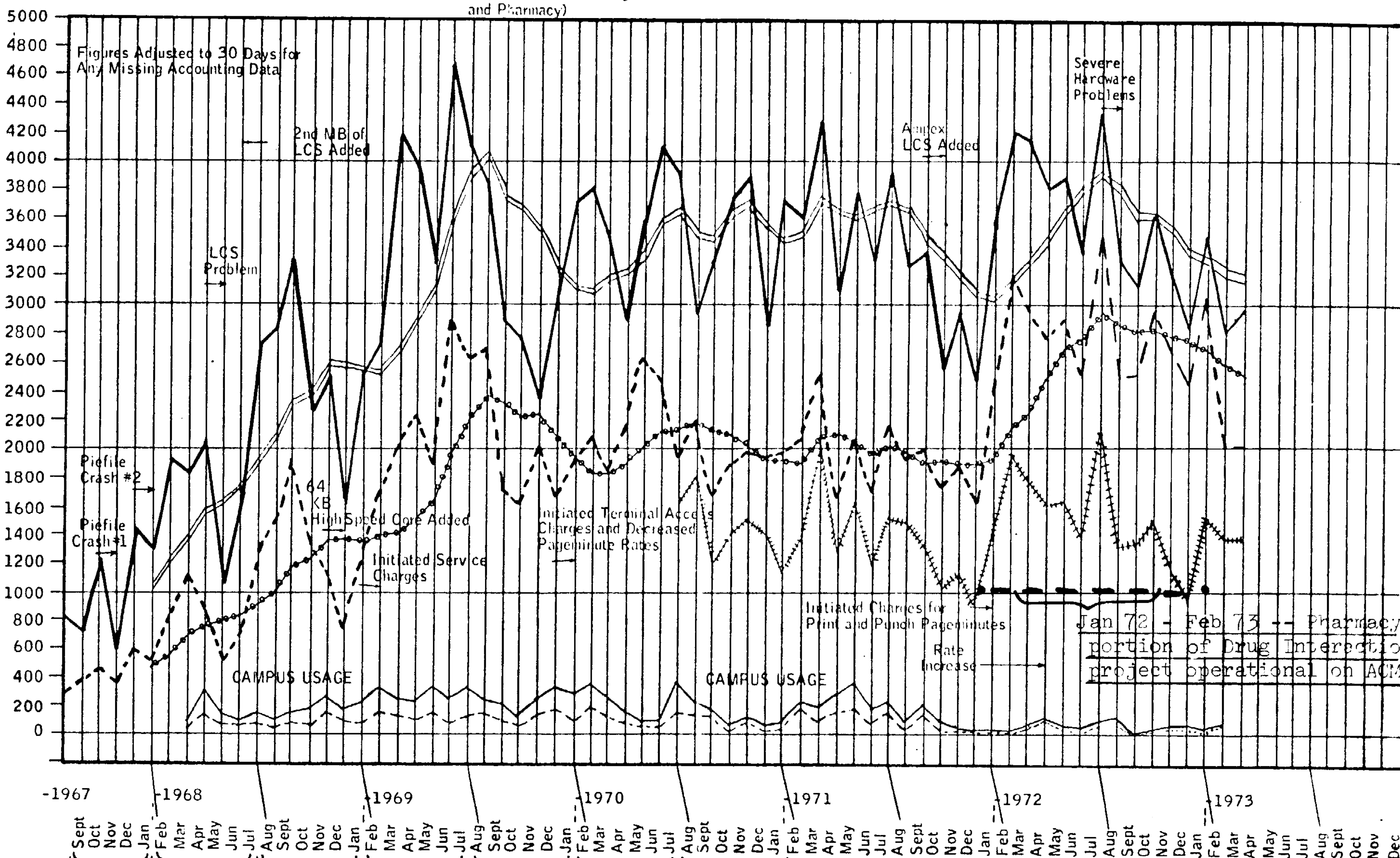
Terminal Hours
(Pageminutes *
1000)

ACME Note
Monthly Usage at ACME

MONTHLY TOTALS
- Terminal Hours
- Pageminutes
- Pageminutes (excluding staff and Pharmacy)

6 MONTH MOVING AVERAGE
- Terminal Hours
- Pageminutes

AU-31
Charles Class/Erica Baxter
February 22, 1973



	Sept–Jan	Feb–Jul	Aug–Jan	Feb–Jul	Aug–Jan	Feb–Jul	Aug–Jan	Feb–Jul	Aug–Jan	Feb–Jul	Aug–Jan	Feb–Jul
6 mos average/mo Terminal hours	943	1647	2542	3653	3176	3586	3455	3617	3066	3828	3423	
Pagemins (*1000)	403	766	1306	1988	2017	2142	1935	1971	1873	2811	2785	
Hardwr downtime		143:18	13:00	8:00	18:36	17:42	12:15	13:02	16:38	14:42	14:53	
Softwr downtime		7:52	6:40	6:42	1:44	2:19	1:12	1:01	:30	1:00	1:04	

Dist: Staff/All

The system has had 365 pages (4,096 bytes) available for service since the last increment of core was added in Jan. 69. As of Jan. 73 the network includes 55 terminals supported at 110 to 1200 baud.

SUMMARY OF COMPUTER RESOURCE USAGE

April 17, 1972 - April 16, 1973

*Cor = Core Research and Development
C = Collaborative
S = Service
T = Training

INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT: Identifying Number	Agency	Current Annual Amt.	BRR Category*	AMOUNT OF USAGE: BATCH Minutes	TIME SHARING: Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 1 Realtime, Sponsored Research (CHARGEABLE)									@ $.01 per pageminute	@ $.10 per block
Baker, Virginia (J. Lederberg)	Genetics	GAME: Computer control of Finnigan 1015 quadrupole mass spectrometer	NGR004	NASA	$ 180,000	C		573.5	702.158	30.850
Bunnenberg, Edward	Chemistry	CHEM: Development of a magnetic circular dichroism biotechnology resource.	---	Dept. Funds	---	S		.1	.555	1.240
Constantinou, Christos	Urology	UROL: Investigation of upper urinary tract physiology.	AM13548	NIH	63,962	C		191.0	72.853	2.218
DeGrazia, Joseph	Nuclear Medicine	RADIOREN: Development of radioisotope techniques for the evaluation of differential kidney function.	---	Pub. Health Hosp. S.F.	---	S		0.0	0.0	.016
DeGrazia, Joseph	Nuclear Medicine	CLINIGAS: Coordination of computer and metabolic gas analyzer.	NGR578	NASA	40,131	S		162.1	96.792	3.242
Dong, Eugene	Cardiovascular Surg.	PATIENT: Examination of cardiac surgery patient data.	---	Clinic Budget	---	S		591.8	391.994	21.148
Dong, Eugene	Cardiovascular Surg.	CLIN: General data reduction.	HE13108	NIH	329,360	S		20.6	14.149	4.349
Dong, Eugene	Cardiovascular Surg.	LAB: Study of the principles of mammalian heart rate control, emphasis on sino-atrial node.	HE08696	NIH	152,535	C		161.4	102.392	12.181
Feigenbaum, Edward	Computer Science	DENDRAL: Mass spectra analysis and interpretation.	RR00612	NIH	260,999	C		881.7	1110.056	26.635
Gersch, Will	Neurology	SYNTHESI: Application of time series methods to problems in neurophysiology and medicine.	---	Dept. Funds	---	S		6.9	6.754	0.889
Glick, David	Pathology	LASER: Laser microprobe analytical system for elemental analysis of microscopic biological samples.	GM16181	NIH	137,793	S		421.6	228.342	5.356
Gold, Jerome	Diagnostic Radiology	SWALLOW: Esophageal blood flow studies.	GM01707	NIH	135,000	C		286.7	126.336	28.819
Green, Paul	Biosciences	AVENA: Kinetic analysis of hormones affecting the growth process.	GB28667	NSF	90,000	S		92.2	92.470	2.798
Hanawalt, Phillip	Biosciences	TRI CARB: Use of radioisotope tracers to study molecular biology of cell growth and repair of damage to genetic material.	GM09901	NIH	96,986	S		121.3	73.676	2.063
Harrison, Donald	Cardiology	CATH LAB: On-line cardiac catheterization data analysis; recognition of abnormal EKG complexes.	LM00152	NIH	91,641	C		154.5	37.323	5.670
Kalis, Leslie	Anesthesia	VISAEP: Visual average evoked potential to graded light intensity as a correlation of pain threshold.	---	Dept. Funds	---	S		.1	0.140	0.420
Kopell, Bert	Psychiatry	ICON: Study of AER's (Averaged Evoked Responses) in EEG's.	AA00498	HSMHA	718,697	S		0.0	0.0	0.030

SUMMARY OF COMPUTER RESOURCE USAGE

April 17, 1972 - April 16, 1973

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INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT: Identifying Number	Agency	Current Annual Amt.	BRR Category*	AMOUNT OF USAGE: BATCH: Minutes	TIME SHARING: Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 1 (cont'd.)	Realtime, Sponsored Research (CHARGEABLE)								@ $.01 per pageminute	@ $.10 per block
Kristan, William	Biosciences	DPERKEL: Analog/digital processing of nerve impulses from swimming leech; study of nervous control of movement.	NS09744	NIH	64,983	S		6.6	2.705	0.498
Lederberg, Joshua	Genetics	EXPT: Use of a Packard liquid scintillation counter to analyze the incorporation of radiolabeled amino acids into brain.	GM00295	NIH	153,727	S		144.9	89.266	1.774
Mazze, Richard	Anesthesia	RENAL: Study of renal failure following general anesthesia.	GM18514	NIH	61,166	S		268.1	147.607	4.298
Pauling, Linus	Chemistry	MENTLRES: Research on the molecular basis of mental disease, involving gas chromatography.	GM19156	NIH	153,014	S		25.1	9.367	5.320
Reynolds, Walter	Genetics	SOO7: Automation of mass spectrometer instrumentation system.	NGR004	NASA	180,000	S		4.9	0.586	2.966
Roth, Walton	Psychiatry	AER: Research into computer processing of EEG data.	AA00498	HSMHA	718,697	S		139.2	43.924	1.161
Samples, John	Otolaryngology	SPEECHPA: Analysis of speech pauses during reading in normal and aphasic children.	NS07514	NIH	157,136	S		6.4	1.950	0.492
Smythe, Harvey	Psychiatry	SLEEP: Analysis of data from all-night sleep EEG's.	NS10727	NIH	239,937	S		22.8	5.985	0.594
Sokolov, Phillip	Biosciences	CIRCRTHM: Study of role of central nervous system in production and maintenance of circadian rhythm.	GM00365	NIH	53,088	S		0.5	0.170	0.134
Sussman, Howard	Pathology	LAB_PAT/LABSYSO: Development of an automated data processing system for the clinical pathology laboratory of Stanford Hospital.	---	Hosp. Funds	---	C		563.1	357.711	6.162
Swanson, George	Anesthesia	RESPRE: Investigation of neural mechanisms which sustain ventilation in the absence of chemical stimulation.	GM12527	NIH	503,159	S		42.1	23.471	0.288
Tatton, William	Biosciences	DPERKEL: Characterization of neural circuits underlying behavior and sensory information processing in mammals and invertebrates.	NS09744	NIH	64,983	S		132.3	62.757	0.774
					SUB-TOTAL			5021.5	3801.489	172.385
Category 2 Non-Realtime,	Sponsored Research (CHARGEABLE)						@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Angel, Ronald	Palo Alto Veterans Hospital	FORCE: Study of neural mechanisms controlling posture and movement in humans.	---	PAVAH	---	S		0.0	0.0	0.012
Aronow, Louis	Pharmacology	LCELL: Laboratory calculation of mechanisms of anti-cancer drug action.	CA05672	NIH	52,491	S		5.9	5.555	0.199

SUMMARY OF COMPUTER RESOURCE USAGE

April 17, 1972 - April 16, 1973

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INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT: Identifying Number	Agency	Current Annual Amt.	BRR Category*	AMOUNT OF USAGE: BATCH Minutes	TIME SHARING: Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Assaykeen, Tatiana	Urology	RENIN: Study of renin secretion mechanisms.	AM13548	NIH	63,962	S		18.6	3.834	0.373
Atkinson, Martha	Med. School Admissions Committee	FLYHIGH: Aid to Admissions Committee in selecting new medical school classes from applicants.	---	Dept. Funds	---	S		71.5	32.599	6.103
Atkinson, Martha	Med. School Admissions Committee	MATCHES: Matching of medical students' clerkship requests with available positions.	---	Dept. Funds	---	S		0.0	0.0	0.024
Atkinson, Martha	Med. School Admissions Committee	FINANCE: Examination of Yale medical student loan system's applicability to Stanford.	---	Dept. Funds	---	S		18.3	10.931	0.048
Austin, Melissa	Anesthesia	IDS: Institutional Differences Study of post-operative procedures and results in hospitals nationwide.	MS46-72-12	N Acad Sci.	574,279	S		9.5	9.125	2.402
Axline, Stanton	Medicine	LYSOSOME: Analysis of kinetics of protein turnover by tissue culture cells.	AI10055	NIH	33,303	S		0.0	0.0	0.024
Bagshaw, Malcolm	Radiation Therapy	SUMMARY: Patient data storage and information retrieval; statistical programs relating to radiation dosimetry.	CA05838	NIH	1,012,612	S		843.8	540.040	38.218
Bale, Richard	Psychiatry	VADRUGSA: Comparative evaluation of drug abuse treatment programs.	MH22853	HSMHA	250,515	S		0.0	0.0	0.008
Belt, Donald	Otolaryngology	HSA: Hearing and vision screening: processing of results of tests administered to elementary school children.	---	Dept. Funds	---	S		37.8	67.664	4.836
Belt, Donald	Otolaryngology	SEC: Vision screening	---	Dept. Funds	---	S		0.0	0.0	0.002
Biggs, Suzanne	Pharmacology	REGRESS: Analysis of membrane proteins.	GM00322	NIH	157,551	S		1.2	0.652	0.275
Blake, David	Community and Preventive	AIR_POL: Student study of correlation between incidence of air pollution and respiratory disease.	GY9654	NSF	12,790	S		16.6	5.541	0.042
Bodmer, Walter	Genetics	POPGEN: Human white blood cells and population genetics.	NS10711	NIH	93,336	S		6.8	5.722	0.888
Brown, Byron	Biostatistics	RESEARCH: Computations in support of development of new biostatistical techniques.	RR05353	NIH	133,817	S		11.9	5.038	2.017
Brown, Byron	Anesthesia	MAASS: Measurement of frequency of surgery in various socioeconomic groups.	---	Comm. Weal.	---	S		93.0	32.373	2.806
Brown, Byron	Biostatistics	BIOSTAT: Computations in support of Dept. of Anesthesia research projects.	GM12527	NIH	503,159	S		44.0	15.052	2.200

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Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Brown, Byron	Biostatistics	STUDENT: Teaching use of ACME in Community and Preventive Medicine courses.	RR05353	NIH	133, 817	T		26.5	7.062	0.307
Brown, Byron	Biostatistics	CLASS: Classwork for course in biostatistics.	RR05353	NIH	133, 817	T		56.6	29.804	5.744
Brown, Byron	Biostatistics	CONSULT: Biostatistical computations in support of many medical research projects.	RR05353	NIH	133, 817	S		146.0	52.158	5.946
Brown, Byron	Anesthesia	JOBST: Analysis of EKG data.	HL10202	NIH	158, 349	S		52.1	22.352	5.335
Brutlag, Douglas	Biochemistry	ULTRA: Studies of the role of divalent metal ions in the reaction mechanism of the enzyme DNA polymerase.	GM07591	NIH	313, 398	S		1.3	1.084	0.134
Buchanan, Bruce	Computer Science	DENDRAL: Mass spectra analysis and interpretation.	RR00612	NIH	260, 999	C	6, 976	378.3	305.966	35.437
Buchanan, Bruce	Computer Science	STAT: Statistical demonstration programs for a course in biostatistics.	GM01922	NIH	301, 996	T		201.6	100.213	0.723
Bunnenberg, Edward	Chemistry	CHEM: Development of a magnetic circular dichroism biotechnology resource.	---	Dept. Funds	---	S		51.2	20.143	1.174
Butler, Edmund	Urology	UROSTATS: Urology operative statistics information and retrieval program.	---	Dept. Funds	---	S		5.0	5.014	0.881
Cann, Howard	Pediatrics	GUAT: Population genetics studies of Mayan Indians of Guatemala.	GM15593	NIH	21, 668	S		250.9	102.842	22.374
Cavalli, Luca	Genetics	LAURA: Data analysis on population genetics.	AT(04-3) 326PA332	AEC	32, 000	S		129.9	72.586	3.130
Cavalli, Luca	Genetics	MARK: Analysis of pygmy anthropometric and demographic data; simulation of genetic drift and selection models.	AT(04-3) 326PA332	AEC	32, 000	S		0.1	0.010	0.003
Cavalli, Luca	Genetics	PAVIA: Population genetics: evolutionary rate, patterns of inheritance in behavioral traits, analysis of record linkage and pedigree information.	AT(04-3) 326PA332	AEC	32, 000	S		291.2	155.782	1.787
Cavalli, Luca	Genetics	JUDY: Text editing for population genetics research.	AT(04-3) 326PA332	AEC	32, 000	S		0.0	0.011	0.018
Cavalli, Luca	Genetics	KEN: Analysis of genetic models of disease; simulation programs.	AT(04-3) 326PA332	AEC	32, 000	S		11.8	3.185	0.228
Chan, Piu Chu	Radiobiology	GROWTH: Simulation of cellular population growth pattern.	CA04542	NIH	34, 928	S		18.6	8.653	0.252

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Category (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $ .017 per pageminute	@ $.10 per block
Chase, Robert	Surgery	CPGFAC: Evaluation of facial growth in cleft palate children and determination of velopharyngeal competence.	DE02803	NIH	31,434	S		0.0	0.0	0.516
Clausen, Mery	Pediatrics	NUTRITIO: Clinical aspects of congenital malformations, human nutrition, genetic diseases, and homeostatic aspects of growth and development.	HD02147	NIH	304,045	S		30.7	9.720	0.312
Clayton, Raymond	Psychiatry	CEYBRAIN: Effect of steroids and hormones on RNA activity of the brain.	---	Commonwealth	---	S		0.0	0.0	1.230
Cohen, Stan	Clinical Pharmacology	DRUGALRT: Computerized system to warn of interactions of drugs administered to patients.	HS00739	NIH	260,944	C		552.4	378.354	55.888
Conner, Robert	Psychiatry	RATRACE: Relation of neuroendocrine function to behavior.	HD02881	NIH	205,688	S		67.4	59.916	0.793
Denney, Richard	Biosciences	EASY: Radioactive annealed RNA bound to DNA in nitrocellulose filters.	GM00158	NIH	124,155	S		2.1	0.576	0.039
Dilley, Jeannette	Immunology	CYTOTOX: Study of murine transplantation antigens on various tissues; description of biological and biochemical characteristics of the soluble transplantations from these tissues.	AM05425	NIH	94,506	S		24.4	17.423	0.166
Dirks, Judie	Psychiatry	PORNO: Analysis of normal subjects' average evoked responses to pictures of nudes.	MH19918	HSMHA	77,702	S		0.1	0.022	0.819
Doering, Charles	Psychiatry	NAPOLEON: Statistical analysis and quality control of hormone assays.	---	Commonwealth	---	C		45.9	13.596	0.333
Doering, Charles	Psychiatry	DESMOLAS: Investigation of the biochemical connection between hormones and stress.	---	Commonwealth	---	S		1.0	0.428	0.377
Drake, Karl	Psychiatry	NEUROPSY: Analysis of neurophysiological and neurobehavioral data, including power spectrum analysis of EEG's.	MH12970	HSMHA	242,645	S		0.0	0.0	0.156
Feldman, Marcus	Biosciences	POPGENET: Modelling of genetic processes and ecological systems.	---	Dept. Funds	---	S		1.9	0.840	0.033
Fletcher, Grant	Anesthesia	DIALYSIS: Statistical analysis of lab results of in vivo and in vitro studies of uptake, metabolism and elimination of sedative drugs.	---	Dept. Funds	---	S		0.3	0.204	0.020
Forrest, William	Anesthesia	DATA: Development of an inexpensive system of quality and quantity control of large amounts of clinical data.	---	Dept. Funds	---	S		0.0	0.0	0.024

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Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Forrest, William	Anesthesia	SURGICAL: Maintenance of records on surgical operations: source of data for reports on these operations.	---	PAVAH	---	S		33.9	19.547	3.097
Forrest, William	Anesthesia	ANALGESI: Development of an inexpensive system of quality and quantity control of large amounts of clinical data.	GM12527	NIH	503,159	S		101.3	38.956	25.488
Fowkes, William	Regional Medical Program	ANALYSIS: Analysis of data from registry of stroke patients.	CCRMP	CCRMP	50,517	S		20.3	10.332	1.453
Fowkes, William	Regional Medical Program	STROKE: Development of a countywide registry for stroke patients in Santa Cruz County; development of a population base for study and analysis.	CCRMP	CCRMP	50,517	S		17.7	11.636	13.577
Frenster, John	Oncology	DEREPRES: Leukemia research: probes of nuclear chromatin in living human bone marrow cells to determine their activity in gene de-repression.	CA10174	NIH	38,129	S		0.6	0.126	0.016
Fries, James	Immunology	DATABANK: Establishment of a large clinical databank of time-oriented patient records; exploration of multiple uses of the stored information.	AI11313	NIH	207,553	C		345.1	152.274	37.096
Garel, John	Ophthalmology	EYELAB: Storage of patient data for Division of Ophthalmology.	---	Dept. Funds	---	S		0.0	0.0	0.014
Goldstein, Avram	Pharmacology	NARCO: Mechanism of the action of narcotics and the fundamental aspects of narcotic addiction.	DA00026	HSMHA	207,462	S		21.3	4.421	1.166
Goldstein, Avram	Pharmacology	OFFSTUFF: Study of methadone maintenance programs for heroin addicts.	MH18960	HSMHA	38,680	S		349.9	183.642	17.907
Goldstein, Dora	Pharmacology	BARB: Establishment of essential parameters for enzyme kinetics in inhibition of flavin enzymes by barbituates.	DA00249	HSMHA	380,203	S		92.8	53.445	1.604
Grant, Scott	Ophthalmology	CORNEA: Simulation of light scattering by the cornea using electromagnetic theory.	EY00431	NIH	181,988	S		5.2	1.812	0.134
Greenberg, Peter	Hematology	CFCASSAY: Evaluation of factors regulating granulopoiesis in human disease states.	CA13141	NIH	55,959	S		48.9	19.921	0.798
Guess, Harry	Mathematics	EVOL: Genetics research: model simulation using various values of mutation rate population size and mutant fitness distribution.	GM10452	NIH	91,670	S		2.6	4.882	0.070

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Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Hahn, George	Radiobiology	RADIATE: Simulation of kinetics of mammalian cell proliferation, design of theoretical dose scheduling for leukemia treatment.	CA04542	NIH	34,928	S		10.7	4.569	1.307
Hamburg, Beatrix	Psychiatry	PEER: Data storage and analysis for a peer group counseling program among secondary school students.	MH13032	HSMHA	66,438	S		84.2	19.851	0.546
Hannigan, John	Drew Health Center	DREWEVAL: Study of a multiphasic health screening program: its effectiveness, community response, etc.	---	Drew Med. Clinic	---	S		20.8	17.109	1.073
Herzenberg, Leonore	Gyn/Ob	STORE/LAB/PIGGY: Immunology, genetics and maternal-fetal immunologic relationships in the mouse.	HD01287	NIH	55,769	S		189.6	91.426	4.044
Hjelmeland, Larry	Computer Science	DENDRAL: Mass spectra interpretation and analysis.	RR00612	NIH	260,999	C		1.7	1.458	0.78[illegible]
Hogness, David	Biochemistry	OREGON_R: Analysis of DNA fragments from Drosophila melanogaster.	GM20158	NIH	96,051	S		22.9	9.138	1.865
Jamison, Rex	Nephrology	MICROPUN: Basic mechanisms of salt and water transport in kidney.	---	Markle Fdn.	---	S		60.3	22.045	1.033
Jazwinski, Stanislaw	Biochemistry	MEMBRANE: Characterization of membrane-bound phospholipase; data obtained from enzyme assays, multichannel separations, etc.	GM07581	NIH	313,398	S		0.0	0.0	0.260
Jones, Stephen	Radiology	LYMPHOMA: Statistical study of various groups and sub-groups of non-Hodgkins lymphoma patients.	CA08122	NIH	286,562	S		9.8	10.214	0.700
Kakihana, Ryoko	Psychiatry	ETHANOL: Data analysis for neuroendocrine research on hormones and stress.	GB31099	NSF	52,000	S		38.4	11.047	0.641
Kallman, Robert	Radiobiology	SURVIVAL: Analysis of data relating the survival of experimental tumor cells to the dose of irradiation received by the cells.	CA03353	NIH	10,220	S		0.0	0.040	0.144
Kalman, Sumner	Pharmacology	DIGIMUNE: Routine calculation of daily assays of plasma, urine, and other biological fluids containing digoxin.	HE13618	NIH	40,595	S		134.1	54.902	2.027
Kessler, Seymour	Psychiatry	MATSPEED: Analysis of mating speed experiments.	GB31099	NSF	52,000	S		10.9	3.463	[illegible]
Kincaid, Randy	Pharmacology	CHEMOTAX: Computer analysis of chemotaxis.	GM00322	NIH	157,551	S		43.4	13.767	[illegible].341
Klyce, Steve	Ophthalmology	EPITHELI: Research on ion transport processes across the corneal epithelium to determine how epithelium maintains its hydration.	EY00915	NIH	69,171	S		67.4	34.725	[illegible]

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Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Kraemer, Helena	Psychiatry	PSYSTAT: Analysis of data from various psychiatric research projects.	---	Dept. Funds	---	S		94.5	34.729	6.330
Kriss, Joseph	Nuclear Medicine	ASSAY: Studies on the pathogenesis of Graves' disease, the effects of X-ray therapy on thyroid function, and the pathogenesis of other endocrine disorders associated with autoimmunity.	AM07642	NIH	62,838	S		135.8	45.067	1.840
Kriss, Joseph	Nuclear Medicine	BLDVOL1: Calculation of plasma volume, blood volume, red cell mass, red cell life span, iron turnover and renal clearance in patients who receive radioactive tracer material.	AM07642	NIH	62,838	S		0.2	0.048	0.048
Lamb, Emmett	Gyn/Ob	EMPIRE: Calculation of relative potency and confidence limits of total gonadotropen activity of human urine extracts.	---	Dept. Funds	---	S		62.8	33.252	0.848
Lederberg, Marguerite	Pediatrics	MACY: Study of women MD's: socio-economic and family impact on their careers.	---	Dept. Funds	---	S		0.0	0.0	0.014
Lehman, I. Robert	Biochemistry	LIGASE: Studies of the enzymatic mechanism of the DNA Ligase of E. coli.	GM06196	NIH	140,812	S		26.2	8.324	0.214
Leiderman, P. Herbert	Psychiatry	PREMIE: Study of human maternal behavior relating the degree of interaction between mother and infant in the post-partum period to later maternal attachment and infant development.	---	Grant Fdn.	10,000	S		24.3	9.564	1.222
Leiderman, P. Herbert	Psychiatry	KENYA: Analysis of data collected in Kenya, relating the effect of social structure of primary family on infants' social attachments in the first year of life.	RR05353	NIH	133,817	S		54.8	18.864	4.034
Lucas, Zoltan	Surgery	KIDTRANS: Tabulation of survival data for renal transplant patients.	---	Dept. Funds	---	S		2.4	1.167	1.301
Luetscher, John	Metabolism	BLOOD PR: Secretion and metabolism of adrenal hormones; identification of curable forms of hypertension.	HE13917	NIH	81,189	S		129.6	38.328	2.194
Maffly, Roy	Metabolism	CO2: Sodium transport; predictive value of tests for blood urea nitrogen and decreased serum sodium concentration.	AM16327	NIH	46,757	S		98.1	40.664	1.072
Maffly, Roy	Metabolism	TEACH: Teaching programs for students and staff: evaluation of patients' acid-base disorders; displayed on Beehive terminal and projected onto large screen for class use.	---	Dept. Funds	---	T		264.5	228.115	7.930

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Maffly, Roy	Metabolism	SERUM: Analysis of blood serum electrolytes from ion-specific electrodes.	72875	Am. Heart	63,690	S		1.2	0.650	0.040
McConnell, Harden	Chemistry	ABSORB: Paramagnetic resonance spectra research; hemoglobin mutations, fluidity of membranes, electrochemical potential of membranes.	GB33501X	NSF	65,000	S		282.9	115.109	6.744
McDevitt, Hugh	Immunology	MARGALO: Calculation of the antigen-binding activity of antisera from mice immunized with various branched multichain synthetic polypeptide antigens.	AI07757	NIH	159,606	S		34.9	11.586	0.175
Melen, Robert	Electronics Lab	ISICHROM: Development of a system of automatic classification of human chromosomes.	N0044	Navy	465,000	S		3.1	0.837	1.104
Melges, Frederick	Psychiatry	TEMPO: Study of psychotic processes; especially relating changes in temporal experience to psychopathological symptoms.	AA00498	HSMHA	718,697	S		106.0	26.925	4.031
Miller, Craig	Cardiology	CAB: Development of risk/benefit guidelines for saphenous vein - coronary artery bypass surgery.	HL05709	NIH	63,346	S		39.8	35.031	2.692
Miller, Rupert	Statistics	THESES: Biostatistical computing by graduate students for theses or other educational use.	GM00025	NIH	90,614	T		5.6	1.569	0.195
Miller, Rupert	Statistics	COURSES: Computing done by staff in connection with the teaching of biostatistics.	GM00025	NIH	90,614	T		0.0	0.0	0.048
Miller, Warren	Psychiatry	PSI: Analysis of self-report psychiatric inventory questionnaire.	---	Dept. Funds	---	S		6.8	2.405	0.376
Minami, Roland	Surgery	RSP: Evaluation of respiratory studies as a measure of velopharyngeal incompetence, comparing it with age, cine-fluorographic results, operation, and time.	DE02803	NIH	31,434	S		12.8	3.922	0.665
Morris, Randall	Surgery	CTX: In vitro assay of transplantation immunity aimed at development of a superior immunosuppressive protocol.	GM01922	NIH	301,996	S		1.0	0.233	0.204
Myers, Woodrow	Youth Opportunities Programs	PREMED: Introduction to computing for minority pre-med students.	---	Dept. Funds	---	T		50.2	17.745	0.063
Nall, Lexie	Dermatology	PSORIASI: Psoriasis research.	---	Dept. Funds	---	S		0.0	0.0	0.060
Nye, William	Medical Microbiology	STRUCTUR: Statistical calculations and bibliography compilations in the field of immunochemistry.	AI00082	NIH	152,418	S		42.8	6.344	0.681

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Ordal, John	Immunology	ALGERNON: Calculation of antigen-binding activity of antisera from mice immunized with various branched multichain synthetic polypeptide antigens.	GM01922	NIH	301,996	S		4.2	1.304	0.252
Ostrem, Dennis	Biochemistry	GLYCYLRS: Enzyme research on glycl-TRNA: kinetics of subunit association, ultra-centrifuge experiments, and amino acid analysis.	GM13235	NIH	174,410	S		76.2	65.192	0.826
Payne, Rose	Hematology	SERNAL: Extension and classification of leukocyte and/or tissue antigens by serologic and genetic analysis of specific human antisera.	HE03365	NIH	85,632	S		36.0	33.945	5.353
Pfendt, Eva	Medical Microbiology	CANVIRTU: In vitro studies of human tumors.	NCI-E-69-2053	NIH	172,369	S		17.2	13.971	0.556
Rapp, Wolfgang	Gastroenterology	OUDINLIN: Immunological determination of the gastric antigenic esterase VI A in gastric juices of patients with gastric diseases.	AM06971	NIH	97,829	S		0.0	0.0	0.210
Reaven, Gerald	Metabolism	PAT DATA: Risk factors in coronary heart disease; modeling of metabolite action important in diabetes mellitus and atherosclerosis; inpatient data on metabolic disorders; participation in nationwide clinical trial of "lipid hypothesis".	HL14174	NIH	620,030	S		849.7	414.699	35.313
Reaven, Gerald	Metabolism	LRCINFO: Study of prevalence of lipids and lipid diseases in closed populations.	HL14174	NIH	620,030	S		0.0	0.0	0.057
Reaven, Gerald	Metabolism	RASSAY: Statistical studies of material obtained from inpatients in study of metabolic abnormalities.	HL14174	NIH	620,030	S		30.2	9.754	0.041
Reaven, Gerald	Metabolism	SCOR: Study of relationship between attitudes and habits in atherosclerosis.	HL14174	NIH	620,030	S		73.4	48.479	6.024
Reaven, Gerald	Metabolism	SLRES: Elucidation of relationship of health habits to atherosclerosis.	HL14174	NIH	620,030	S		83.0	42.878	1.342
Reaven, Gerald	Metabolism	WASSAY: Assays of cholesterol and triglyceride to determine distribution of lipid diseases in free living populations.	HL14174	NIH	620,030	S		31.3	10.374	0.034
Reaven, Gerald	Metabolism	INPAT: Opened in error; never used.	HL14174	NIH	620,030	S		0.0	0.0	0.002
Reaven, Gerald	Metabolism	DISPLAY: Graphics display program and modeling programs for the research detailed above.	HL08506	NIH	71,305	S		3.2	2.456	3.859

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Reynolds, Walter	Genetics	TEXTS: Text management support for engineering efforts in instrumentation: commercial technical data and information retrieval programs.	NGR004	NASA	180,000	S		0.0	0.0	6.996
Robertson, William	Pediatrics	UGAG: Urinary analysis of glycosamenoglycans; immunoglobin concentrations in sera; binding of ligands to macromolecules.	---	Hart-fd. Fdn.	---	S		11.0	4.836	0.207
Rosenberg, Leon	Medical Microbiology	ALEXINE: Studies of serum complement in mice.	AI09341	NIH	49,202	S		17.8	6.639	0.215
Rosenberg, Saul	Oncology	MEDONCOL: Development of time-oriented patient record system for patients with malignant diseases.	---	Am. Cancer	---	C		346.0	243.640	9.029
Rosenberg, Saul	Oncology	TOD: Same as above, converted to TOD, ACME's Time-Oriented Database system.	---	Am. Cancer	---	C		52.1	47.867	2.932
Rosenberg, Saul	Oncology	STATIST: Statistical analysis of survival rates of cancer patients.	---	Am. Cancer	---	S		80.9	28.568	2.419
Rosenquist, Grace	Gastroenterology	GASTRIN: Calculation of serum gastrin concentrations of normals and patients with G.I. tract diseases.	AM06971	NIH	97,829	S		65.6	26.788	0.127
Rosenthal, William	Otolaryngology	RESEARCH: Auditory processing in language deviant children; longitudinal study and follow-up of language deviant children.	NS07514	NIH	157,136	S		2.2	0.481	0.561
Roughgarden, Jonathan	Biosciences	POPECOL: Computer simulation of models of population growth.	---	Dept. Funds	---	S		0.0	0.0	0.004
Russell, Alan	Biochemistry	AFFINITY: Enzyme assay calculation.	GM07581	NIH	313,398	S		0.0	0.0	0.102
Russ, Frederica	Otolaryngology	CRIBGRAM: Attempt to validate an automated approach to hearing screening in the newborn.	NS07974	NIH	42,521	C		1.5	0.766	0.019
Schubert, Earl	Otolaryngology	SONICS: Analysis of signal waveforms by Fourier, correlational and similar techniques.	---	Dept. Funds	---	S		21.1	8.790	0.647
Schwartz, Donald	Anesthesia	RESPOT: Calculation of cardiac indices; correlation with blood ionized calcium levels.	GM12527	NIH	503,159	S		129.5	70.411	1.089
Simpson, Jack	Physics	SUSIE: Design work for a superconducting magnetic beam transport channel for use in pion cancer therapy.	GI35007	NSF	817,700	S		9.6	6.285	2.930
Sklar, Alan	Psychiatry	CATAPULT: Relationship of parental separations during the first 18 years of life and personality characteristics of children.	---	Dept. Funds	---	S		31.8	8.985	0.940

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Category 2 (cont'd.)	Non-Realtime,	Sponsored Research (CHARGEABLE)					@ $50/hr		@ $.017 per pageminute	@ $.10 per block
Smith, James	Medical Microbiology	CANVIR/CANVIR1: Development of automated system for classification of human chromosomes.	NCI-E-69-2053	NIH	172,369	S		44.1	53.149	4.161
Smith, Kendric	Radiobiology	CHBR: Data analysis of sedimentation patterns of DNA following X-irradiation.	CA10372	NIH	529,889	S		211.1	67.886	0.148
Solomon, George	Psychiatry	STRESS: Relating various forms of stress and environmental manipulation to immunity.	MH15976	HSMHA	54,306	S		6.4	1.649	0.720
Stark, George	Biochemistry	CHACS: Enzyme experiment data analysis and processing of chromatograms generated by an amino acid analyzer.	GM11788	NIH	74,137	S		23.5	5.322	1.139
Steward, John	Med. School Student Affairs	MR: Computerization of student records of medical school.	---	Dept. Funds	---	S		10.4	4.801	0.022
Stocker, Bruce	Medical Microbiology	STM: Genetics and physiology of salmonella typhimurium.	AI00082	NIH	152,418	S		31.1	11.253	8.957
Strickland, Robert	Gastroenterology	GASTRIC: Analysis of gastric secretory function tests.	AM05418	NIH	66,785	S		0.0	0.0	0.250
Stiedeman, Don	Genetics	ADMIN: Capital equipment inventory.	NGR004	NASA	180,000	S		23.5	8.222	2.178
Vosti, Kenneth	Infectious Diseases	VOSTI: Cross-tabulation of variables associated with bacterial infections.	AI03638	NIH	38,112	S		3.8	3.322	2.778
Watson, Stanley	UCLA	HUDA: Investigation of biological bases of pain relief.	---	UCLA Funds	---	S		10.0	6.283	0.010
Weissman, Irving	Pathology	THYMUS: Statistical analysis and data handling for pathology research.	AI09072	NIH	71,007	S		35.3	7.771	0.516
Whitson, Robert	Regional Medical Program	MPS EVAL: Evaluation of multiphasic screening project in San Joaquin County to discover its effect on disease treatment patterns.	---	HSMHA	50,517	S		2.2	0.686	2.470
Wolcott, Leslie	Psychiatry	MINPIN: Testing statistical correlations between drug and non-drug data, e.g., amphetamines, placebos, THC, etc.	AA00498	HSMHA	718,697	S		0.2	0.037	0.173
					SUB-TOTAL		6976	91115.4	4844.785	472.799
Category 3	Non-Stanford Medical (CHARGEABLE)								@ $.025 per pageminute	@ $ .10 per block
Belt, Donald	Otolaryngology	SEC: Process and evaluate hearing and vision screening data.	---	Personal Funds	---	S		0.0	0.0	0.022
Belzer, Folkert	Univ. of Calif at SF	KIDNEY: Selection of recipients for renal homotransplantation; measurement and calculation of hemodynamic changes in transplant patients for detection of incipient rejection.	---	Univ. Calif.	---	S		394.8	401.350	13.137

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Category 3 (cont'd.)	Non-Stanford Medical (CHARGEABLE)								@ $.025 per pageminute	@ $ .10 per block
Chang, Herbert	Prentice Electronics	P3000_SC: Preparation for possible ACME use of Prentice P3000 communications controller.	---	Prentice Electronics	---	C		2.1	0.508	0.079
Daughters, George	Palo Alto Medical Research Fdn.	PLAYTIME: Instruction in computer use for PAMR staff.	---	PAMR	---	T		5.5	1.055	0.182
Daughters, George	Palo Alto Medical Research Fdn.	CINES: Myocardial dynamics.	---	PAMR	---	C		103.8	23.520	0.433
Daughters, George	Palo Alto Medical Research Fdn.	LABCHECK: Routine terminal use for PAMR Clinical Laboratory.	---	PAMR	---	C		22.9	4.770	0.094
Efron, Brad	Statistics	EFRON: Biostatistical analysis of drug data.	---	Personal Funds	---	S		0.1	0.008	0.060
Kountz, Samuel	St. Univ. of NY	TXKIDNEY: Donor-recipient pairing for national kidney transplant sharing program.	---	St. Univ. NY	---	S		1.6	1.216	0.277
Mead, Carol	Palo Alto Medical Clinic	CARPPA: Correlation of cardiac health and exercise, medication, smoking habits, etc.	---	PA Med. Clinic	---	S		0.7	0.143	0.015
Stewart, Louis	Jung Institute	DREAMS: Concordance of psychiatric dream data.	---	Jung Inst.	---	S		0.0	0.0	0.000
Tickner, Ernest	Palo Alto Medical Research Fdn.	VISCOUS: Viscous behavior of blood.	F44620	PAMR	---	S		26.4	17.052	0.402
Tickner, Ernest	Palo Alto Medical Research Fdn.	MURMURS: Development of computer-averaged transient routine to detect heart murmurs.	---	PAMR	---	S		37.6	46.118	0.219
							SUBTOTAL	595.5	495.740	15.032
Category 4 Medical Students (FREE)									@ $.02 per pageminute	@ $.10 per block
Athearn, Fred	Student	HEART: Conversion of the digitalized results of ultrasonic studies of the heart into form allowing a model of heart surfaces to be constructed and analyzed.				T		0.6	0.130	0.024
Bosley, Mac	Student	PHATCITY: Learning computing and PL/ACME.				T		2.6	0.540	0.035
Brast, Neil	Student	RODENTS: Statistical programs for student's research.				T		2.5	0.235	1.131
Brunda, Michael	Student	MEDMICRO: Evaluation of data from gamma counter on per cent cytotoxicity in cell suspensions exposed to a variety of developed antisera against thymus and brain determinants.				T		13.4	4.681	0.775

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Category 4 (cont'd.)	Medical Students (FREE)								@ $.02 per pageminute	@ $.10 per block
Bull, Kenneth	Psychiatry	K BULL: Effects of injections of epinephrine v. nor-epinephrine on agonistic (aggressive, withdrawal, fear) and autistic behaviors in Rhesus monkeys.				T		5.4	1.412	0.320
Calvert, James	Student	TEXT: Solving the economic problem of medical research funds allocation; one criterion: change in mortality rate.				T		0.0	0.0	0.840
Cavalli, Luca	Genetics	HUMGEN: Classwork for course in human genetics.				T		21.3	12.163	0.568
Cavalli, Luca	Genetics	BIOMETRY: Elementary biostatistics course for undergraduates, aimed especially at those who have difficulties with math.				T		96.6	69.228	0.511
Chester, Thomas	Student	PLAQUE: Anti-tumor immune responsive effects of interferon and interferon inducers.				T		22.7	11.104	1.927
Chiampi, Mona	Student	MEMBESTA: Calculation of enzyme activities and carbohydrate content of cell fractions.				T		29.7	8.129	0.505
Corby, James	Student	HURRY: Relationship between attention and enhancement of average evoked response (AER) magnitude.				T		0.9	0.177	0.402
Dekker, Don	Student	UCG: Ultrasound studies of human heart.				T		71.3	29.609	3.432
Dimsdale, Joel	Student	GETPEACE: Characterization of goals in psychiatric wards and ward pressures on patients and staff to conform to the goals.				T		1.2	1.138	2.824
Dubowy, Ronald	Student	TURTLE: Enzyme changes in the skeletal muscles of chronically exercized rats.				T		7.1	1.484	0.114
Felder, Ralph	Student	NEUROVIS: Mathematical modelling of visual system of the cat.				T		3.0	0.422	0.051
Feldman, Gary	Student	ASTHMA: Monitoring of airway resistance values during sessions with asthmatic patients and normal subjects.				T		0.0	0.0	0.010
Funk, Glenn	Student	RHINO: Study of rhinoviruses.				T		1.5	0.308	0.216
Gamel, John	Student	DOGLAB: Indicator dilution techniques for measuring pulmonary blood flow and lung transfer function.				T		0.0	0.0	0.105
Gartrell, Nanette	Student	GAY: Analysis of responses to questionnaire on psychiatrists' attitudes toward gay women.				T		16.3	3.973	0.226

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							BATCH	TIME SHARING		
			Identifying Number	Agency	Current Annual Amt.		Minutes	Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 4 (cont'd.)	Medical Students (FREE)								@ $.02 per pageminute	@ $.10 per block
Graber, Mark	Student	HEXION: Interaction of Lac Repressor protein with DNA and inducing sugars using NMR spectroscopy.				T		19.9	6.164	0.085
Huset, Richard	Student	INDIANFR: Pre-natal risk vs. outcome studies of Indian and white populations.				T		51.1	13.391	1.157
Jacobs, Beverly	Student	COMPUTE: Thesis research project on mechanism of insulin action.				T		0.1	0.047	0.232
Jan, Wesley	Student	NOMAN: Information processing, storage, retrieval and display for students' research on enumerating a minor cell population by fluorescent techniques.				T		56.4	17.412	3.699
Klyde, Barry	Student	Estrogen-induced alterations in specific species of chicken liver tRNA.				T		95.5	53.878	1.152
Leith, Bonnie Sue	Student	GROCURV: Analysis of growth curves of tissue cultures, comparing them to a logistic curve and analyzing variance.				T		24.3	6.453	0.472
Lenssen, Barbara	Student	INFANTS: Analysis of data for doctoral dissertation on infants' fear of strangers.				T		1.3	0.446	0.232
Levine, Rodney	Student	CPS: Clarification of mechanisms of pyrimidine synthesis in mammals and the relationship of that synthesis to the control of cellular proliferation.				T		140.2	51.788	4.417
Lipp, Martin	Student	MEDSPOT: Survey of marijuana use among medical personnel.				T		0.0	0.0	4.899
Mascver, Gerald	Student	MYCOPLAS: Amino acid analysis of media used for growth of mycoplasma and tissue culture cells.				T		0.2	0.054	0.192
Miller, Craig	Student	CAB: Development of risk/benefit guidelines for saphenous vein - coronary artery bypass surgery.				T		9.1	10.266	0.732
Miller, Stephen	Student	LEARN: Analysis of data from an ANGER scintillation camera in connection with kidney blood flow studies; computer diagnosis of liver and cardiac disease.				T		0.0	0.0	0.216
Mischak, Ronald	Student	HISTOCOM: Evaluation of data from gamma counter on per cent cytotoxicity in cell suspensions exposed to a variety of developed antisera against thymus and brain determinants.				T		0.0	0.0	0.073
Mobley, William	Student	NBIOCMED: Statistical analysis for thesis project on proteins; storage of research notes and data, edited class notes and references.				T		0.0	0.0	0.048

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Category 4 (cont'd.)	Medical Students (FREE)								@ $.02 per pageminute	@ $.10 per block
Myers, Woodrow	Student	MSTP: Instruction in statistics and introduction to computers for advanced minority high school students in the Youth Opportunities Program (YOP).				T		48.0	13.533	0.106
Neff, Nicola	Student	POLYRIBO: Extraction of polyribosomes and ribosomes from human fibroblast cells in culture to determine relative proportions and quantity throughout cell life culture.				T		89.5	44.786	2.021
Nestor, Larry	Student	DIFFDX: Establishment of computer program to aid in differential diagnosis.				T		0.0	0.0	0.072
Nola, Gaeton	Student	DIGMI: Effects of several drugs on hemodynamic parameters in dogs.				T		35.2	8.851	1.059
Nuwer, Marc	Student	NEURON: Modelling of interactions of groups of neurons.				T		57.6	30.555	1.163
Odell, Robert	Student	CIS: Learning use of ACME system.				T		6.6	2.045	0.135
Peterson, Daniel	Student	MODELIN: Formulation of comprehensive model for insulin metabolism in the human body.				T		0.0	0.0	0.038
Pope, Stephen	Student	AY21011: Cardiovascular function parameters of various pharmacologic agents.				T		0.0	0.0	0.028
Raybin, Daniel	Student	ASSAYS: Calculation of enzyme assays and enzyme kinetics.				T		2.2	0.624	0.425
Rosenfeld, Ron	Student	CCUPSYCA: Study of psychophysiological adaptation of male patients to the Coronary Care Unit.				T		0.0	0.0	0.002
Rosenthal, William	Student	RESEARCH: Auditory processing in language deviant children; longitudinal study and follow-up of language deviant children.				T		0.0	0.0	0.138
Sachs, David	Student	POPCIT: Statistical analysis of questionnaires completed by newspaper reporters and editors on their attitudes and orientations toward environmental health issues.				T		2.7	3.748	0.716
Sack, Robert	Student	MASOCH: Item analysis of questionnaire to determine which questions best discriminate between normals and psychiatric patients; also cluster analysis for internally correlative items.				T		22.1	6.052	0.560
Schwartz, Barry	Student	CELLCOUN: Analysis of Coulter Counter data for study of aging process at cellular level.				T		1.8	0.447	0.060

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Category 4 (cont'd.)	Medical Students (FREE)								@ $.02 per pageminute	@ $.10 per block
Siever, Larry	Student	GRADIENT: Study of gradients of biogenic amines in the spinal cord cerebrospinal fluid.				T		0.0	0.0	0.006
Sinclair, Allen	Student	HEARTCEL: Measurement of intervals between beats of individual heart cells and administration of drugs to cells to change environmental conditions.				T		0.0	0.0	0.034
Spinelli, Nico	Psychiatry	COMPBIOL: Class account for "Computers in Biology and Medicine."				T		32.9	26.765	0.562
Sproul, Myrna	Student	FETAL: Data analysis for thesis project on relationship of maternal corticosteroids to the development of the fetal hypothalmic-pituitary-adrenal axis.				T		25.2	21.616	0.145
Unknown Users	Mostly Students	SCRATCH: Minor use of the system without data storage.				T		440.5	150.554	0.161
							SUB-TOTAL	1458.5	614.208	38.372
Category 5 Realtime,	Core Research (FREE)								@ $.02 per pageminute	@ $.10 per block
Bacon, Virginia (J. Lederberg)	Genetics	GAME: Computer control of Finnigan 1015 quadrupole mass spectrometer.				Cor		109.2	143.923	13.170
Gersch, Will	Neurology	ACME: Development of time series analysis service programs for ACME users.				Cor		592.8	394.915	15.709
Lederberg, Joshua	Genetics	DENDRAL: Mass spectra analysis and interpretation.				Cor		3160.5	4146.608	190.332
							SUB-TOTAL	3862.5	4685.446	219.211
Category 6 Non-Realtime,	Core Research (FREE)								@ $.02 per pageminute	@ $.10 per block
Cann, Howard	Pediatrics	GUAT: Testing of new utility program for dumping files to tapes readable at other computer facilities.				Cor		0.0	0.0	0.540
Chang, Herbert	Prentice Electronics	P3000_SC: Preparation for possible ACME use of P3000 communications controller.				Cor		10.4	1.579	0.053
Cohen, Stan	Clinical Pharmacology	DRUGALRT: Computerized system to warn of interactions of drugs administered to patients.				Cor		364.5	239.170	12.984
Lederberg, Joshua	Genetics	PILOT1: Demonstration programs.				Cor		462.5	204.063	14.328
Lederberg, Joshua	Genetics	PILOT2: System testing and monitoring.				Cor		281.2	117.959	9.217
Rosenberg, Saul	Oncology	MEDONCOL/TOD: Test case for use of ACME's Time-Oriented Database (TOD) system.				Cor		257.0	240.886	7.773
							SUB-TOTAL	1375.6	803.657	44.895

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Category 7 Staff (FREE)									@ $.02 per pageminute	@ $.10 per block
Bassett, Robert	ACME	ACMECONS: Application program development; user consultation.				Cor		723.8	461.129	7.787
Baxter, Erica	ACME	NOTES: Maintenance of ACME Note index and list of user publications.				Cor		71.6	25.902	6.568
Baxter, Erica	ACME	TRAINING: ACME user accounting records.				Cor		20.6	6.983	0.781
Becker, Sheldon	Computation Center	ACME: System development and testing.				Cor		0.0	0.0	0.008
Berman, Joseph	ACME	RACME: System development and testing.				Cor		2.1	0.965	6.084
Berns, Robert	ACME	DENDRAL: System development and testing.				Cor		9.8	3.953	6.513
Breverman, Charles	ACME	APPLICAT: System development and testing.				Cor		71.5	16.742	1.098
Breverman, Charles	ACME	RADIO: Development of radioimmunoassay programs.				Cor		72.4	13.479	2.090
Briggs, Russell	ACME	ACME: System development and testing.				Cor		0.8	0.176	6.142
Briggs, Russell	ACME	RBPDP-11: Disc monitor for PDP-11.				Cor		3.2	0.478	3.774
Crouse, Linda	ACME	CATH LAB: Development of real-time medical applications.				Cor		25.1	7.109	4.689
Feigenbaum, Edward	Computation Center	DEMOS: System demonstrations.				Cor		0.0	0.0	0.132
Feigenbaum, Edward	Computation Center	TO29TEST: System demonstrations.				Cor		0.0	0.0	0.024
Freret, Payne	ACME	LOMA: Development of graphics software.				Cor		1.5	0.285	0.264
Frey, Regina	ACME	ACME: File system testing; consulting programs.				Cor		180.5	40.734	13.073
George, Denise	Computation Center	OS: System development and testing.				Cor		0.0	0.0	0.002
Germano, Frank	ACME	TOD: Development of Time-Oriented Database System (TOD).				Cor		283.6	204.121	7.214
Germano, Frank	ACME	USERSERV: User consultation and applications program development.				Cor		122.9	57.227	1.331
Giusti, Rick	ACME	PI: System development and testing.				Cor		220.0	103.771	4.315
Goheen, Mark	ACME	ACEGIL: System development and testing.				Cor		236.6	98.754	1.364

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Category 7 (cont'd.)	Staff (FREE)								@ $.02 per pageminute	@ $.10 per block
Granieri, Charles	ACME	ACME: System development and testing.				Cor		127.3	57.107	2.101
Harrison, Jeff	ACME	SUMMER: System development and testing.				Cor		74.0	31.896	0.661
Heathman, Mike	ACME	MINE: System development and testing.				Cor		81.3	77.241	3.794
Hu, Jean	ACME	ACME: System development and testing.				Cor		0.0	0.0	8.172
Hundley, Lee	ACME	ACME: System development and testing; emphasis on real-time data acquisition.				Cor		125.6	54.334	5.057
Jamtgaard, Ron	ACME	GOAL: Director's office projects.				Cor		115.0	30.988	1.950
Jamtgaard, Ron	ACME	MYJOB.TASK: Task management.				Cor		0.0	0.008	0.372
Lederberg, Joshua	Genetics	TESTS: Systems tests.				Cor		102.6	36.001	3.110
Leong, Leon	ACME	WORK: Development of applications program.				Cor		44.5	27.968	1.648
Lew, Ying	ACME	SUMMER: System development and testing.				Cor		109.5	34.139	2.068
Martin, Charles	Computation Center	ACME: System development and testing.				Cor		0.0	0.0	0.002
Matheson, Russ	ACME	PI: System development and testing.				Cor		2.7	3.336	5.182
Miller, Stu	ACME	ACME: System development and testing.				Cor		125.2	56.239	1.307
Neimat, Marie-Anne	ACME	NEW: System development and testing.				Cor		22.2	6.298	0.226
Nozaki, Tom	ACME	ENGINEER: Engineering applications.				Cor		35.4	11.049	2.795
Prowell, Marlin	ACME	WAR: Applications program development.				Cor		150.6	64.098	1.592
Sanders, William	ACME	ASDFG: Hardware and software development.				Cor		0.2	0.050	1.342
Schroeder, John	ACME	ACME: System development and testing.				Cor		1.0	0.150	0.019
Stainton, Robert	ACME	SCC: System development and testing.				Cor		79.4	16.785	1.657
Stubbs, Bert	Computation Center	ENGINEER: Engineering applications.				Cor		0.0	0.0	0.024
Tribolet, Chuck	ACME	CAI: Development of computer-aided instruction for teaching PL/ACME.				Cor		176.8	55.653	9.617

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Category 7 (cont'd.)	Staff (FREE)								@ $.02 per pageminute	@ $.10 per block
Weyl, Steve	ACME	DATABASE: Development of Time-Oriented Database System (TOD).				Cor		144.0	58.151	2.556
Weyl, Steve	ACME	SWEYL: Applications program development.				Cor		215.0	129.489	1.972
Weyl, Steve	ACME	SMAC: Applications program development.				Cor		0.0	0.0	0.004
Whitner, Jane	ACME	STATISTI: Statistical program development.				Cor		508.4	217.727	4.105
Whitner, Jane	ACME	STATTEST: Statistical program development.				Cor		0.0	0.0	0.183
Wiederhold, Gio	ACME	TEST: System testing.				Cor		126.0	31.051	10.168
Wiederhold, Gio	ACME	CSMP: Continuous system modelling program development.				Cor		0.0	0.0	4.092
Wiederhold, Gio	ACME	DEMO: Demonstration for ACME visitors.				Cor		27.0	12.370	1.521
Wiederhold, Voy	ACME	MANUAL: Maintenance of PL/ACME Manual.				Cor		120.6	19.136	15.446
ACME Staff	ACME	JQPUBLIC: Development and storage of PUBLIC files.				Cor		72.1	25.534	9.554
ACME Staff	ACME	DATABANK.TODD: Public file of Time-Oriented Database (TOD) programs.				Cor		48.4	20.743	0.366
ACME Systems Staff	ACME	PROGRAMS: Collection of systems programs.				Cor		12.0	3.748	2.579
IBM Customer Engineers	IBM	I CE TERMDIAG: Terminal testing and diagnosis.				Cor		48.0	12.550	0.135
PL/ACME Classes	ACME	PLACME: Practice programming for PL/ACME classes.				T		326.2	106.272	1.925
							SUB-TOTAL	5067.0	2241.919	180.555
Category 8 Stanford University Hospital		(CHARGEABLE)							@ $.017 per pageminute	@ $.10 per block
Barber, Vic	SUH Data Processing	SUHDP: Accounting	---	Hosp. Funds	---	S		16.8	7.300	0.957
Barber, Vic	SUH Data Processing	MEDELCO: Statistical survey for a data collection/transmission system.	---	Hosp. Funds	---	S		211.9	460.017	32.005
Daly, Virginia	SUH Clinical Lab-Immunology	CH50: Establishment of normal values for human serum total complement levels and clinical tests on patients to determine their level.	---	Hosp. Funds	---	S		11.7	4.464	0.072

SUMMARY OF COMPUTER RESOURCE USAGE

April 17, 1972 - April 16, 1973

*Cor = Core Research and Development
C = Collaborative
S = Service
T = Training

INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT: Identifying Number	Agency	Current Annual Amt.	BRR Category*	AMOUNT OF USAGE: BATCH: Minutes	TIME SHARING: Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 8 (cont'd.)	Stanford University Hospital (CHARGEABLE)								@ $.017 per pageminute	@ $.10 per block
Forrest, William	SUH Clinic	SCHEDULE: Automation of monthly scheduling of doctors for "on call" duty.	---	Clinic Budget	---	S		48.2	27.398	2.202
Petralli, John	SUH Clinical Lab-Infectious Diseases	MED_DATA: Computer method for improvement of antibiotic sensitivity data and guidance in therapy.	---	Hosp. Funds	---	S		2035.0	777.931	84.559
Petralli, John	SUH Clinical Lab-Infectious Diseases	PROGRESS: Program development for Infectious Disease Lab computing.	---	Hosp. Funds	---	S		14.4	2.293	1.931
Petralli, John	SUH Clinical Lab-Infectious Diseases	INFCON: Infection control: data on isolation patients.	---	Hosp. Funds	---	S		104.1	16.271	1.834
Sussman, Howard	SUH Clinical Lab-Pathology	CLO50937: Statistical analysis programs for data generated by Clinical Laboratory Information System.	---	Hosp. Funds	---	S		175.7	42.753	1.242
							SUB-TOTAL	2617.8	1338.427	124.802
Category 10 Realtime,	Pilot and Pending Proposal (FREE)								@ $.02 per pageminute	@ $.10 per block
Bunnenberg, Edward	Chemistry	CHEM: Development of a magnetic circular dichroism biotechnology resource.				S		78.1	144.557	8.390
Kadis, Leslie	Anesthesia	VISAEP: Visual average evoked potential to graded light intensity as a correlate of pain threshold.				S		34.0	29.388	0.410
							SUB-TOTAL	112.1	173.945	8.800
Category 11 Non-Realtime,	Pilot and Pending Proposal (FREE)								@ $.02 per pageminute	@ $.10 per block
Belt, Donald	Otolaryngology	HEAR: Collection and processing of hearing loss data.				S		0.0	0.0	0.072
Cavalli, Luca	Genetics	LAURA: Data analysis on population genetics.				S		190.9	106.758	2.440
Cohen, Leon	Neurology	MOTOR: Statistical analysis of single motor unit action potentials recorded from normals and patients. Aim is to develop diagnostic method for diseases of peripheral nerves and muscle.				S		13.6	15.780	0.960
Schwartz, Donald	Anesthesia	RESPOT: Calculation of cardiac indices; correlation with blood ionized calcium levels.				S		10.9	7.020	0.198
							SUB-TOTAL	215.4	129.558	3.670

SUMMARY OF COMPUTER RESOURCE USAGE

April 17, 1972 - April 16, 1973

*Cor = Core Research and Development
C = Collaborative
S = Service
T = Training

INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT: Identifying Number	Agency	Current Annual Amt.	BRR Category*	AMOUNT OF USAGE: BATCH Minutes	TIME SHARING: Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
Category 12 Realtime, Extended Non-Funded (FREE)									@ $.02 per pageminute	@ $.10 per block
Constantinou, Christos	Urology	UROL: Investigation of upper urinary tract physiology.				S		130.8	107.699	1.173
							SUB-TOTAL	130.8	107.699	1.173
Category 13 Non-Realtime, Extended Non-Funded (FREE)									@ $.02 per pageminute	@ $.10 per block
Leiderman, P. Herbert	Psychiatry	KENYA: Analysis of data collected in Kenya, relating the effect of social structure of primary family on infants' social attachments in the first year of life.				S		4.3	1.359	1.796
							SUB-TOTAL	4.3	1.359	1.796
Category 16 Combination of Core Research and Application (CHARGEABLE)									@ $.012 per pageminute	@ $.10 per block
Sera, Hiram	SUH Pharmacy	ALERT: Drug Interaction Project, hospital pharmacy service.	---	Hosp. Funds	---	S		3670.2	7456.016	95.581
							SUB-TOTAL	3670.2	7456.016	95.581
Category 17 Operations (FREE)									@ $.02 per pageminute	@ $.10 per block
Class, Charles	ACME	ACME: Operations management; system testing and demonstration.				Cor		6710.0	4800.367	10.425
Cower, Rich	ACME	FLOWERED: Daily operations.				Cor		174.3	78.438	2.903
Matous, James	ACME	GET: Daily operations.				Cor		0.0	0.0	0.600
Montgomery, Rich	Computation Center	KP: Text editing.				Cor		0.0	0.0	0.024
Rieman, James	ACME	VAT: Daily operations.				Cor		3.9	0.816	0.322
Sutter, Jan	ACME	ACME: Daily operations.				Cor		53.4	6.838	3.994
							SUB-TOTAL	6941.6	4886.459	18.268
Category 9 Non-Health-Related Users (CHARGEABLE)									@ $.02 per pageminute	@ $.10 per block
							SUB-TOTAL	576.3	340.154	23.388
						GRAND TOTAL	6,976	122764.5	31920.861	1420.727
						GRAND TOTAL EXCLUDING PHARMACY**	6,976	119094.3	24464.845	1325.146

**These totals are shown because Pharmacy utilization involved many pageminutes but little actual computing. The usage distorts the "pageminute" as a measure of overall system use.

due to failures

Percentage of scheduled time not available to users 2.1%

RESOURCE USAGE

pril 16, 1973

*Cor = Core Research and Development
C = Collaborative
S = Service
T = Training

CR CONTRACT SUPPORT		BRR	AMOUNT OF USAGE			
			BATCH	TIME SHARING		
Agency	Current Annual Amt.	Category*	Minutes	Terminal Access Hours	Pageminutes (K)	Block Storage(K) (Block=2K Bytes)
	Number of Projects					
opment	69			16920.5	12511.209	461.004
	18		6,976	4663.7	3681.548	254.657
	176			98208.8	14281.907	626.189
	61			2395.2	1106.043	55.489
	324		6,976	122188.2	31580.707	1397.339
arch	23			576.3	340.154	23.388
	347		6,976	122764.5	31920.861	1420.727

SUMMARY OF COMPUT

April 17, 1972 -

INVESTIGATOR	DEPARTMENT/ INSTITUTION	PROJECT TITLE	DIRECT GRA Identifyi Number
		Core Research and De	
		Collaborative	
		Service	
		Training	
		SUB-TOTAL	
		Non-Health-Related R	
		GRAND TOTAL	

Time scheduled for users 6063 hours

Time not available to users 128 hours

VIII. APPENDICES

A. Rationale of Shared Data Base Concept

B. Medical Center Computer Planning Chronology

C. Small Machine Multiplexor
(Excerpt of ACME Note HAD.)

D. ACME Note Index (May 11, 1973)

E. ACME User Publications

APPENDIX A

DATE: March 16, 1973

TO : P. Carpenter

FROM : E. Levinthal

SUBJECT: Rationale of Shared Data Base Concept

This memorandum elaborates the rationale supporting the shared data base concept as it relates to the Medical Center Computing Facility. Computing at the Medical School can be categorized as follows:

1. Use of in-patient or out-patient data by clinical departments. This involves, in varying amounts, three components, a) teaching, b) research, c) patient-service management (i.e. fees, records, bills, etc.).

2. Non-patient related computing by clinical departments. This part is only indirectly related to the shared data base issue. Insofar as clinical faculty are using a computer resource for their patient related computing needs, they are apt, as a matter of convenience and familiarity, to want to use the same facility for the remainder of their needs. This will be modulated by considerations of price and services offered.

3. Non-patient related computing carried out by non-clinical faculty. This is clearly unrelated to the data base concept. It is, of course, related to the cost and services offered on the 370/158 system compared to those offered elsewhere. Many of these users take advantage of functions which call statistical routines and which are now built into the PL/ACME system. These will also be an important requirement of users in categories 1 and 2. In this case therefore the issue (as in category 2) is the service rendered, not the data base.

Addressing solely category one, memoranda were solicited from several members of this class. The responses are attached* and provide support for the shared data base concept.

There is clearly a momentum to use computers to handle patient related problems. Faculty are able to find resources to pursue these problems and will pursue them whether or not a shared data base in a central computer system is available. In principle the communication link researcher-to-researcher and researcher-to-business office are transactions that can be carried out by movement of paper or digital tapes or hardware interfaces between stand-alone facilities.

*Memos attached from Drs. Cohen, Fries, Harrison and Merigan.

In practice linkages are only made when the perceived need is deemed worth the effort. Without a central system the "potential" barrier to forming linkages can involve costly software and hardware interfaces. In a clinical research and teaching environment the number of possibly useful combinatorial linkages is large. If the "potential" barrier is great, innovation and experimentation is impeded. The forces in the system are then centrifugal instead of centripetal.

Since the management of the clinics and hospital also depends more and more on computer manipulation and extraction of data, the total systems behavior will have important economic as well as academic consequences.

The proposal for Computer Health Care Application Research gives an insight into the clinical and academic benefits of a shared common data base. This and several other grant proposals, involving interdepartmental collaboration have called for linking of data bases. The second section of the proposal addresses the important problem of the definition of the data base. The third portion, deals with file and retrieval systems for a clinical data base. This involves the potential utilization by twelve specific clinical activities of a shared data base. This grant, if implemented would spend approximately $86,000 per year in computer services. Some of these developments are currently underway on ACME.

In addition to the academic research needs of the clinical faculty, there are the requirements of the hospital for a shared data base. These are derived from managerial and economic imperatives as well as the hospital's educational and research goals.

There is no current completely acceptable solution that meets the requirements of a complete Hospital Information System (HIS). The search for this solution is a very important problem and one in which Stanford should be involved. It will affect many aspects of medical education and teaching as well as practice within a hospital environment. Within the next several years many elements of such systems will be successfully implemented and will be important parts of the operation of Stanford Hospital. The 370/158 has the capacity to allow Stanford to implement a hospital information system. The design of such a system and the timing and funding of its implementation are not part of this plan.

The Technicon HIS at El Camino provides insights into costs and CPU requirements of HIS. From the operation of the El Camino system since the first of this year, it now looks like they will in fact realize net savings of $85,000 per month, most of which will be realized by reductions in nursing staff personnel. El Camino is a hospital with 446 beds and 60 bassinettes. The Technicon Hospital Information System is designed around two 370/155's to support 2,000 beds at $6.00 per day. The CPU cost is about one-third the total cost. This is in addition to the cost of business operating systems. Roughly, this says that implementation of such a system at Stanford with 612 beds and 57 bassinettes would approximately double the dollars that would be available to be spent by the Hospital for central processing over our worst-case projections and a 50 per cent increase in our conservative projection in whatever year an HIS should be installed.

P. Carpenter March 16, 1973

It will be economically important in the future to bring together dispersed elements of a patient information system into a coherent whole. It may be too difficult and expensive to do so, if dispersion has gone on too long. This is the difference between a stand-alone community hospital and a hospital-cum-medical school. The former can wait until it knows exactly what it wants to do. Stanford Medical School faculty and their research and teaching interests are in integral part of Stanford Hospital. They will and should carry out their academic functions in the best way available to them. Nothing can or should stop the dispersive process except the better alternative of a well-managed reliable central system that by its very nature makes collaboration easy.

ECL/mla

Attach.

DATE: March 12, 1973

TO : Elliott Levinthal, Ph.D.

FROM : Stan Cohen, M. D.

SUBJECT: Need for Common Computer Facility at the Medical Center

As we have discussed previously, there is an important need for a computer facility at the medical center to provide capability for faculty to share programs and data related to both clinical activities and research projects. At the present time, individual projects being carried out by various faculty members constitute component parts of what will probably eventually develop into a hospital information system capable of handling large amounts of patient-related data. Included among these components are the drug interaction warning system of the Division of Clinical Pharmacology, the Microbiology laboratory system developed on ACME by Dr. Merigan and his collaborators, the Clinical Chemistry and Hematology laboratory system developed by Dr. Sussman, the Medical Records system of Dr. Jim Fries, and the Cardiology data system of Dr. D. Harrison.

Patient care at this medical center requires that these separate data bases be available on a central computer system so that information accumulated by one project can be shared by others. For example, the identity of organisms cultured by the Clinical Microbiology laboratory and their resistance pattern should be accessible by the pharmacy system programs, so that a prescription that is inappropriate for a particular organism or drug resistance pattern can be detected at the time it is filled. Similarly, data being accumulated by the clinical chemistry laboratory indicating inadequate renal function should be available to the pharmacy system, so that alteration of dosage may be made for a drug eliminated from the body by excretion through the kidneys. Conversely, drugs that artifactually influence the results of laboratory test findings by interference with spectrephotometric determinations and other test procedures, and this information should be available to the clinical laboratory. Cardiology data should be available for similar reasons, and since drug influence interpretation of cardiovascular tests, pharmacy data should be available through the cardiology system. All of the types of data indicated here, plus clinical findings related to the patient history and physical examination should be part of the time-oriented medical record system being developed by Dr. Fries.

Although this brief memo stresses the patient-care benefits that would derive from having a large medical center computer system available for sharing of data bases and programs, I also want to emphasize the importance of such a system to faculty research. Linkage of the clinical microbiology laboratory and pharmacy systems will enable epidemiological investigations of the effects of antibiotic use on resistance patterns of organisms isolated from patient populations. Similarly, research to detect new effects of drugs on clinical chemistry tests will also be feasible if the data bases can be shared. Atlhough these are just a few examples, there are many other instances where sharing of data bases will enable important investigative questions to be asked and answered.

I hope that this brief memo provides the information you are seeking.

DATE: March 8, 1973

TO : Elliott Leventhal

FROM : James F. Fries

SUBJECT: Advantages of a variety of medical database operations sharing the same computing equipment.

Within the medical center and hospital there are a number of patient related computer databanks. Inevitably, the number and variety of clinical databank operations will increase over coming years. Material included in these databanks will be diverse yet similar. Thus, patient identifying information, financial and accounting information, clinical information required for insurance and third party carriers, historical and physical examination data elucidated by physicians, therapy prescribed and drugs dispensed, and the multiple forms of information emanating from various clinical laboratories, x-ray, cardiac catheterization and pathology departments will be accumulated in computer databanks. Over the long term, the facility with which information may be exchanged between these different operations will be of great importance. A research study may require stratification in terms of socio-economic data kept by the business office. The business office may require clinical information available in other databanks to process insurance forms. Billing may ultimately be related to the actual provision of the service at the physician level as documented in the chart and from laboratory information as it becomes available to the physician. Without provision for linkage and exchange of information the individual databank operations will require duplication of effort in data entry. Without capability of linking laboratory computer systems to clinical medical record databanks, laboratory data must be manually re-entered.

It can be stated fairly that medical computing has consisted in large part of duplication of effort both at Stanford and elsewhere. As the need for computer based clinical information systems grows there is the possibility of ever greater fragmentation and duplication of effort. The existence of a central computing facility for the medical center and hospital will allow planned growth, minimal redundancy, and exchange and pooling of clinical data. It will place the hospital and medical school in a strong position to meet increasing governmental requirements for "quality assurance" and medical audit.

JFF/hcp

JF.

STANFORD UNIVERSITY • OFFICE MEMORANDUM • STANFORD UNIVERSITY • OFFICE MEMORANDUM • STANFORD UNIVERSITY • OFFICE MEMORANDUM

March 8, 1973

Dr. Elliott Levinthal
Genetics Department

Dr. Donald C. Harrison
Cardiology Division

Advantages for a Hospital Computing System

Following our discussion yesterday, I have considered the advantages of a medical school computing system which would be a combination of hospital and medical school programs. The overall advantages are as follows:

A. Having a joint facility in the medical center would permit a common data base for all patients. This is essential for ongoing clinical research and for ease in efficiency of administrative operations. The case for this is as follows:

1. All patients under the care of Stanford faculty members in the Stanford University Hospital are either referred from the Stanford clinics prior to admission or are seen in follow-up in the clinics. Thus, it is essential that a data base include both aspects of the patient's record. This would encompass laboratory reports, x-ray studies, and ongoing follow-up data. These patients are frequently part of research protocols relating to the action of specific drugs, to the effects of surgical procedures, etc., and represent the basis for much of the clinical research being carried out by the clinical faculty.

2. A patient seen by one particular group in the hospital is frequently seen by others and data common to studies being carried out by several interrelated groups should be available to the various division and departments. This is particularly true in the case of Cardiology where patients are first seen by the medical cardiologist. Data are accumulated on the patients by the clinical laboratories, by the x-ray units, by the cardiologic units with special computer facilities such as the catheterization laboratory or the EKG laboratory, and then the patients undergo some surgical procedure in the Surgery Department. These patients are then followed up jointly by the various members of the Medicine, Surgery, and Radiology faculty. Consultants from Infectious Disease, from Immunology, and from other disciplines also frequently are asked to see these patients. To develop new concepts regarding the pathogenesis of disease, to test this in clinical populations, and to determine the effects of interventions upon these diseases, it is essential that these groups interrelate their data.

3. At the same time clinical data are being transmitted to patient's records, hospital charges can be assessed. Thus, for ease and efficiency of administrative detail, a cooperative computer facility is necessary.

B. With increased emphasis upon judging the quality of medical care and upon determining cost effectiveness of care, the integration of hospital activities and medical school activities becomes absolutely essential. Computer surveillance for drug interactions, for physician performance, and for developing new educational activities related to this aspect of medicine, necessitate a combined hospital medical school computer facility.

C. The accumulation of a critical mass of individuals working in hospital information systems for Stanford Medical School seems essential. The interrelationships of data from small computer systems in the various divisions and departments and support for these interfaces would be provided by a combined computer facility.

For the reasons of improving the delivery of health care, for enhancing clinical research, and for improving integrated teaching programs I would strongly support the development of a hospital medical school computer facility.

DCH:gr

DATE: March 9, 1973

MAR 12 1973

TO : Elliott Leventhal, M.D.
Associate Dean

FROM : Thomas C. Merigan, M.D.
Chief, Division of Infectious Diseases

SUBJECT:

This memo is in response to your questions in regard to my thoughts concerning the ACME system and its present and future contributions to clinical investigation. The availability of equipment and the ease of the language of ACME has personally benefited me enormously during the past 5 years while we have been working with patient oriented systems forour Diagnostic Microbiology and hospital epidemiology functions. As you know, all of our antimicrobial identification and antibiotic sensitivity data goes into ACME on an on-line basis from our hospital service laboratory. This involves only a minimal amount of time for our secretaries and technicians and produces a useful return from two standpoints: the antimicrobial sensitivity data is quality controlled prior to its issuance to physicians and all of our previous experience is immediately accessible for our clinical consultants as well as the Diagnostic Microbiology Laboratory personnel.

In regard to hospital epidemiology, the filed information is automatically put together on a monthly and semi-annual basis for reporting to the Infection Control Board members and the state and county authorities. The infection control nurses use this information in deciding whether there is any increased incidence of nosocomial infection at Stanford University Hospital, and now records dating back two years are available in that area whereas the antibiotic sensitivity and isolation information goes back some four years allowing many types of comparisons which wouldn't be possible without this regular recording of data.

I think the point you are particularly interested in, however, is how a commonly shared system among various clinical users which is tied in with the hospital system might be particularly advantageous. We find that as the ACME system was used for development and now the maintenance of our infection control and diagnostic microbiology systems, these two systmes can be linked up quite easily and personnel who operate one can also utilize the other. However, a very exciting proposition has come up in that our systems are being linked to Dr. Stanley Cohen's pharmacy based system on drug interaction because our languages are compatible. His system was also initially developed on ACME equipment. Of course, he uses the hospital Business Office information in his pharmacy based system. We would use a shared data base with him as well as provide on-line quality control for the use of antibiotics. Hence, when drugs are ordered from the pharmacy prior to their issuance to the wards, the reports currently coming out of our Diagnostic Microbiology Laboratory would be used together with appropriate rules to advise all concerned as to their suitability.

It is quite likely that Dr. Howard Sussman's clinical chemistry information system will also be linked in the future to these systems to provide data on potential limitations to use of antimicrobials which are an important part of the quality control of physician decision making. As you can see, having all three of these systems linked up to a common hospital base facility obviously allows interactive programs and shared data bases which would not be possible without much interfacing difficulties. Therefore, I believe a common hospital system will promote similar collaboration for others in the future.

Can you send me a copy of the application on Computer Health Care Applications Research for my files? Thank you.

APPENDIX B

STANFORD UNIVERSITY HOSPITAL
DATA PROCESSING DEPARTMENT

March 7, 1973

TO: Peter F. Carpenter, Assistant Vice President of Medical Affairs

FROM: V. H. Barber, Assistant Controller for EDP

SUBJECT: Medical Center Computer Planning Chronology

Presented below is a chronology of events related to computer planning from late 1970 to date.

Late 1970 - Early 1971

Medical Center Sub-Committee for Computing accomplished very little except for a survey of computer and data processing needs at the Stanford University Medical Center.

October 1971

President's Computer Science Advisory Committee annual visit results in general observation that computer planning has deteriorated.

December 8, 1971

Medical Center computer briefing to Dean Clayton Rich. Presentations by:

V. Barber
C. Dickens
G. Franklin
R. Jamtgaard
T. Phillips
M. Roberts

December 28, 1971

Medical Center Computer Planning Committee created.

Chairman: E. Levinthal
Members: S. Cohen, M.D.
J. DeGrazia, M.D.
E. Dong, M.D.
S. Kalman, M.D.
R. Jamtgaard
T. Rindfleisch
J. Stead
J. Williams
V. Barber

P. F. Carpenter | March 7, 1973

Medical Center Computer Planning Committee meetings were held on:

1/24/72 Various configurations of computers, utilization of HDP and ACME
1/31/72 loads were monitored. Organizational structures were studied;
2/15/72 long- and short-term plans were considered. Needs of research
3/6/72 groups were put forth. First major report of hardware alterna-
3/20/72 tives was presented March 20, 1972.
4/10/72
4/24/72
5/3/72
5/19/72
5/31/72
Various meetings in June

July 18 - August 3, 1972

Presentations of the various alternatives to computing in the Medical Center were made to the Computer Planning Committee.

July 18 Position paper advocating PDP-10 for the Stanford Medical Center Service Computing Facility - R. Jamtgaard and T. Rindfleisch.

July 26 Stanford University Medical Center Proposed Service Facility position paper - V. Barber.

August 3 Position paper advocating that computing service for the Stanford University Medical Center be supplied by a University computing facility - G. Franklin, T. Phillips, M. Roberts.

August 11, 12, 1972

Recap of Committee activity and alternatives for computing to Dean Rich. Made recommendation to him for computing. The conclusions of the Committee are attached in letters from E. Levinthal dated August 17 and August 18, 1972.

August 22, 1972

Medical School Executive Committee meeting. Clayton Rich, M.D., updated Executive Committee on computing alternatives (see attached letter of August 22, 1972).

August 21-23, 1972

Clayton Rich dismissed original committee (see 12/28/71) and created an interim committee:

Chairman: J. Stead
Members: V. Barber
R. Jamtgaard
E. Levinthal

P. F. Carpenter March 7, 1973

Purpose: Summarize the financial and technical findings of the Medical Center Computer Planning Committee.

August 30, 1972

Interim Committee made its summarizing report to Clayton Rich (Copy attached: Letter of August 30, 1972).

September, 1972

Gene Franklin made recommendation to Vice Presidential Group regarding University-wide solution to computing. He was directed to draft a policy statement and a plan.

November 8, 1972

An Advisory Group on Computing Merger was established consisting of:

Chairman: G. Franklin
Members: K. Creighton
C. Dickens
T. Gonda, M.D.
E. Levinthal

This group appointed a Planning Task Force made up of:

Chairman: C. Dickens
Members: V. Barber
R. Jamtgaard
M. Ray
F. Riddle

November - December 1972

Task Force has several sub-committees. Various meetings were held during this period of time.

December 29, 1972

Task Force submitted its report and recommendation to the Advisory Group. Recommendations are attached.

January 1973

Dean Clayton Rich asked if the original SUH Data Processing proposal (see July 26, 1972) could offer a possible solution to Medical Center computing.

P. F. Carpenter March 7, 1973

January - February 1973

Numerous meetings and analyses were conducted in this period. Results were a 360/65 or 370/158 if properly organized and planned could solve Medical Center computing needs.

February 23, 1973

Recommendation to Vice Presidential Group for purchase of a 370/158.

March 1973

Medical Center computing solution still under study.

vhb:adg

APPENDIX C

(Excerpt from ACME Note HAD)

IBM 2701/SATELLITE COMPUTER MULTIPLEXOR DESIGN AND OPERATION

I. INTRODUCTION

This paper is intended to describe the design criteria, specifications and feature, theory of operation, and operational procedures for the IBM 2701/SATELLITE COMPUTER MULTIPLEXOR. The design criteria section explains some design philosophies and some desirable features that such a system should have. Features section gives a list of specifications and features. Theory of operation explains in detail how this system works. And finally operational procedures section gives detailed trouble shooting procedures for problem isolation and procedures to bring on a new user.

II. DESIGN CRITERIA

The purpose of a HOST/SATELLITE COMPUTER MULTIPLEXOR is to allow several remote satellite computers to communicate directly to a host computer and vice versa. The main function of the satellite computer multiplexor is to allow only one satellite computer to communicate to/from the host computer at a time. The satellite computer multiplexor should be capable of handling up to sixteen remote satellite computers. The satellite computer multiplexor should be designed such that it will be independent of the host computers' and satellite computer's designs and/or operational characteristics. All remote satellite computers, 100 feet away from the host computer, must transmit data serially to/from the host computer via the satellite computer multiplexor. The satellite computer multiplexor must be capable of timing out in the event of any malfunction or due to one particular satellite computer which has used up its allotted time in transmitting data to/from the host computer. And lastly, the host computer must be capable of interrupting any of the satellite computers via the satellite computer multiplexor.

In order to meet the above criteria, the satellite computer multiplexor can be thought of as made up of three basic sections: host computer interface, multiplexor control, and satellite computer I/O control, as shown in Figure 1.

The function performed by the host computer interface is handling all I/O signals to/from the host computer.

The functions performed by the multiplexor control are queueing satellite computer interrupt requests, establishing communication with the host computer, making sure that proper identification from the satellite computer is passed to the host computer, passing status to the host and to the satellite computer at all phases of the data transfer, detecting time-out conditions, monitoring and flaging any malfunction for trouble-shooting purposes, and allowing the host computer to interrupt any satellite computer.

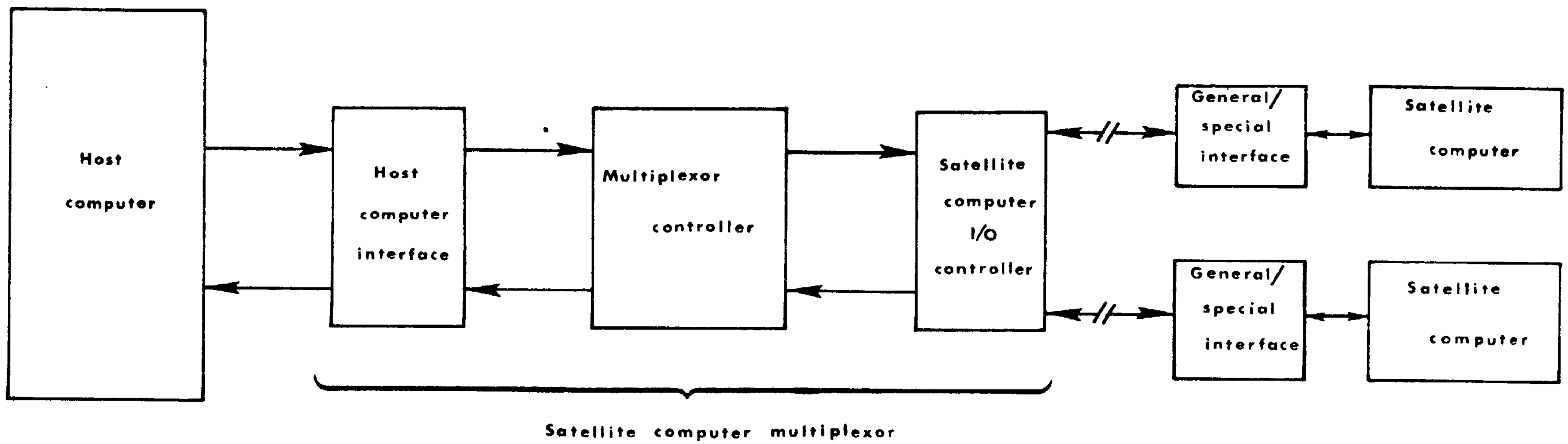

FIGURE 1 SATELLITE COMPUTER MULTIPLEXOR

The functions performed by the satellite computer I/O control are serializing and deserializing data to/from remote satellite computers and allowing parallel data transfer if satellite computers are within 100 feet of the host computer. Serial data are to be transmitted bit asynchronous and an optional choice between word or character asynchronous or synchronous.

In order to maintain complete flexibility at the satellite computer end because of different computers, the interface between the satellite computer multiplexor and the satellite computer is to be divided into general and special interfaces. The general interface is to handle all I/O signals to/from the satellite computer multiplexor and the special interface is to handle all I/O signals to/from a particular satellite computer.

For implementation, the host computer is an IBM 360/50 and the satellite computer multiplexor is interfaced to one of the ports of an IBM 2701 Parallel Data Adapter (PDA). This means that the satellite computer multiplexor will work with any IBM 360/370 host computer as long as it is interfaced through an IBM 2701 PDA port. Remote satellite computers, on the other hand, can be DEC PDP-8, 9, 10, 11, 12, 15 or XDS Sigma 3, 5, 7, or Hewlett/Packard HP-2411, 2115, 2116, or VArian 620i, 620f, or etc.

III. SPECIFICATIONS AND FEATURES

1. Handle up to 16 simultaneous satellite computers.

2. The satellite computer multiplexor is interrupt driven. It operates strictly on demand/response basis.

3. Each satellite computer talks to the IBM 360 on a first come, first served basis.

4. Each satellite computer can be assigned to any one of the 16 multiplexor channels.

5. Each satellite computer has a hardware key address at the satellite computer multiplexor end for ID purposes.

6. Transmission mode is by serial asynchronous half duplex for remote and/or parallel asynchronous for local operation.

7. Transmission speed is hardwired and the available speeds are: 250K*, 100K*, 50K, 10K, 5K baud per second.

8. Word transmission rate for maximum word length (20 bits) is: 12.5K, 5K, 2.5K, 500, 250 words per second.

*Recommended for twisted pair less than 1000 feet or coaxial cable for longer distances

9. Maximum serial bit transmission between satellite computer multiplexor and satellite computer is 20 bits; that is 1 start bit, 2 control bits, 16 data bits, and 1 stop bit.

10. Maximum word length from satellite computer is 16 bits.

11. Data path between IBM 2701 and satellite computer multiplexor is 16 bits wide.

12. The satellite computer has the option to run in complete demand/response (synchronous by character) or semi-complete demand/response (asynchronous by character) modes. Note this is not a programmable function.

13. The satellite computer running under complete demand/response mode requires four twisted pairs and operates at lower data rate.

14. The satellite computer running under semi-complete demand/response mode requires only two twisted pairs and operates at higher data rate.

15. The IBM 360 asynchronously can interrupt any satellite computer via the multiplexor.

16. The IBM 360 can pass status to a satellite during the normal transmission cycle.

17. The satellite computer will receive all error and termination conditions through coded messages from the multiplexor so that it can act accordingly.

18. Detailed handshaking procedures between the satellite computer and the host computer are described in the section "Asynchronous/Synchronous Data Transfer between Satellite and Host Computers".

APPENDIX D

ACME Note | AA-40

ACME Notes Index

Erica Baxter
May 11, 1973

ACME Notes, written by all members of the ACME staff, are informal working papers. They are divided below into four main categories: General Information, Administration and Utilization, System Information, and User Information. Subcategories under System Information and User Information parallel each other. Programs on ACME's PUBLIC file and the ACME Statistical Library are listed at the end of the Index.

The letters in the ACME Note codes are for filing and reference purposes only; the numbers in the codes--except for part of the J series--indicate reissues. All but historians can dispose of superseded issues. The J series and parts of other ACME Notes are incorporated into the PL/ACME Manual (AM) revisions.

If you wish to have a copy of an ACME Note, it is available at the ACME office. Those notes preceded by an asterisk (*) are new or have been changed in some way since the last ACME Notes Index was issued.

ACME Notes which have become OBSOLETE with this issue of AA are listed separately in the last section to this index.

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JAN 10, 1973

AR-1 A Summary of the ACME System (Wiederhold)
Speech given at Argonne National Laboratory.
OCT 31, 1966

AS-2 A Summary of the ACME System (Wiederhold)
NOV 11, 1966

ASD-1 New Environments for Statistics (Wiederhold)
JUL 24, 1970

ASQ-1 Square Computers in Round Sieves - An Approach to Determining the Suitability of Computing Alternatives - Minis, Maxis, Shared - For Various Problems (Gio Wiederhold)
Position Paper for the Second Annual Communications Conference at California State University at San Jose, Jan. 24-25, 1973
NOV 15, 1972

ATS-1 Instrumentation in a Time-shared Environment (Reynolds)
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ATSC-1 Comparison of ACME and Three IBM Time-Sharing Systems (Frey)
JUL 12, 1972

ATYNET-1 Tymshare Network Feasibility (Stainton)
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AV-4 Visitor's Information Sheet (Germano)
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BASS-1 An Assessment of Current Developments in Computer Technology and Their Significance for Development at the Stanford Medical Center (Wiederhold)
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BDEN-1 Beyond Lisp (Wiederhold)
MAR 29, 1972

BDW-1 The Use of a General-Purpose Time-Shared Computer in Physiology Research (Dong/Wiederhold)
Presented at National Heart and Lung Institute's Conf. on Resch. Animals, WDC, Jan. 72.
JUN 30, 1972

BSD-1 Interactive Use of a Timesharing System for Medical Laboratory Support (Crouse/Wiederhold)
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ESA-1 Statistical Programs and Subroutines Available at ACME (Whitner)
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PLCH-1 A Choice of Language to Support Medical Research (Wiederhold)
Position paper for a panel discussion on "Computer Language for Medicine," to be held at the 1972 ACM Conference, Boston
MAR 6, 1972

PMOD-1 Need for a Medical Applications Oriented Data Base Protocol and Support Facility (Weyl)
JUL 6, 1972

PSCS-1 Proposal for Small Computer Service by ACME (Stainton)
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PVM-3 Paging Rates for a Joint Stanford Computing Facility (Wiederhold)
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PVMT-1 Remarks on Paging Reference Distribtuion (Rindfleisch/Wiederhold)
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SHARE-1 Trip Report - SHARE Interim Meeting, Dec. 3-6, 1972 (Frey)
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SUMFS-1 Specification of FORTRAN String Handling (G. Wiederhold)
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WCDS-1 SYS/360 Standard Instruction Set Sorted on Machine Code (Miller)
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YCC-3 1052 Console Commands (Class/Sutter)
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YCD-2 Clip Deck--Change a Volume Label (Class)
JAN 4, 1973
YCLEAN-2 Scratching Temporary Data Sets (Class)
DEC 19, 1972
YCOL-1 Computer Operator's Lunch, Dinner Schedule (Matous)
JAN 26, 1971
YCON-1 Converting Upper-Case Alpha Characters to Lower-Case with the Addition of a Punch (Class)
APR 4, 1969
YDAS-3 DASDI Disk Pack (Class)
DEC 20, 1972
YDB-1 Examples of Broadcasts and Debug Messages (Class)
JUN 4, 1968
YDEBE-1 MVTDEBE - OS/360 Multi-Purpose Utility (Frey)
DEC 7, 1971
YDR-2 DUMP/RESTORE ACME Operating System (Class)
MAY 29, 1969
YEREP-2 Hardware Debugging Program--EREP (Class)
APR 12, 1969
YHELP-1 What to Do in Case of an Irrecoverable Disk Error (Class)
APR 21, 1969
YIBM-2 ACME's IBM Hardware (Class)
DEC 28, 1970
YIBMTP-1 Operator Procedure: User Disk/Tape Dump/Restore Procedure (Germano)
JAN 4, 1973
YIPL-4 System IPL Procedures for Release 20.6 of OS/360 (MVT) (Class/Sutter)
DEC 19, 1972
YLCS-1 Procedure to Test 2361 Bulk Core--LCS (Class)
JUN 4, 1968
YLISP-1 Operator Procedures- Overnight LISP Jobs (Granieri/Class)
FEB 6, 1973
YLOG-1 ACME 360 Console Log (Class)
JUN 3, 1970
YLPB-1 Loading Printer Buffer (Class)
JUN 4, 1968
YLT-2 Label Tapes (Class)
DEC 19, 1972
YM-9 ACME Monthly Accounting Programs ACCTTING and NEWACCT (S. Miller)
OCT 12, 1972
YMC-8 Billing Cards for SCC (Miller)
OCT 12, 1972
YMS-5 ACME Monthly Accounting Program: SUMMARY (Miller/Liere)
AUG 18, 1972
YNP-2 Loading NAMEs, PROJECTs, and DATA SETs on ACME (Class/Matous)
APR 9, 1969
YOAS-2 Operating the ACME System (Class/Sutter)
OCT 21, 1970
YOWT-1 1800-360 Interface Recovery Instructions (Class)
APR 11, 1968
YOX-1 Procedure for 270X Error Restart (Denke)
MAR 6, 1968
YPDP-1 Loading the PDP-11 (Lew)
NOV 16, 1972
YPOW-1 Recovering From a Power Failure and Powering Off (Class)
JUL 3, 1969

YPP-3 Reading User Cards Under ACME (Frey)
DEC 7, 1971

YPRIN-1 Operator Instructions for Obtaining User Output: PRINOPUN and PUNCHOUT (Prowell/Bassett)
SEP 12, 1972

YREP-1 Reporting Equipment Failures (Prowell)
JUL 14, 1972

YSAD-5 Core Dumping Procedure When ACME Hangs Up in a Wait State, Loop, or Abends (Class/Sutter)
OCT 11, 1970

YSAN-2 ACME Status Using Sanders Display (Kelley)
APR 7, 1969

YSER-2 Hardware Debugging Programs--SEREP (Class)
APR 14, 1969

YSG-5 Deleting, Changing, and Merging NAMEs and PROJECTs (Girardi/Emerson)
JUL 29, 1970

YTAP-1 Stand-alone Operation of IBM 2400 Serial Tape Drives (Smith)
NOV 20, 1969

YTAPE-1 Contents of ACME Tape Library (PDUMP Tapes Excluded) (Cower)
SEP 20, 1972

YTERM-1 IBM 2741 Terminal Diagnostic Test Program (Smith)
APR 14, 1969

YTV-1 TV Test Program (Class)
JUN 4, 1968

YULOG-1 Operator Instructions for Final Preparation of the UNILOG Report (Cower)
JAN 2, 1973

YVTOC-3 List VTOC and Scratch Data Sets (Class)
DEC 19, 1972

USER INFORMATION

AM-5 How to Use. . .PL/ACME Manual (V. Wiederhold)
Costs $5.00. Obtain at the ACME Office. (The manual dated Aug. 15, 1967 and having 3 updates has the same information as the manual dated Sept. 25, 1968.)
SEP 25, 1968

AMC-5 How to Use PL/ACME--Chart (Wiederhold)
NOV 10, 1972

APRIM-4 PL/ACME Primer (Buchanan)
MAR 28, 1972

ELVSIM-1 PDP-11 Simulator on ACME (Lew)
JUN 14, 1972

GADVF-3 PL/ACME Advanced Course--Third Session (Godwin)
SEP 16, 1969

GADVM-2 PL/ACME Advanced Course--First Session (Godwin)
SEP 16, 1969

GADVW-2 PL/ACME Advanced Course--Second Session (Godwin)
SEP 16, 1969

GBEGF-3 PL/ACME Beginning Course--Third Session (Godwin)
SEP 16, 1969

GBEGM-2 PL/ACME Beginning Course--First Session (Godwin)
AUG 11, 1969

GBEGW-2 PL/ACME Beginning Course--Second Session (Godwin)
AUG 11, 1969

GDEF-2 Excessive Use of DELETE ENTIRE FILE (Bassett)
JUN 10, 1969

GPROB-1 Statistics Problem Set for the Beginning PL/ACME Course (V. Wiederhold/Brown)
FEB 8, 1973

J7-1 User Note (Wiederhold)
JUL 11, 1967

J8-1 User Note (Wiederhold)
AUG 1967

J10-1 User Note (Wiederhold)
OCT 2, 1967

J11-1 User Note: Data Files and ON-Conditions (Miller/Feinberg)
NOV 1, 1967

J12-1 User Note: RUN, ATTN Key, Truncation of Character Strings, SKIP, TAB (Wiederhold)
DEC 19, 1967

J13-1 User Note: Character Strings, IF, Options (Wiederhold)
JAN 8, 1968

J13-2 User Note: ON-Condition Blocks, Checkout, Commands, Display Message, KEY, OPEN, Data Files, UNDEFINED, Linenumber Control, PUBLIC Files, ONCODE, UPDATEing Data Sets (Wiederhold)
JAN 26, 1968

J14-1 User Note: Suppressing Broadcasts, PUT, DO Loops, IF, Array Functions, PUT LIST, GET LIST, Subscripted Labels, Character Strings, DISPLAY, Program Files, SHOW (Wiederhold)
FEB 28, 1968

J15-1 User Note: Program Protection, COMMENTS, PUT TEXT, IMAGE, PUT SKIP IMAGE, PUT TAB IMAGE, INITIAL Attribute, FREE, ALLOCATE, ALLOCATION, COUNT (Wiederhold)
MAR 25, 1968

J16 User Note: SHOW, DELETE, Removal of Restrictions, Program Library, New Character-String Functions, DELAY (Wiederhold)
JUN 10, 1968

J17 User Note: DIRECT Files, RUN, Closing and Reopening Files, MODIFY, TRUNC Function, READ and WRITE Program Statements (Wiederhold)
AUG 5, 1968

J18 User Note: Character Strings, PUT DATA, GET IMAGE, MODIFY TO..., SHARED, External Procedures, Procedure Parameters, ON MESSAGE, Linenumbers Above 7999, FORTRAN on ACME, A_USER__.PROBLEMS (Wiederhold)
OCT 2, 1968

J19 User Note: 108 Errors, Paper Holders, GET IMAGE Restrictions, ACME's Move, File Storage (Wiederhold)
NOV 20, 1968

J20 User Note: KEY, HIGHKEY, LOGOFF Statement, CRUNCH, RECORDHX, Double Precision (Wiederhold)
JAN 9, 1969

J21 User Note: User Publications; Double Precision; Paper Tape; KEYSORT; Use of Card Reader, Punch, and Printer; SHOW CATALOG; New Plotting Subroutines; Staff Locations and Extensions (Staff)
APR 16, 1969

J22 User Note: SUBVEC and MOVE, SHOW, RUN Bug, Fast String Routine, New ON Conditions, Use of Printer, Double Precision, Bugs in Subscripting Routines, PACKing and UNPACKing Functions, Dumping Files Onto Tape, PL/ACME Courses, ACME/Campus Link, Staff Changes (Staff)
JUN 27, 1969

J23 User Note: Corrections to User Note J22, Subroutine ABORT, PACK and UNPACK Functions (Staff)
JUL 7, 1969

J24 User Note: JUSTIFY Rewritten, Revision of Automatic Output Formats, MULTR and ORDER, Changes in Text File Handling, High Key and Deleting Records, ON-CONDITIONS, FREE Statement, Error Message 90 Changed, SUBVEC Function (Staff)
OCT 17, 1969

J25 User Note: Copying Files Restricted, Character String Functions Used in Argument Lists, RETURN Statement Bug Fixed, Terminal Service Rates, Subroutine NOPERMIT, Change in IBM Maintenance Schedule (Staff)
DEC 31, 1969

J26 User Note: User Rate Reduction, Double Precision, String Functions, Logical Functions, Computer Operator Schedule, High Speed Printer, Dummy Program Commands, PROGRAM xxx PUBLIC (Staff)
MAR 26, 1970

J27 User Note: Textfile Linenumbers, Program (Dataset) Listing Service, ACME/Campus Link, PL/ACME Courses, Staff Changes, Constants in Call (Staff)
JUN 1, 1970

J28 User Note: PL/ACME Courses, LISP, Graphics Hardware Additions, Small Machine Assemblers, Subroutine CATALOG and Function FILES (Staff)
SEP 15, 1970

J29 User Note: Lecture on Small Machine Assemblers, More Core for 1800, New PUBLIC Program NEWS, Protecting Text Files Against Loss of Lines (Staff)
NOV 5, 1970

J30 User Note: New Options for GET and PUT Statements, DEC Assembler, Bugs, Improvement in Subroutine BASIC, Write-Ups of New StatisticalPrograms, "Unknown Users", ACME Holiday Service. (Staff)
DEC 15, 1970

J31 User Note: Medical Center Survey,LISP Seminar,Overnight Jobs,Public File Programs,Operating Schedule (Staff)
FEB 4, 1971

J32 User Note: PL Translator,ACME/CAMPUS Link,Record Size Increase,Plotting Program GRAPHH,CLEAN Option (Staff)
MAR 25, 1971

J33 User Note: ACME Keywords,Conversion Program PLA_PL1,Truth Tests in ACME, Computer Room Modifications (Staff)
MAY 25, 1971

J34 User Note: Consulting Schedule,Program JOBTAKER PUBLIC,Graphics Package OPS (Staff)
JUL 20, 1971

J35 User Note: Special Announcement, Hardware Substitutions, Bulk Core, Disk Drives, Small Machine Interface (Jamtgaard)
OCT 22, 1971

J36 User Note: New Bulk Core and Disks, PLOTPRIN, Loma Linda Graphics, New Commands in PL/ACME (Staff)
NOV 5, 1971

J37 User Note: Performance Tests on New Bulk Core, New Text Editing Features, DATACOPY, EVENT, User Tape Services, New Character String Function, New Information on LOGOFF (Staff)
NOV 18, 1971

J38 User note: Holiday Schedule, Permitting of Real Time Lines, User Services, Consulting Service Schedule, Clean Up Your Files! (Staff)
DEC 21, 1971

J39 User note: Seminar on Time-Oriented Medical Records, Small Machine Multiplexor, Medical Center Computer Facility Planning Committee, Printing and Punching Services, Double Precision Argument Bug, New Show Command: SHOW DSOPEN (Staff)
FEB 7, 1972

J40 User note: Revised Operating Hours, Medical Computing Seminars, PL/1 versus PL/ACME Compatibility, Small Machine Multiplexor Interface, System Errors 226 and 237(File System), Program CATALOG PUBLIC, Fast Fourier Transforms, Antilogs (Staff)
FEB 28, 1972

J41 User note: Revised Rates for ACME Service, New Terminal Support (Memorex), Medical Computing Seminars, Reassignment of Gio Wiederhold, New ACME Note Index, New LISTAKER/JOBTAKER Feature, Bug: Character String Variable and Title Option, Card and Paper Recycling, Acknowledging ACME in Publications (Staff)
APR 10, 1972

J42 User note: Medical Center Computer Facilities Planning Committee, Small Machine Multiplexor Schedule, 30 Char/Sec Typewriter Terminals, 120 Char/Sec Alphanumeric CRT Service, SUMEX Research Proposal, Comments on Lack of Core Storage Error Messages, New Version of PUBLIC Program COPIER, User Listings Schedule, PDP-11 Simulator, New Versions of PUBLIC Programs LINREG and LACKFIT (Staff)
JUN 13, 1972

J43 User note: Application of the ACME Quantity Discount to More Than One ACME Account, New PUBLIC Program RECOMPOS: Recomposing PL/ACME Programs from Card Decks, Error in ACME Note ELVSIM: PDP-11 Simulator on ACME, ACME Staff Directory (Staff)
JUL 11, 1972

J44 User note: Medical Center Computer Facilities Planning Committee, 30 Char/Sec Typewriter Terminal Selection, Transfer of Lee Hundley to SLAC, ACME Grant Status, New ACME Statement and Command to Adjust Width of Output (Staff)
AUG 9, 1972

J45 User note: 30-Character-Per-Second Terminal Availability, Frank Germano-New User Services Manager, SHOW FREQUENCY-Debugging/Optimization Aid, New PUBLIC Programs BIBLIO and BIBUP: Interactive Keyword/Entry Programs, New PUBLIC Program CONCORD: Generates Concordance Files from Text Files, New PUBLIC Program ARSPEC: Spectral Density Analysis, New PUBLIC Program SURVIVE: Life Table Construction, LISP Bug, Error in PUBLIC Program TSQUARE, Error in ACME Note FDFORM-1 (Format of ACME Dump Tapes for Users) (Staff)
SEP 14, 1972

J46 User note: Do You Have Data Storage and Retrieval Problems?, Pilot Study/Implementation of Public Data Bank Programs, Time Oriented Data Bank Seminar, Comment on Pageminute Accounting, G.E. Terminet Terminals, Terminal Demonstration, New PUBLIC Programs: QSORT, QRANK, and SORTEXT - Sorting Routines, New PUBLIC Program TEACHER: Teaches PL/ACME, "Super ACME Index, Recovery from Realtime Input/Output Failures (Staff)
OCT 23, 1972

J47 User note: Medical Center Computing: What is going to happen? (Staff) Announcement of Informational Meeting
NOV 10, 1972

J48 User note: Index to the ACME PUBLIC Programs, New PUBLIC Program IBMTAPE: Enters Requests to Dump/Restore Users' ACME Files to/from Tape, ACME Holiday Schedule, Radioimmunoassay Users, New PUBLIC Program ARITHDAT: Arithmetic Date Routines, New PUBLIC Programs BSORT and BRANK, SORTEXT Users, Correspondence Terminal Support Changes (Staff)
DEC 20, 1972

J49 User note: New Medical Center Computing Facility, ACME Datafile Compression, Revised ACME Operator Schedule, Comments from ACME Users, SIGBIO Colloquium on Time-Oriented Medical Records, New Seminar Series, Personnel Changes, Changes in PUBLIC Program DATACOPY, Use of LF or INDEX Key, New and Revised Linear Regression Programs on PUBLIC File, Long Print Job Problem (Staff)
FEB 13, 1973

*J50 User note: Medical Center Computer Facility, TOD Seminar, PL/ACME Classes, LISP Available (Staff)
MAR 8, 1973

KCC-1 PL/ACME Collating Sequence (Wiederhold/Emmons)
MAY 12, 1969

NI-2 Initialization of Variables (Hundley)
SEP 27, 1969

NSC-1 Subscripting Cost (G. Wiederhold)
AUG 17, 1972

ONC-4	Values Returned by the ONCODE Function (Feinberg) NOV 12, 1969
OND-3	ON-Condition Syntax (Feinberg/Liere) APR 16, 1970
OP-3	Terminals--ACME Automatic Output Formats (Wiederhold) SEP 27, 1969
PL-4	A Brief Description of PL/ACME (Berman/Breitbard) JAN 10, 1972
PLC-2	Compatibility Requirements for PL/ACME Programs to Use IBM's PL/1 (Wiederhold/Frey) MAR 8, 1972
PLD-4	Breakdown of PL/I and PL/ACME Features (Wiederhold) JUL 9, 1971
PSS-1	Programming to Save Space (Breitbard) NOV 12, 1968
SYM-1	Symbolic Output--Proposal (Wiederhold) APR 6, 1970
TEP-2	ACME Implementation of External Procedures (Granieri/Breitbard) AUG 4, 1969
TP-6	Text Editing and Processing on ACME (Wiederhold) JAN 31, 1972
TS-7	String Handling Functions (Wiederhold) SEP 12, 1969
TST-1	Structures in PL/ACME (Frey/Schrader) JAN 13, 1970
TW-1	Options for GET and PUT Statements to Allow In Memory Conversion (Wiederhold) JAN 7, 1971
WDB-1	Proposal for Arithmetic on Strings (Wiederhold) SEP 4, 1970

INPUT/OUTPUT

TERMINALS AND DISPLAYS

*DECT-1	PDP-11 DECtape on ACME (Lew) MAR 30, 1973
DELL-1	Evaluation of General Purpose Graphics Terminal (GPGT 315C) (Freret) Loma Linda NOV 21, 1972
DS-1	Sample for Sanders 720 Display (Cummins) DEC 8, 1967
DSLL-2	315C (Loma Linda) Display Terminals (Freret) SEP 15, 1972
DSP-1	Data Plugs for Sanders Display (Weatherby) DEC 9, 1967
DSR-1	Sanders 720 Display System Routines (Cummins) SEP 14, 1970
EPORT-2	User Instructions: Execuport 300 Terminal (Stainton) OCT 10, 1972
FS-1	PL Statements for Stream Input/Output (Miller) FEB 9, 1967
KBEE-2	Using the Beehive Terminals on ACME (Wiederhold/Stainton) SEP 8, 1972
KT-4	Using the Model 33 Teletype (Stainton) JUN 15, 1972
KTB-1	Character Translations for Teletype and Beehive Terminals (Wiederhold) FEB 14, 1972
KTBA-1	Changes to TTY Translation Tables (Stainton) MAY 17, 1972
*KU-5	Using Correspondence Code 2741 Terminals (Stainton) MAY 3, 1973
KV-1	ACME Vocabulary (Wiederhold) JAN 4, 1970
PLT-2	ACME Plotting Routines (Sanders) NOV 13, 1970
PPLO-1	Proposal: Interactive Programs for File Editing and Data Plotting (Weyl) APR 20, 1972
TERSUR-1	Terminal Selection Survey (30 to 120 Char/Second Devices) (Stainton) AUG 7, 1972
TF-3	Formats in PL/ACME (Wiederhold/Berman) SEP 15, 1970

TNET-1 User Instructions: Western Union or G.E. Terminet 300 Terminals (Stainton)
OCT 16, 1972

TT-1 Special Character String Input/Output Procedures (Sanders)
FEB 1, 1968

WBEE-2 Using the Beehive Terminal On ACME Through the PDP-11 (Briggs)
NOV 4, 1971

WPDPB-1 Using the Litton Printer On ACME Through the PDP-11 (Briggs)
AUG 13, 1971

FILES

DBD-2 ACME Data Bases for Drs. Eugene Dong and Phillip Caves -- Cardiovascular Surgery Research (Weyl)
DEC 15, 1972

*DBMS-1 Comparison of Commercial Data Base Management Systems (Germano)
APR 12, 1973

DBS-1 Present and Potential Patient-Related Databanks at the Stanford Medical Center (Germano/Wiederhold)
OCT 27, 1972

DBT-1 ACME Data Base for Cancer Virus Tumor Samples (Medical Microbiology - Dr. Hayflick) (Weyl)
JUL 19, 1972

DDB-1 Pediatrics Project--Data Checking (Drew)
SEP 13, 1967

DDS-3 Dumping Data Sets Onto Tape (Frey)
JUN 7, 1971

DI-1 Drug Interaction Project ACME Programs (Crouse/Hunn/Bassett)
NOV 3, 1972

ECC-3 ACME User Utilities (Frey)
MAR 31, 1969

EIRP-1 Information Retrieval Program (Radiation Therapy Dept.) (J. Hu)
NOV 18, 1971

EP-6 ACME Program Library: Using PUBLIC Files (Wiederhold/Bassett)
SEP 27, 1969

EPA-2 Example of a Program to Copy a Program (Wiederhold)
JUL 25, 1968

FDFORM-1 Format of ACME Dump Tapes for Users (Frey/Lew)
AUG 25, 1972

FF-3 File Description and Opening (Miller/Frey)
AUG 11, 1969

FI-5 Data Set Names and File Names (Miller/Frey)
AUG 11, 1969

*FILCMP-2 ACME Datafile Compression - User Information (Germano)
MAR 9, 1973

FK-1 Data Set Protection (Miller)
FEB 27, 1968

FO-2 Input/Output ON-Conditions (Miller)
JAN 29, 1968

FP-5 Input/Output Statements in PL/ACME (Frey)
SEP 15, 1971

FR-4 PL/ACME Statements for Record Input/Output (Miller)
OCT 24, 1968

FSS-2 ACME File Organization and Optimum Use (Frey)
OCT 9, 1969

FT-2 Magnetic Tape Format (Miller/Frey)
JUL 29, 1968

FX-5 Current Implementation of the File System (Frey)
FEB 12, 1973

HTP-1 Preliminary Data Base for Heart Transplant Pilot Research on Dogs (Weyl)
JUL 12, 1972

*TDOV-2 TOD System Overview (Germano)
APR 10, 1973

TDPDT-1 Detranslation of a Databank Schema Using PUBLIC Program TD_DTRA (Weyl)
FEB 28, 1973

TDPRE-1 Redefinition of a TOD Databank Using TD_RECOM (Weyl)
FEB 28, 1973

*TDPT-2 Definition of a TOD Databank Using TD_TRA (Weyl)
APR 10, 1973

TDSUB-2 User-Supplied TOD Subprograms for Data Checking and Coding (Weyl)
FEB 14, 1973

*TDUA-1 How to Write a SCHEMA for a Time Oriented Medical Record Databank (TOD) (V. Wiederhold)
APR 10, 1973

*TDUB-1 How to Enter and Correct Data on TOD (V. Wiederhold)
APR 10, 1973

*TDUONA-1 Programs PRELET - ONCOLET: Oncology Letter Writing Programs (Whitner)
TOD User Applications Documentation
MAR 16, 1973

TIDA-2 TOD Implementation Documentation A - TOD Analysis Programs (Germano)
MAR 1, 1973

*TIDB-2 TOD Operational Statistics Structure (Germano)
TOD Implementation Documentation - B
APR 6, 1973

*TIDC-2 The TRANSPOSE File (Germano)
TOD Implementation Documentation - C
MAR 9, 1973

*TIDC-3 The TRANSPOSED Files (Germano/Weyl)
TOD Internal Documentation
APR 10, 1973

TIDD-1 Program PRE_PROC (Germano)
TOD Implementation Documentation - D
NOV 17, 1972

*TIDE-1 Structure of the TOD Index File (Giusti)
TOD Internal Documentation
MAR 28, 1973

*TIDF-1 TOD Survival Kit - Structure and Linkage (Whitner)
TOD Internal Documentation
MAR 16, 1973

*TIDG-2 Record 1 in the TOD Descriptor File, td_desc (Germano/Weyl)
TOD Internal Documentation
MAR 26, 1973

*TIDH-1 Structure of the Subset Library File, td_subs (Weyl)
TOD Internal Documentation
MAR 28, 1973

*TODADM-1 Administrative Procedures for the PL/ACME Time-Oriented Databank (TOD) System (Germano/Weyl)
MAR 22, 1973

*TODATA-1 Stanford Medical Center TOD Data Descriptor Dictionary (Germano)
MAR 29, 1973

*TODCST-1 Analyzing the Costs of Running a TOD Databank (Germano)
MAR 22, 1973

TODD-1 Definition of the PL/ACME Time-Oriented Data Bank Protocol (Weyl)
OCT 18, 1972

*TODDDL-1 The TOD Databank Description Language (Weyl)
APR 3, 1973

*TODI-3 Introduction to TOD (Time Oriented Databank) System (Germano/Weyl)
APR 5, 1973

*TODIDX-1 Keyword Index to TOD ACME Notes (Weyl)
MAY 9, 1973

TODPDA-1 Operational Overview for a TOD Databank (Germano)
TOD Program Documentation
FEB 12, 1973

TODPDB-1 TOD Scatterplot Program (Germano)
TOD Program Documentation
FEB 12, 1973

TODPDC-1 TOD Reviewdx Program (Germano)
TOD Program Documentation
FEB 12, 1973

*TODPDD-2 TOD Retrieval Module Summary Sheet (Germano)
MAR 22, 1973

*TODPDE-1 TOD Survival Kit - User Instructions (Whitner)
MAR 16, 1973

*TODPDF-1 Patient Chart Listing Program TD_PLIST (Giusti)
TOD Program Documentation
MAR 9, 1973

*TODPDG-1 Checking Data Values and File Linkage Using Program TD_CHECK (Giusti)
TOD Program Documentation
MAR 9, 1973

*TODPDH-2 Construction of Range File Using TD_RANGE (Giusti)
TOD Program Documentation
APR 16, 1973

*TODPDI-2 Construction of Transpose File Using TD_TPOSE (Weyl/Giusti)
APR 16, 1973

*TODPDJ-2 TOD Debug Lister Program TD_QKLST (Giusti)
TOD Program Documentation
MAR 26, 1973

*TODPDK-2 Constructing TOD Index Files with Program TD_INDEX (Giusti)
TOD Program Documentation
APR 16, 1973

*TODPDL-1 Listing of TOD Header & Parameter Files Using TD_QLIST (Bassett)
TOD Program Documentation
MAR 13, 1973

*TODPDM-1 Using TOD Retrieval Modules as Debug Programs (Giusti)
TOD Program Documentation
MAR 13, 1973

*TODPDN-1 Obtaining a Proof Listing of the Schema File Using TD_DLIST (Germano)
MAR 22, 1973

AA-...

*TODPDO-1 Definition of Patient Subsets for Analysis Using Program TD_SALL, TD_SAND, TD_SOR, and TD_SSUPR (Weyl)
TOD Program Documentation
MAR 22, 1973

*TODREF-1 Index to TOD ACME Notes (Weyl)
APR 4, 1973

REAL-TIME

BAA-2 1800 Users and Applications (Constantinou)--Urology (Crouse)
NOV 12, 1968

BAB-1 1800 Users and Applications (Bellville)--Anesthesia (Crouse)
JUN 4, 1968

BAC-1 1800 Users and Applications (Kadis)--Anesthesia (Crouse)
JUN 4, 1968

BAD-1 1800 Users and Applications (Mesel)--Radiology (Crouse)
JUN 4, 1968

BAE-1 1800 Users and Applications (Morris)--Genetics (Crouse)
Further detailed in ACME Note TRA.
JUN 4, 1968

BAF-1 1800 Users and Applications (Stryer)--Biochemistry (Crouse)
JUN 4, 1968

BB-1 Infectious Diseases Project (Petralli)
DEC 29, 1970

BCA-2 A Time-Shared Digital Computer System for On-Line Analysis of Cardiac Catheterization Data (Crouse, et al)
JAN 23, 1968

BCR-1 360/1800 Communication Routines (Cummins)
OCT 15, 1970

BGOLD-1 Programs for Processing of Temperature Data in SCLERODERMA (J. Gold/Wiederhold)
DEC 30, 1971

BN-2 EEG Averaging for Dr. Kopell (Nelson)
JUN 12, 1968

BUL-2 UNPACKing Routines (Cummins)
AUG 29, 1969

BV-1 PDP-8 to the 360 Echo Check via PL/1 (Tschantz/Fitzgerald)
JUL 17, 1967

KPERM-2 PERMIT18 Function - User Permit on 1800 (Granieri)
DEC 13, 1971

KPRI-4 Priority Status (Cummins)
MAR 27, 1969

RU-4 Example of an ACME Run (Liere)
JUN 28, 1968

TR-2 Respiratory Project on the 1800 (Hintz)
MAR 22, 1967

UDE-3 1800 User Lines, Interrupt, and Director Information (Crouse)
NOV 7, 1968

UEM-1 1800-360 Error Messages (Crouse)
OCT 2, 1968

UEVT-1 Realtime EVENT Function (Frey)
NOV 4, 1971

UF-1 1800 Word (Crouse)
OCT 24, 1969

UIT-1 1800 Time-Share Program--Internal Timing (Hundley)
OCT 30, 1968

UOR-1 Real-Time Data OVERRUN (Cummins)
MAY 29, 1968

UPC-3 1800 Users' Projects Chart (Crouse)
SEP 19, 1969

URECOV-1 Recovery from Realtime Input/Output Failures - User Instruction (Frey)
OCT 20, 1972

URTD-2 Procedure for Temporarily Changing 1800 Real-Time Directory Entries (Cummins)
OCT 11, 1968

US-3 1800 Data Sampling Parameters (Hundley/Wiederhold)
NOV 24, 1971

USAFE-1 1800 User Safety Circuit (Wiederhold)
JUN 8, 1970

UU-5 1800 Usage for the Time Sharing System (Crouse)
OCT 31, 1968

UW-1 A Warning About the 1800-System/360 Adapter (Cummins)
FEB 19, 1968

HARDWARE

CPT-3 Using the Paper Tape Punch and Reader (Hundley)
NOV 12, 1971

HA-2 Transmission of Digital Data (Holtz)
DEC 4, 1968

HAA-1 Analog Transmission from O.R. 14 to Sigma 5 at Space Engineering (Curtis)
Engineering Note #015A
JUL 7, 1970

HAC-1 Loma Linda Terminal/ACME 1800 Link (Matheson/M. Hu)
EUN057
OCT 11, 1971

HAC-1 Biosciences/ACME 1800 Digital Analog Link (M. Hu)
EUN046
SEP 1, 1971

HAH-1 Radiology Diagnostic - Nuclear Medicine/1800 Digital Link "OR" Connection (Matheson)
Engineering Note 062
SEP 19, 1972

HAI-1 Radiology Diagnostic/ACME 1800 Analog Link (Nozaki)
Engineering Note 063
SEP 25, 1972

HAJ-1 Neurology EEG Lab/ACME 1800 Analog Link (Matheson)
Engineering Note 066
OCT 30, 1972

HAK-1 Scintillation Counter/Paper Tape Punch (Matheson)
Engineering Note 067
NOV 6, 1972

HBE-1 Beehive CRT Display Terminal to PDP-11 Interface (Stubbs)
JAN 3, 1972

HBSC-1 ACME Interface Connection for Biological Sciences Laboratories (Curtis/Osborne)
MAR 11, 1970

HCB-1 Clinical Billing Office/Sanders System (Curtis)
NOV 14, 1969

HCHE-1 Chemistry Connection (Nozaki)
Engineering Note #042
FEB 1, 1971

HCIC-3 Carnegie Institution Connection (Osborne/Holtz)
AUG 26, 1969

HCL-1 Clinical Laboratory/Dr. Derek Enlander (Curtis)
JAN 6, 1970

HCR-1 ACME Interface Connection for Cardiology Room S017 (Curtis)
Engineering Note #018
MAR 3, 1970

HCVC-1 PDP-12 Relocation for Cardiovascular Surgery (Curtis)
Engineering Note #025
MAY 18, 1970

HE-2 Laboratory Connection for Dr. Doherty - Room A379 (Osborne)
MAR 19, 1970

HEPR-1 Varian EPR Recorder to IBM 1800 Interface (M. Hu/Matheson)
JUL 20, 1971

HF-4 Dr. E. Mesel Radiology Lab Connection (Curtis/Holtz)
AUG 11, 1969

HG-5 Dr. Bellville Laboratory Connection (Holtz/Osborne)
OCT 6, 1969

HH-2 Microwave Laboratory Connection (Osborne)
OCT 7, 1970

HJ-3 ACME Interface for Cardiovascular Surgery (Curtis)
MAR 31, 1970

HL-3 Connection of Small Computer to the ACME System (Holtz)
NOV 13, 1967

HLP-1 Litton Printer to PDP-11 Interface (Stubbs)
JAN 3, 1972

HNM-1 Nuclear Medicine Connection--Dr. DeGrazia (Curtis)
SEP 12, 1969

HOR-2 Installation in Room S280 and Operating Rooms 10 and 11 (Holtz/Weatherby)
JUL 29, 1968

HORA-2 Connection from Cardiology Lab to PDP-8 in Room S284 (Curtis)
MAR 11, 1970

HOS-2 Coronary Care Connection (Holtz/Osborne)
JUL 29, 1968

HRL-1 Dr. Heinrich Rose Lab Connection--Surgery (Holtz/Maguad)
JUL 29, 1968

HSCI-1 Scan Converter Interface (Stubbs)
JUN 18, 1971
HSI-2 Standard ACME Interface (Holtz)
NOV 27, 1968
HTC-1 Cardiology Lab Connection (Holtz/Maynard/Hoffman)
JUL 26, 1967
HTRE-1 PAR 262 Interface (Arndt)
DEC 1, 1970
HTRI-1 Dr. Hardyck--Tape Recorder Interface (Holtz/Hoffman)
APR 9, 1968
HUA-1 Connection to Analog Computer (Holtz)
JAN 12, 1968
HUM-1 Biology Lab Scintillation Counter Connection (Holtz/Morris)
SEP 15, 1967
HUN-1 LINC-8 Connection (Holtz)
JAN 31, 1968
HUO-2 PDP-8 Interface--Dr. Nelsen (Holtz)
MAR 25, 1968
HUU-1 Urology Lab. Connection (Holtz)
SEP 15, 1967
HVA-5 V.A. Hospital Lab Connection (Psychiatry)--Dr. Kopell (Holtz)
MAR 28, 1969
HX-1 Computation Center Remote Control Box (Holtz/Larned)
JUL 26, 1967
HY-2 Genetics Lab Connection, Rooms S309 and S367 (Holtz/Curtis)
APR 9, 1969
HZZ-1 Dr. Zboralske Lab Connection (Holtz/Curtis)
NOV 27, 1968
MPXA-1 2701 PDA/Satellite Machine Multiplexor - General Information (Frey)
DEC 8, 1972

ACME SUBROUTINE LIBRARY

EA-4 General Use of ACME Libraries (Liere)
SEP 18, 1969
EAA-6 ACME Subroutine BASIC: Basic Descriptive Statistics--Handles Missing Data (Whitner)
DEC 18, 1970
EAB-8 ACME Subroutine CORLATE: Correlation Coefficients (Whitner)
OCT 9, 1970
EAC-6 ACME Subroutine ONETAB: One-Way Frequency Distribution (Whitner)
DEC 15, 1971
EAD-5 ACME Subroutine CROSTAB: Two-Way Frequency Distribution (Whitner)
OCT 25, 1971
EAE-8 ACME Subroutine TTEST: Student's t-test (Liere/Whitner)
FEB 12, 1971
EAF-4 ACME Subroutine RANK: Ranks Set of Data Values from Smallest to Largest (Whitner)
OCT 12, 1970
EAG-4 ACME Subroutine BASTAT: More Basic Descriptive Statistics (Moore/Whitner)
FEB 19, 1971
EAH-3 ACME Subroutine TIE: Correction Factor for Ties in Ranked Data (Liere/Whitner)
DEC 22, 1970
EAI-5 ACME Subroutine CHISQU: Chi-Square Test for Contingency Table (Liere/Whitner)
JUN 23, 1970
EAJ-8 ACME Subroutine SRANK: Spearman Rank Correlation Coefficient (Whitner)
JUL 16, 1971
EAK-5 ACME Subroutine UTEST: Mann-Whitney U-test (Whitner)
OCT 13, 1972
EAL-6 ACME Subroutine SIMREG: Simple Linear Regression (Liere/Whitner)
FEB 11, 1971
EAO-4 ACME Subroutine GDATA: Independent Variable Used in Polynomial Regression (Liere/Whitner)
FEB 4, 1970
EAQ-4 ACME Subroutine MINV: Inverts a Matrix (Liere)
SEP 5, 1969
EAR-4 ACME Subroutine AUTO: Autocovariance (Shih/Whitner)
FEB 10, 1971
EAS-6 ACME Subroutine CROSS: Cross-Covariance (Whitner)
APR 26, 1971
EAT-6 ACME Subroutine ANOVA1: One-Way Analysis of Variance (Liere/Whitner)
MAR 17, 1971
EAU-6 ACME Subroutine ANOVA2: Two-Way Analysis of Variance (Liere/Whitner)
MAR 12, 1971

MAR 12, 1971

EAV-4 ACME Subroutine MATPRD: Multiplies Two Matrices (Liere)
SEP 5, 1969

EAW-3 ACME Subroutine SMOOTH: Smooths Time Series (Liere/Whitner)
FEB 4, 1970

EAX-3 ACME Subroutine CLRATIO: Confidence Limits for Ratio of Two Means (Liere)
SEP 12, 1969

EAY-1 ACME SubroutineORDER: Dependent and Independent Variables from Symmetric Correlation Matrix (Liere)
SEP 12, 1969

EAZ-3 ACME Subroutine TRANSPOSE (Whitner)
APR 8, 1970

EBF-3 ACME Subroutine MATADD: Adds Two Matrices (Liere)
JAN 24, 1969

EBT-2 ACME Subroutine EIGEN: Calculates Eigenvalues and Eigenvectors for a Symmetric Matrix (Liere)
MAY 26, 1969

EBZ-2 ACME SubroutineRUNGA: First-Order Differential Equations by Runga-Kutta Method (G. Sanders)
FEB 17, 1969

ED-3 Statistical Library Testing Programs (Liere/Whitner)
APR 7, 1970

EDM-2 ACME Subroutine MULTR: Multiple Linear Regression (Liere/Whitner)
JUL 19, 1971

EDO-2 ACME Subroutine WALT: Moves Half-Word Integer Data from One Array to Another (Breitbard)
AUG 11, 1969

EDW-1 ACME Subroutine PLOTLINE: Plots Curve on Designated Digital Plotting Device (G. Sanders)
OCT 9, 1969

EDX-1 ACME Subroutine PLOTTS: Plots Time Series on Designated Digital Plotting Device (G. Sanders)
SEP 12, 1969

EEG-1 ACME Subroutine WTSREG: Simple Linear Regression for Weighted or
Unweighted Data (Whitner)
DEC 15, 1970

EEW-1 Accuracy of ACME Statistical Subroutines (Whitner)
AUG 9, 1971

EEX-1 Usage of ACME Statistical Subroutines (Whitner)
JUL 30, 1970

EEY-1 ACME Subroutine CODE: Encodes and Decodes User's Files (Hale/Whitner/Nye)
DEC 16, 1970

ACME PROGRAM LIBRARY - MOST ON PUBLIC FILE

AH-1 ACME Program Library HELP: Information on ACME Keywords (G. Sanders)
MAY 24, 1968

BER-1 ACME Program Library PLA_PL1: Converting a PL/ACME Program Into an
Equivalent PL/1 Program (Berman)
JUN 16, 1971

COUNT-1 Structure of the Count File JQPUBLIC.ACME.count (Goheen)
SEP 28, 1972

DDA-1 Pediatrics Project--Routine No. 1 (Drew)
AUG 8, 1967

EAM-5 ACME Program Library LACKFIT: Test for Linearity of
Regression (Whitner)
NOV 1, 1972

EAN-6 ACME Program Library MULT: Multiple Regression (Liere/Whitner)
JUL 8, 1971

EAP-4 ACME Program Library GENCORR: Correlation Coefficients (Handles
Missing Data) (Kraemer)
FEB 16, 1973

EARITH-1 ACME Program Library ARITHDAT: Arithmetic Date Routines (Germano)
DEC 12, 1972

EARSPE-2 ACME Program Library ARSPEC: Spectral Analysis by Autoregressive Model
Technique (Gersch/Weyl)
AUG 31, 1972

EBD-4 ACME Program Library WEIGTREG: Weighted Linear Regression (Whitner)
APR 10, 1970

EBE-3 ACME Program Library LINREG: Linear Regression (Whitner)
NOV 8, 1972

EBG-3 ACME Program Library JACKNIFE: Confidence Limits for a RAtio
of Two Means (Moore/Whitner)
FEB 11, 1971

EBH-1 ACME Program Library ONCALL: Scheduling Program for Residents
on Call (Moore)
JAN 8, 1968

EBI-3 ACME Program Library PCPLOT: Frequency Plot (Moore/Whitner)
JUN 24, 1970

EDS-2	ACME Program Library UNCRUNCH: Restoring CRUNCHed Program Datasets (Bassett) JAN 21, 1971
EDT-2	ACME Program Library DPOWELL: Fitting Program for Nonlinear Functions (G. Sanders) AUG 29, 1969
EDU-1	ACME Program Library ALPHABET: Alphabetization of Elements of String Records (G. Sanders) JUL 3, 1969
EDV-1	ACME Program Library TABRIT: Composes Programs with Tabular Output (Nye) AUG 11, 1969
EDY-1	ACME Program Library FORTALGN: Aligning a FORTRAN Text File for Compilation (Liere) APR 17, 1970
EDZ-1	ACME Program Library ASM_ALGN: Aligning a 360 Assembly Language Text File for Assembly (Liere) APR 17, 1970
EEA-1	ACME Program Library STEPREG: Stepwise Multiple Linear Regression (Whitner) AUG 27, 1970
EEB-1	ACME Program Library EZALIGN: Aligning a Text File to a Desired Line Width (Brotz) JUL 17, 1970
EEC-2	ACME Program Library TYPEWRIT: Printing a Text File with Page Breaks (Brotz/Saal) AUG 19, 1970
EED-1	ACME Program Library UPDATENP: Updating the NEWSTEXT File (Sanders) OCT 13, 1970
EEN-1	ACME Program Library NEWS: News Items Can Be Printed Out on User's Terminal (Sanders) OCT 14, 1970
EEZ-1	ACME Program Library SCRATCH: Deletes Datasets from User's File (Whitner) AUG 14, 1970
EFA-1	Translating FORTRAN Programs to PL/ACME Using DATAPROG, UNEKEVAR and TRANSLATE (Emmons) SEP 23, 1968
EFC-2	ACME Program Library UNEKEVAR: Unique Variables (Emmons/Liere) NOV 25, 1970
EFD-2	ACME Program Library TRANSLATE: Translation of FORTRAN Programs to PL/ACME (S. Miller) AUG 7, 1972
EFE-2	ACME Program Library LISTAKER - Listing/Punching Service (Bassett) FEB 1, 1971
EFFT-2	ACME Subprograms FFT and FFTD: Fast Fourier Transforms (Whitner) JUL 24, 1972
EG-1	ACME Subprogram GRAPHH: Creates Display and Plotter Output (Hale) MAR 22, 1971
EIBMTP-1	ACME Program Library IBMTAPE: Dump/Restore User Tapes (Germano) DEC 18, 1972
EOPS-1	Versatile Plotting System (Hale) JUN 15, 1971
EPCDES-1	Proposal for Common Data Entry Subprogram for Statistical Programs on the PUBLIC File (Whitner) JUL 7, 1972
EPP-2	ACME Subprogram PLOTPRIN: Plots Graphs and Prints on Line Printer or Terminal (J. Hu) FEB 16, 1972
EPUBDIR-1	ACME PUBLIC File Directory (Germano) DEC 12, 1972
ERECOM-1	ACME Program Library RECOMPOS: Recomposing PL/ACME Programs from Card Decks (Bassett) JUL 6, 1972
ESORT-1	ACME Program Library QSORT, QRANK, SORTEXT, and GENSORT: Sorting (Goheen/Neimat) SEP 19, 1972
ESURV-1	ACME Subprogram Library SURVIVE: Life Table Construction (Bauriedel) SEP 8, 1972
ETEAS-1	Organization of the Computer-Assisted Instruction Project on ACME: TEACHER PUBLIC (Neimat) SEP 22, 1972
ETEAU-1	ACME Program Library TEACHER: Teaches PL/ACME Language (Neimat) SEP 22, 1972
ETLR-1	ACME Subprogram LACFTSUB: Test for Linearity of Regression (Whitner) NOV 1, 1972
UEI-1	ACME Realtime Library Program IRON: Smoothing by IRONing with an Exponential Decreasing Window (Wiederhold) DEC 13, 1971
ULA-1	ACME Real Time Program Library AZTEC: Data Reduction for a Sequence of Samples (Wiederhold) NOV 23, 1971
ULC-1	ACME Realtime Library CUADRO: Smoothing Using a Square Window (Wiederhold) FEB 17, 1972
WTX-2	Text Processing Routines (Wiederhold) SEP 22, 1971

Revision of AA-39 dated March 12, 1973.
Dist: Staff/All

EBIB-1 ACME Program Library BIBLIO and BIBUP: Interactive Keyword/Entry Programs (Coheen)
AUG 25, 1972

EBK-4 ACME Program Library POLY: Polynomial Regression (Liere)
OCT 2, 1969

EBL-2 ACME Program Library RUNGK_1: Runge-Kutta Solution of First-Order Ordinary Differential Equation (Liebes)
AUG 21, 1968

EBM-4 ACME Program Library ZEROFIT: Least-Squares Line through Origin (Whitner)
NOV 24, 1969

EBN-3 ACME Program Library BSORT and BSORTC: Sorting (Germano)
DEC 14, 1972

EBNC-1 ACME Program Library BRANK and BRANKC: Bubble Sort Ranking (Germano)
DEC 14, 1972

EBO-3 ACME Program Library PEEL: Exponential Curve Fitting (G. Sanders/Liere)
OCT 17, 1969

EBP-2 ACME Program Library KWTEST: Non-Parametric Analysis of Variance--One-Way (Kraemer)
JAN 12, 1969

EBQ-4 ACME Program Library PLOT: Scatter Plotting (Liere)
MAR 27, 1969

EBR-3 ACME Program Library SCHUSTER: Schuster Periodogram (Schach)
FEB 7, 1969

EBS-3 ACME Program Library RUNGA6: Runge-Kutta Integration (G. Sanders)
JUN 15, 1969

EBU-3 ACME Program Library TIMESER: Spectral Analysis (Liere)
SEP 6, 1972

EBV-2 ACME Program Library GOODFIT: Test for Goodness of Fit (Liere)
JUL 11, 1969

EBW-2 ACME Program Library DISCRIM2: Discriminant Analysis for Two Groups (Schach)
FEB 7, 1969

*EBX-3 ACME Program Library TSQUARE: Hotelling's T Square (Schach)
MAR 9, 1973

EBY-4 ACME Program Library CHI_2BY2: Chi-Square Statistic with Continuity Correction (Whitner)
OCT 30, 1970

ECABLE-1 ACME Program Library CABLE: Cable Inventory Management (Harrison)
AUG 17, 1972

ECONCO-1 ACME Program Library CONCORD: Generates Concordance Files From Text Files (Goheen)
AUG 25, 1972

EDA-1 ACME Program Library MAPIT: Mapping Bacterial Chromosomes (Nye)
AUG 5, 1968

EDB-3 ACME Program Library DATAPROG: Writing a Data File Into a Program File (Liere)
JUL 15, 1969

EDD-3 ACME Program Library HEXARITH: Hexadecimal Integer Arithmetic Routines (Liere)
JAN 13, 1970

EDE-5 ACME Program Library JUSTIFY: Text Justification (Liere/Whitner)
DEC 28, 1970

EDF-2 ACME Program Library RUNGK_2: Runge-Kutta Solution of Second-Order Ordinary Differential Equations (Liebes)
APR 18, 1969

EDG-3 ACME Program Library POWELL: Fitting Program for Nonlinear Functions (G. Sanders)
AUG 19, 1969

EDH-1 ACME Program Library LISTER: Listing the User's Program (Liebes)
SEP 19, 1968

EDI-3 ACME Program Library MATCH: Matching Donors to Recipients for Transplants (Bauriedel)
MAY 17, 1972

EDJ-3 ACME Program Library LINSYS: Solution of Simultaneous Equations (Whitner/Jones)
OCT 16, 1972

EDK-2 ACME Program Library ANOVATWO: Two-Way Analysis of Variance--Unequal Cell Frequencies (Brast)
FEB 7, 1969

EDL-1 ACME Program Library EDITER: Converting a Program to a Standard Format (Liebes)
NOV 14, 1968

EDN-2 ACME Program Library BALTHREE: Analysis of Variance for a Balanced Three-Way Design (Kraemer)
FEB 7, 1969

*EDP-4 ACME Program Library COPIER: Reproducing a Complete or Partial Program Data Set (Bassett)
APR 17, 1973

EDPD-2 ACME Public Program D_EMPTY: Deletes Empty Files (Wiederhold)
MAR 2, 1972

EDQ-3 ACME Program Library DATACOPY: Reproducing a Complete or Partial Data File (Wiederhold)
FEB 20, 1973

EDR-3 ACME Program Library CRUNCH: Collapsing Program Datasets (Bassett)
JUN 25, L971

APPENDIX E
USER PUBLICATIONS

1. Published in Regularly Scheduled Periodicals During Fiscal 1973

Alderman, E.L., W.H. Barry, A.F. Graham, and D.C. Harrison, "Hemodynamic Effects of Morphine and Pentazocine Differ in Cardiac Patients," NEW ENGLAND JOURNAL OF MEDICINE, Vol. 287, pp. 623-627, Sept. 28, 1972.

Alderman, E.L., A. Branzi, S. Sanders, D.C. Harrison, and B.W. Brown, "Evaluation of the Pulse Contour Method of Determining Stroke Volume in Man," CIRCULATION, Vol. XLVI, September 1972.

Barry, W.H., A.M. Marlon, and D.C. Harrison, "The Hemodynamic Effects of Strontium Chloride in the Intact Dog," PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE, Vol. 141, No. 1, pp. 52-58, October 1972.

Branzi, A., H. Mailhot, E.L. Alderman, and D.C. Harrison, "Ultrasound Determination of Left Ventricular Position for Volume Angiography," CHEST, Vol. 62, pp. 29-33, July 1972.

Brown, C.R., P.F. Shroff, and W.H. Forrest, Jr., "Relative Potency of Triclorofos Compared to Pentobarbital as a Hypnotic," J. OF CLIN. PHARM. AND NEW DRUGS, Vol. 12, No. 8 and 9, pp. 306-312, August-September 1972.

Brown, C.R., W.H. Forrest, Jr., and H. Hayden, "The Respiratory Effects of Pentobarbital and Secobarbital in Clinical Doses," JOURNAL OF CLINICAL PHARMACOLOGY, Vol. 13, pp. 28-35, January 1973.

Buchanan, B.G., E.A. Feigenbaum, and N.S. Sridharan, "Heuristic Theory Formation: Data Interpretation and Rule Formation," MACHINE INTELLIGENCE 7, Edinburgh University Press, pp. 267-290, November 1972.

Forrest, W.H., Jr., P.F. Shroff, and D.L. Mahler, "Analgesic and Other Effects of Nalmexone in Man," J. OF CLIN. PHARM. AND THERAP., Vol. 13, No. 4, pp. 520-525, July-August 1972.

Forrest, W.H., Jr., C.R. Brown, P.F. Shroff, and G. Teutsch, "Relative Potency of Propiram and Morphine for Analgesia in Man," JOURNAL OF CLINICAL PHARMACOLOGY, Vol. 12, No. 11 & 12, Nov.-Dec. 1972.

Goldman, R.H., R.N. Deutscher, E. Schweizer, and D.C. Harrison, "Effect of a pharmacologic dose of digoxin on inotropy in hyper- and normokalemic dogs," AMERICAN JOURNAL OF PHYSIOLOGY, Vol. 223, No. 6, pp. 1438-1443, December 1972.

Herman, M.M., K.G. Bensch, K.W. Marich, and D. Glick, "The Effects of Gold Thioglucose on Mouse Fibroblasts in vitro: Morphological and Laser Microprobe Studies", EXPERIMENTAL AND MOLECULAR PATHOLOGY, Vol. 16, No. 2, pp. 186-200, April 1972.

Joffe, J.M., K. Milkovic, and S. Levine, "Effects of Changes in Maternal Pituitary-Adrenal Function on Behavior of Rat Offspring," PHYSIOL. BEHAV., Vol. 8, pp. 425-430, 1972.

Lamb, E., and A.L. Cruz, "Data Collection and Analysis in an Infertility Practice," FERTILITY AND STERILITY, Vol. 23, No. 5, pp. 310-319, May 1972.

Lamb, E., "Prognosis for the Infertile Couple," FERTILITY AND STERILITY, Vol. 23, No. 5, pp. 320-325, May 1972.

McConnell, H. M., and P. Devaux, "Lateral Diffusion in Spin Labeled Phosphatidyl Choline Multilayers," J. AM. CHEM. SOC., Vol. 94, p. 4475, 1972.

Marich, K.W., J.B. Orenberg, W.J. Treytl, and D. Glick, "Health Hazards in the Use of the Laser Microprobe for Toxic and Infective Samples," AMERICAN INDUSTRIAL HYGIENE JOURNAL, pp. 488-491, July 1972.

Northway, W.H., R. Petriceks, and L. Shahinian, "Quantitative Aspects of Oxygen Toxicity in the Newborn: Inhibition of Lung DNA Synthesis in the Mouse," PEDIATRICS, Vol. 50, No. 1, pp. 67-72, July 1972.

Raybin, D.M., L.L. Bertsch, and A. Kornberg, "A Phospholipase in Bacillus megaterium Unique to Spores and Sporangia," BIOCHEMISTRY, Vol. 11, No. 10, pp. 1754-1760, 1972.

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Saffir, A.J., and H.M. Myers, "A Modern Statistics Course for Dentists Using a Time-Sharing Computer", JOURNAL OF DENTAL EDUCATION, April 1972.

Scandella, C.J., P. Devaux, And H.M. McConnell, "Rapid Lateral Diffusion of Phospholipids in Rabbit Sarcoplasmic Reticulum," PROC., NAT. ACAD. SCI., Vol. 69, No. 8, pp. 2056-60, 1972.

Smith, D.H., B.G. Buchanan, R.S. Engelmore, A.M. Duffield, A. Yeo, E.A. Feigenbaum, J. Lederberg, and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference VIII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidiation of Estrogenic Steroids," JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, Vol. 94, pp. 5962-5971, 1972.

Stenson, R., L. Crouse, and D.C. Harrison, "Computer Measurement of Cardiac Output by Dye Dilution: Comparison of Computer, Fick, and Dow Techniques," CARDIOVASCULAR RESEARCH, Vol. VI, No. 4, pp. 449-456, July 1972.

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2. Other Publications

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Brown, C.R., P.F. Shroff, and W.H. Forrest, Jr., "The Oral Hypnotic Bioassay of Hydroxazine and Pentobarbital for Night-time Sedation," in preparation (winter 1972).

Cohen, S.N., L. Crouse, M.F. Armstrong, and G.Hunn, "A Computer-Based System for Prospective Identification of Drug Interactions", PROCEEDINGS OF THE FIFTH INTERNATIONAL CONFERENCE ON SYSTEM SCIENCES, Univ. of Hawaii, 1972.

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