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NATIONAL INSTITUTES OF HEALTH

DIVISION OF RESEARCH RESOURCES

BIOTECHNOLOGY RESOURCES BRANCH

SECTION I - RESOURCE IDENTIFICATION

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Name of Resource	Resource Address	Resource Telephone No.
Health Computer Sciences Resource	Division of Health Computer Sciences, Box 511 Mayo Memorial Building U of M, Minneapolis, Minn. 55455	612-373-5613
Principal Investigator	**Title**	**Academic Dept.**
Eugene Ackerman	Professor and Director	Laboratory Medicine
Grantee Institution	**Type of Institution (Private Univ., State Univ., Hosp., etc.)**	**Investigator's Telephone No.**
University of Minnesota	State University	612-373-5616

Name of Institution's Biotechnology Resource Advisory Committee:

Health Sciences Computer Advisory Committee

Membership of Biotechnology Resource Advisory Committee:
(Indicate Chairman and those who have reviewed this report)

Name	Title	Department	Institution
Dr. Arnold Lazarow, Chairman	Professor & Dept. Head	Anatomy	U of M
Dr. Kathleen Keenan	Associate Professor	Dentistry	U of M
Dr. Eugene Johnson	Professor of Biometry	Biometry Division, School of Pub.Health	U of M
Dr. Ivan Frantz	Professor	Medicine	U of M
Dr. H. Mead Cavert	Associate Dean	Medical School	U of M

(Other members did not read report before submission.)

Typed Name & Title of Principal Investigator	Signature	Date
Eugene Ackerman, Professor and Director	Eugene Ackerman	10/10/72
Typed Name & Title of Grantee Institution Official C. T. Johnson, Assistant Vice President Business Administration	C. T. Johnson	10/11/72

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II-A-1. Introduction

Section II-A of the Annual Report for Grant RR-267 presents, in narrative form, the operations of the resource. This has been divided for convenience of presentation into a series of subsections giving overviews of specific areas and, where appropriate, indicating the perspectives for future activities. Briefly, during the report period covered, the Health Computer Sciences Facility Resource has been following the plans and time-tables anticipated in the renewal application approved in 1971. These have continued to be viable and appropriate. No major changes are envisioned during the next year. Nonetheless, as discussed in several of the subsections of this report, long-standing goals were reached and new projects were activated. In particular, the activities of the Division of Health Computer Sciences have continued to expand into projects which are not part of the Facility Resource supported by Grant RR-267.

An annual report of this nature is perforce written by many persons and exposes their unique points of view. The first six subsections, as well as the last, highlight many of the topics which the resource Director feels are most important. The other subsections present reviews of their areas of responsibility written by the three Assistant Directors. By way of contrast, the remainder of Section II and all of Section III have been prepared by the Administrative Officer, and Section IV contains contributions from users and staff.

Of the various events which have occurred during the past year, perhaps most significant for the long-term future of the Division of Health Computer Sciences has been the growth of institutional support. The nature of this support and its implications are discussed in the following subsection. This added support has resulted in a large measure from actions of local committees and administrative units whose current composition is summarized in subsection 3. The character and accomplishments of an academic research unit reflect critically the composition of its staff. Within Health Computer Sciences at the University of Minnesota an orderly growth has occurred. The changes so produced were considered sufficient to warrant a special subsection for this topic.

A major shift in operational philosophy has been the added use of interactive computing. This was included in the proposal submitted in 1970 and major strides have been taken towards this goal. Although keenly aware of the years of development which remain, the principal investigator did present a talk summarizing these activities at the ACM '72 meeting. The position paper for that talk is included to summarize the current status of interactive computing at this Resource.

Following subsections detail the operation of the Resource with regard to the items in the Biotechnology Resource Branch's guidelines, namely, core research and development, collaborative research, training, and services. These all reflect progress, growth, and plans for the future made possible by support through Grant RR-267.

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Finally, a summary of past, present, and future concludes Section II-A. The successful operation of this Biotechnology Resource is a source of pride for all its staff members. However, it is clear that the field of biomedical computing is continuing to evolve rapidly and that the staff in Health Computer Sciences must continue to develop and apply innovative advances in technology to problems in the Health Sciences.

II-A-2. Institutional Support

A most serious problem for many research resources is obtaining commitments for continuing support from their parent institution. The latter is often rightfully proud of the one-time support supplied, and feels that continued support for essential health sciences research resources should come from Federal budgets. Whether this is a general phenomenon or not, it certainly characterized the University of Minnesota's administrative assessment of Health Computer Sciences as recently as eighteen months ago. For the sake of the record, the nature of this support should be emphasized. It included over 50K$ for building modifications to make the installation of the CDC 3300 computer system possible, and over 250K$ for the laboratory or office space for Health Computer Sciences on the third floor of the VFW Cancer Research Center building. It also included an investment of over 275K$ of State funds towards the purchase of the CDC 3300 system. (The latter funds include the interest payments which make possible the purchase of that system over a number of years.)

In addition to these one-time-only payments totaling almost 600K$, the University of Minnesota promised the tenured support of Professor Ackerman and provided tenured support for Professor E.A. Johnson. Approximately 4K$/year plus fringe benefits of the latter's support has come from GRS-G funds in recognition of his activities as a faculty member of the staff of the Health Computer Sciences Facility Resource. However, no other continuing funds were provided. The Advisory Council of the National Institutes of Health's Division of Research Resources severely criticized the University of Minnesota for this lack of support. They were joined in this criticism by the University of Minnesota's Health Sciences Computer Advisory Committee.

In response, the University has provided two types of added support for its Division of Health Computer Sciences. The first consisted of support by the Medical School of 5K$ of salary plus fringe benefits for the period of 1 January 1972 to 30 June 1972. This was replaced by support, at a continuing annual rate, of 30K$ of salary plus fringe benefits on the part of the various units of the Health Sciences. This support was to enable an expanded academic program. The Medical School has stated that it plans to ask the State Legislature for added funds to enable raising the faculty salary support in Health Computer Sciences by an added 10K$ on 1 July 1973 and to a continuing rate of 50K$/year on 1 July 1974.

The second type of support has been provided by the University Computer Services. The latter is a branch of the office of the Vice President for Academic Affairs. The University Computer Services is dedicated to the support of instructional uses of computers throughout the University system.

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In recognition of the use of the computers in Health Computer Sciences, the University Computer Services provided 8.8K$ of salary support for the period of 1 January 1972 through 30 June 1972. This was replaced by continuing support of 14K$/year of salary plus fringe benefits, plus 6K$/year of support for supplies and other expenditures. The Director of the University Computer Services, Dr. Frank Verbrugge, has stated his intention of requesting added support at the next State Legislative Session.

Thus it appears that the biotechnology resource is in a much sounder position than it was 18 months ago as far as institutional support is concerned. It should be noted that a number of problems still remain. Uppermost in the concerns of the principal investigator is that of space. Currently, the Division has approximately 1500 square feet in the room for the CDC 3300 and approximately 2800 square feet on the third floor of the VFW Cancer Research Center. However, providing adequate space for the hardware on hand and/or approved, and providing office space for a staff, faculty, and graduate student body of over 50 persons requires added space. About 400 square feet of space has been promised in the Health Services Building. Requests for an added 2000-3000 square feet are currently pending. Any of these will require renting space which may necessitate some type of negotiation to re-partition overhead and direct costs.

To summarize this section, although problems remain, the University of Minnesota has made major commitments to the on-going and continuing support of Health Computer Sciences. It is our hope that this support will continue to grow as that Division continues to demonstrate its important roles in the educational and research programs in the Health Sciences.

II-A-3. Committees and Administration

The institutional support noted in the preceding subsection has resulted in a large measure from the local support expressed by the various advisory and administrative committees concerned. Detailing all of these is beyond the scope of this Annual Report. Only the most immediately pertinent ones will be reviewed here.

a. The Health Sciences Computer Advisory Committee is the facility committee described in the guidelines for Biotechnology Resources. It has met at least once per quarter and has concerned itself with the overall policies and support of the local Resource. In particular, recommendations from this committee for faculty and facility support were one of the key elements in making such support possible. Members of this committee for the 1972-1973 academic year are:

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Health Sciences Computer Advisory Committee

Arnold Lazarow, Chairman	Department of Anatomy
Jacob E. Bearman	Division of Biometry
Henry Blackburn	Laboratory of Physiological Hygiene
Ivan Frantz	Department of Medicine
Eugene A. Johnson	Division of Biometry
Kathleen Keenan	School of Dentistry
Jack Miller	Department of Pharmacology
John O'Leary	Department of Family Practice & Community Health
Edward Rippie	Department of Pharmaceutics
Peter Sammond	University of Minnesota Hospitals
Richard Varco	Department of Surgery

Ex Officio Members

Eugene Ackerman	Division of Health Computer Sciences
Ellis Benson	Department of Laboratory Medicine
Bruce Boraas	Division of Health Computer Sciences
H. Mead Cavert	Medical School
Michael Diffley	Division of Health Computer Sciences
Laël Gatewood	Division of Health Computer Sciences
James Nelson	Division of Health Computer Sciences
Frank Verbrugge	University Computer Services

b. A similar committee with all-university responsibility is called the University Computer Advisory Committee. It must approve all hardware and rate structure changes. (However, rates in the health sciences are referred to the committee described in a. above). Members of this committee for the 1972-1973 academic year are:

Thomas Hoffmann, Chairman	Department of Management Sciences
Eugene Ackerman	Division of Health Computer Sciences
Douglas Anderson	Division of Educational Psychology
Ronald Anderson	Department of Sociology
Francis Boddy	Graduate School
Russell Burris	Center for Study of Programmed Learning
Raymond Collier	Dept. of Psychological Foundations of Education
Walter Fishel	Agricultural and Applied Economics
John Gergen	Computer Center (Duluth Campus)
Donald Harriss	Department of Chemistry (Duluth Campus)
John Hoyt	Agricultural Extension Service
Clinton Johnson	Assistant Vice President, U of M
Stephen Kahne	Hybrid Computer Center
Arnold Lazarow	Department of Anatomy
Lawrence Liddiard	University Computer Center
Andy Lopez	Dept. of Computer Math (Morris Campus)
John Neter	Department of Management Sciences
John Overend	Department of Chemistry
Peter Patton	University Computer Center
Peter Roll, ex officio	Office of the V.P. for Academic Affairs
Ben Rosen	Computer, Information, and Control Sciences
Wesley Simonton	Library School

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c. In addition to these two, the University Senate has a Committee on Computer Facilities which has been relatively inactive in the past. Its members are appointed for three-year terms and are not eligible for immediate reappointment. Its membership this academic year and the number of years they have left to serve are:

Eugene Ackerman, Chairman (1)	Division of Health Computer Sciences
Ronald Anderson (3)	Department of Sociology
Dave Berg, ex officio	Budget Planning and Information Services
John Gergen (1)	Computer Center (Duluth Campus)
Audrey Grosch (1)	Library
James Henderson (2)	Department of Economics
Russell Hobbie (2)	Department of Physics
Frank Martin (3)	School of Statistics
Ellen Pirro (2)	Department of Political Science
Frank Verbrugge, ex officio	University Computer Services

Student Members

Jim Rounds
Paul Wozniak
Dave Drummond

d. A very active subcommittee of the Health Sciences Computer Advisory Committee is called the Subcommittee on Subsidized Time. University Computer Services support of Facility equipment and operation requires providing computer services to educational, graduate student, and new research projects. Great care is exercised to assure that on-going projects pay for their use of the facility's resources and that only health-related projects are undertaken. Members of this subcommittee are:

Ivan Frantz, Chairman	Department of Medicine
Bruce Boraas, Executive Secretary	Division of Health Computer Sciences
Kathleen Keenan	School of Dentistry
Jack Miller	Department of Pharmacology
Richard Moore	Division of Health Computer Sciences
James Nelson (ex officio)	Division of Health Computer Sciences

e. The affairs of the Division of Health Computer Sciences are reported at the faculty meetings of its parent Department, namely, Laboratory Medicine. Dr. Ellis S. Benson continues as Head of this Department and Mr. Don Howard is its Senior Administrative Officer. In addition, faculty meetings and special seminars of the Division of Health Computer Sciences are held more frequently than once per quarter. These meetings are generally informational rather than decision making. Faculty and senior staff in Health Computer Sciences are expected to attend these meetings. Other interested persons are also invited.

f. The detailed administration of the Biotechnology Resource has been reviewed by an administrative committee, which often meets weekly. Members of this active group are: Eugene Ackerman, Laël Gatewood, Bruce Boraas, Michael Diffley, James Nelson and Margie Henry.

g. A Biotechnology Research Committee has been active in reviewing core as well as collaborative research projects. Members of this committee are:

Lael Gatewood, Chairman
Michael Diffley
Eugene A. Johnson
Richard Moore

h. In addition frequent meetings have been held of the Systems and Services groups. These have served both informational and planning needs.

II-A-4. Personnel Changes

During the past report period, a number of changes have occurred in the Division of Health Computer Sciences. All of these in one way or another have affected the operation of the Biotechnology Resource supported by grant RR-267. In this section, attention is drawn to the post-doctoral and senior level changes which have occurred.

First, however, three administrative changes within the University should be noted. One of these is the appointment of Neil Gault, M.D. to the position of Dean of the Medical School. It is anticipated that his appointment will affect Health Computer Sciences by providing added administrative stability. Second, Dr. Richard McHugh has resigned from his academic duties as director of the Division of Biometry and has been replaced by Dr. Marcus Kjelsberg. Collaborative efforts involving Dr. Gatewood and Dr. Kjelsberg assured a continuing strong positive relationship. The third person is Dr. J. Ben Rosen, who assumed the position of Head of the Department of Computer, Information, and Control Sciences. He has proven to be a sincere colleague interested in Health Computer Sciences, actively helping in the selection of a new faculty member.

Turning now to the faculty in Health Computer Sciences, this was decreased by Dr. John W. Rosevear's resignation, effective 29 October 1971 to accept an industrial job with Kallestad Laboratories. Dr. Rosevear has continued to serve on the faculty as Clinical Associate Professor but receives no compensation for this. His interactions with the Resource Operations is now minimal.

A major change is anticipated with the addition of Claus E. Liedtke, Dr. Ing., as Assistant Professor effective 1 January 1973. Dr. Liedtke has a doctoral degree in computer science and has been interested in speech analysis and synthesis, as well as in analog and hybrid signals. He plans to work in a collaborative fashion with investigators in the electrocardiography and electroencephalography laboratories here at Minnesota.

A new part-time instructor, David Juncker, Ph.D., has also been added to our faculty. Dr. Juncker will assist Dr. Gatewood in one of the training programs making use of the facilities supported by RR-267. Dr. Juncker has had considerable engineering and computer experience and recently completed a Ph.D. in Physiology.

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Post-doctoral fellows have also had a major influence on the operation of the Resource, constantly challenging what is being done and why, and how local facilities and training compare to that provided elsewhere. The most recent post-doctoral fellow, Francis M. Roger, M.D., returned in August to his native Belgium having received a M.S. degree in Biometry as well as learning added skills in computer technology and epidemiology. Currently three post-doctoral students are associated with the Division of Health Computer Sciences; all three have M.D. degrees. They are Dr. Christian Brohet from the University of Louvain in Belgium, Dr. Donald Connelly, and Dr. John Gage. Dr. Brohet is a qualified electrocardiographer interested in expanding his knowledge of on-line computer processing. Dr. Connelly, a former engineer, hopes to further his skills in areas involving an overlap of his engineering and medical training. He will simultaneously pursue a Ph.D. degree in Biometry and a residency in Laboratory Medicine. Dr. John Gage is particularly interested in medical data bases, their automated capture, storage and retrieval. He is currently pursuing a graduate program in Biometry and an internship in Laboratory Medicine.

Among the continuing staff, note should be taken of Dr. Laël C. Gatewood. In addition to her duties as Assistant Professor of Laboratory Medicine and Assistant Director of Health Computer Sciences, she has taken on two new major assignments. One is as a member of the HSMHA Study Section on Health Care Technology. The other is as the Deputy Director (for data management) of the Statistical Coordinating Center for the National Heart Lung Institutes study entitled Multiple Risk Factor Intervention Trials (MR FIT). This title may be changed to Coronary Prevention Project.

Among the remainder of the staff, there has been a continual slow progression some leaving, being qualified for better jobs and other new individuals replacing them. The faculty in Health Computer Sciences has also been expanded by offering a joint appointmentment to Walter Schoener, a Research Associate in Anatomy. Also Dr. Ivan Fahs has been appointed as Clinical Associate Professor. Informal appointments have also been given to Dr. D. McQuarrie (Surgery and V.A. Computer Center), Dr.W. Giloi (Computer, Information, and Control Sciences) and Dr. A. Lazarow (Anatomy).

It is hoped that during the next few months that Mr. Richard Heath will complete his Ph.D. and be promoted to Research Associate. It is also hoped that Mr. M.W. Diffley and Mr. B.A. Boraas will complete their Ph.D. requirements during the next report period. However, it is realized that their full-time job requirements make such progress quite slow.

From a longer term point of view, it is hoped to add the equivalent of one-half to one full-time senior faculty member with basic training in computer and information sciences and two full-time equivalent senior faculty members with medical or medical sciences training.

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II-A-5. Interactive Computing Position Paper

Interactive languages have grown increasingly popular in recent years in health sciences computer centers. Such languages may be general purpose ones similar to those available in a batch mode or may involve special features for particular types of operations. By and large, interactive uses tend to be less efficient of computer time and resources; they can be justified only in terms of their conservation of the user's time and required skills. In contrast to a large university computer center where most of the users are poorly paid or unpaid students, most users in the health sciences tend to be well-supported graduate students, highly skilled technicians, residents, or faculty members. This places then a greater premium on the user's time than in the general university computer setting. Within the health sciences, in contrast to many industrial scientific computer centers, many of the users are not professional programmers. Accordingly, emphasis on interactive languages, including special purpose ones, is a particularly important part of a health sciences computer center.

Nonetheless, many applications will be best pursued by more traditional means. Thus health sciences computer centers have sought to supply batch mode, remote job entry and interactive services. Unfortunately, most of the computer systems selected for such applications did not include in their manufacturer-supplied software all of these facilities. Most frequently the interactive, special-purpose languages seem to have been lacking. In this paper, some of the steps taken at the University of Minnesota to remedy these deficits are considered. In particular, attention is focused on a general purpose sub-operating system, CRTOS, for a CDC 3300 system running under CDC's MASTER operating system, and two special purpose interactive languages, one an author language named BRANCHEX, and another a continuous system simulation language called MIMO. Briefer mention will be made of a mapping system using graphic displays in a semi-interactive mode.

These languages have been developed to meet the particular needs of the health sciences community at the University of Minnesota. As this community changes, and as its interests change even more dramatically, it is anticipated that the interactive languages available will also evolve. The present paper, then, is a status report on the current situation. It is hoped that this in turn will be regarded as a case history, highlighting the principal ideas and concerns about interactive computer languages for the Health Sciences at the University of Minnesota.

Turning first to CRTOS, this subsystem was developed after preliminary use of special CRT-oriented FORTRAN and BASIC subsystems elicited a great interest on the part of the users. CRTOS makes all the features of the MASTER operating system available to the terminal user and, in addition, allows easy program editing, text-editing, and file maintenance. It also contains within it a HELP feature which plays the role of a user's manual for both the beginner and the sophisticated programmer. Initially, CRTOS was designed to serve the hard-wired CRT terminals attached to the CDC 3300. Subsequent

modification allowed its extension to other terminals, including teletype-writers and other computers all of which can communicate via a star-type network.

The author language, BRANCHEX, was designed to allow the convenient use of the computer system as a tool for medical students. Emphasis has been placed on computer-aided instruction. The various parts of the BRANCHEX compiler and sub-operating system were written originally in FORTRAN. Subsequently, many parts have been rewritten in the assembly language COMPASS. BRANCHEX operates as a sub-system under CRTOS; it can handle source-language programs written by the author or pre-compiled programs processed in the card-batch stream.

The continuous simulation language MIMO was written to satisfy simultaneously several desires. One was to have ready access to an analog simulation language within the Health Sciences Center. Another was to enable interactive use similar in concept to manual control of an analog computer. The third was to take explicit advantage of the General Purpose Graphics Terminal attached to the CDC 3300 system. MIMO, its development and its application to studies in cardiovascular physiology, has been included in a recent Ph.D. thesis. It is also used for studies involving deterministic models of physiological control systems.

Finally, note should be taken of an interactive mapping system allowing the combination of demographic, geographic, medical, and public health information in an easily displayed format using the General Purpose Graphics Terminal. Such applications, while involving relatively unsophisticated computer science, are carefully tailored to the needs of the health sciences investigators. These applications may, indeed, prove to be among the most important ones for the entire health sciences community.

Numerous co-workers have played a central role in the development of interactive languages reviewed here. It is not practical to try to name all of these here, but particular mention should be made of Michael W. Diffley, George Klee, Alan Rector, Lewis Wolfenson, Lael Gatewood, Trudi Juncker, Bruce Boraas, and Jon Lake. The essayist has functioned as a coordinator and a reporter as well as a user of these languages.

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II-A-6. Training Overview

Training in health care technology and the use of the research resource continues to be a major goal of the Division of Health Computer Sciences. As described in previous sections of this Annual Report, support has been obtained from the Health Sciences units, University Computer Services, and dedicated federal funding for personnel salaries, student stipends, and educational computer uses. This has enabled a training program which varies from didactic courses for graduate, medical, and post-doctoral students to informal seminars and short courses on specific topics.

Health Computer Sciences staff members serve on the graduate faculties of Biometry, Computer and Information Sciences, Laboratory Medicine, Biophysics, Bioengineering, and Operations Research. During the last year two Ph.D. degrees and three M.S. degrees were granted by Biometry to students working in Health Computer Sciences. Abstracts describing the research of four of these students are included in Section IV. In addition, training in biomedical computation was provided for a pre-med student from Albion during a summer internship.

In order to support its training activities in health computer sciences on a firmer basis, the Division has applied for a training grant to the National Center for Health Services Research and Development (HSMHA). Although encouraged by National Center personnel and favorably approved by both the Health Services Training Study Section and the Health Services Council, this application has not been funded. Recently this proposal has been transferred to the Bureau of Health, Education and Manpower (NIH) and will be reconsidered during the next year. Meanwhile, student support has been obtained from a Post-doctoral Fellowship from the National Center for Health Services Research and Development, an internship in Laboratory Medicine, stipends from the Biometry Training Grant (also funded by the National Center) and numerous part-time jobs made possible by the presence of the research resource. The intern and the post-doctoral fellow are both receiving residency credit in Laboratory Medicine for their studies in Health Computer Sciences. This latter type of training has thus strengthened the ties of the resource to the rest of the Department of Laboratory Medicine and the Medical School.

Activation of the Health Computer Sciences star-type computer network has made possible the utilization of the resource from the Learning Center in the Biomedical Library. Here medical and paramedical students are currently using acoustically-coupled CRT terminals to access a variety of CAI-type programs locally written in the author language, BRANCHIT. One of the more popular programs available is a translation of the Cardio-pulmonary Resuscitation (CPR) program written in the MUMPS language at Massachusetts General Hospital by Dr. Edward Hoffer. It is our plan to also use these terminals to interface with TYMSHARE, supported by the National Library of Medicine, which offers additional computer-aided instructional programs.

Because of funding limitations, only a small number of didactic courses have been given in the past year. These included a sequence of 3 quarters of a 3 credits/quarter course entitled Special Topics in Health Computer Sciences and the three quarter sequence in Biomedical Computing offered each year to approximately 70 health sciences students. Short courses were held on specific

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topics, such as the use of package programs, file processing, and display techniques. An elective course for students in their final year of medical school was also held throughout the year. In addition, a seminar was presented weekly under the title Joint Biophysical Sciences Seminar. Representative speakers and their topics from this past year's series are listed below.

Jan Nyboer, M.D., D.Sc. Wayne State University Detroit, Michigan	Pulmonary Applications of Impedance Plethysmography
Hubert V. Pipberger VA Hospital, Wash., D.C.	Recent Advances in Automated Vector and Electrocardiography
Dr. Luc Lambotte University of Louvain, Belgium	Automatic Monitoring of Circulatory Metabolic and Electrophysiologic Parameters in Isolated Perfused Organs
Professor Harold Shipton University of Iowa	Display Devices for Biomedicine
Dr. Eugene Harris Div. of Computer Research and Technology, NIH	The Effect of Intra- and Inter-Individual Variation in Distributions of Single Measurements
Dr. John Mills University of Manchester, England	Variations in Human Performance and Temperature Over 24 Hours
Dr. Russell Burris Center for Study of Programmed Learning, U of M	Computer-Assisted Instruction (CAI) - Projects at the University
George Klee Medical Student - U of M	Detection of Distorted Arterial Pressure Waves in Computerized Cardiac Monitoring
Dr. Otto H. Schmitt Dept. of Biophysics, U of M	Electrographic Health Assessment - Virgin Territory for Optimization
Alan Rector Medical Student	Approaches to Computer-Aided Decision Making in Medicine
Professor Chang Won Song Dept. of Radiation Therapy U of M	Changes in Vascular Function and Oxygenation of Irradiated Tumors
Dr. Naip Tuna Dept. of Medicine, U of M	What is "Normal" in Electrocardiography?
Dr. William G. Kubicek Dept. of Physical Medicine and Rehabilitation, U of M	Clinical and Research Applications of Impedance Measurements

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II-A-7. Core Research Program

The program in biotechnology research has furthered the development of end-products which represent significant, innovative, and exportable contributions to substantive health sciences disciplines. All core research projects are expected to use advanced biotechnology and to have components which can contribute to a spectrum of applications. The close interrelationships with systems and training have contributed to the general applicability of these components, which we term modules. These components are often proposed in classes, developed by systems, demonstrated in categorical research projects, and eventually exported by services and external publication to our resource users and other health science centers.

The modules being developed in this fashion are in various stages of progress, ranging through problem definition, analysis, development, documentation, complementation, evaluation, and exportation. A period of not more than two years is allocated to this process, since definable and realistic goals must be established. Currently, these modules include MIMO (Minnesota Modeling Language), multivariate routines, interactive graphics, non-linear optimization, BRANCHIT (branching author language), digital plot routines, large file processing, terminal interpretive languages, and data quality assurance. It is hoped that implementation of languages available on other systems could be added, perhaps through extensions of the computer network.

The general emphasis in the core research program has been toward local abilities and needs within the health sciences center. Expertise is strongest in the areas of simulation of mathematical models and studies based on access to large data bases. The modules outlined above contribute by applying biotechnology to these areas. A survey was made in the past year of all core projects by the Biotechnology Research Steering Committee, which sought to define requirements, activity to date, and relevance of each project. This analysis served to identify areas of strengths which were encouraged by further support, and areas where redefinition and emphasis served to reorient project direction. It is planned to resurvey all projects annually to continue the growth shown in the past year.

Core research projects which have been supported are listed by abstract in Section Four. In the general area of simulation, these included studies of chromatographic peak detection and resolution, on-line detection of distorted pressure signals during critical care monitoring, analysis of differences in membrane permeability of cells from normal and leukemic subjects, evaluation of performance measurements of the computer operating system and comparison of the physiological handling of exogenous insulin when labelled with and without a radioactive tracer. Many file-based studies depending on ready access and manipulation of large data bases have been moved to the collaborative research area because the original problems were identified by an investigator outside of the Division and innovative support was provided by our staff. However, core research has been continued in the areas of multivariate classification algorithms as applied to laboratory data, the development of an automated system for testing diagnostic decision-making criteria, and the analysis of physician-computer interactions in designing a diagnostic coding system for a medical subspecialty.

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II-A-8. Core Development Program

The Systems Section of HCS is responsible for development and maintenance of all HCS hardware and software systems. The developmental efforts focus on applying well-established principles in innovative ways to ensure that the HCS computing facilities continue to serve the needs of the Health Sciences at the University of Minnesota. The major thrust of these efforts has, in the past year, been to bring Phase 1 of the General Communication System (GCS) to operational status on the HCS PDP-12. This system forms the central part of the HCS computer network development which was described in the proposal submitted in 1970 and discussed further in the annual report submitted in October of 1971. This section presents, the major goals of the computer network development, the status of the system at this date, and the plans for the next year. Further detail is presented in the Budget Justification (Section III-D) and in the Detailed Description of Resource Projects (Section IV-A).

The HCS computer network is comprised of a communications system and a variety of terminal systems. In our terminology, a terminal system is any device or set of devices which attaches to the communication system. Thus the current set of terminal systems includes TTY's, a mini-computer, a graphics terminal and the CDC 3300 system. A design goal of the communications system is that it provides a means of switching messages between any pair of terminal systems on the network. Moreover, flexibility is maintained to allow a variety of line speeds and protocols. The block diagram of the current configuration (Figure 1) should indicate that we have been successful in meeting these goals.

The general goal in this effort is to provide access to a wide variety of computing resources in flexible ways to the Health Sciences. Taking a computer network approach was based on several considerations including:

1. Remote access to computing facilities is a need that has been demonstrated to exist and grow in the health sciences.
2. Mini-computers with an increasing performance/cost ratio continue to be developed.
3. Special very high powered computer systems continue to be developed which are, at least as far as health sciences is concerned, essentially one of a kind. Such facilities include the 360-91 system at UCLA and the ILLIAC IV system.
4. The technological problems associated with computer communication are, in general, being reduced.

These considerations led us to conclude that a computer network approach to computing in the health sciences was appropriate. Thus we see mini-computers becoming increasingly popular in many health science applications. In some of these applications, however, a need for access to more computing resources than could be conveniently or economically located in the laboratory will be apparent. In such cases, on-line access to other computing resources over a communication network could tend to reduce the net cost to the investigator while increasing his access to computing. Similarly, by eventually attaching the HCS network to other networks or centers, the totality of computing resources

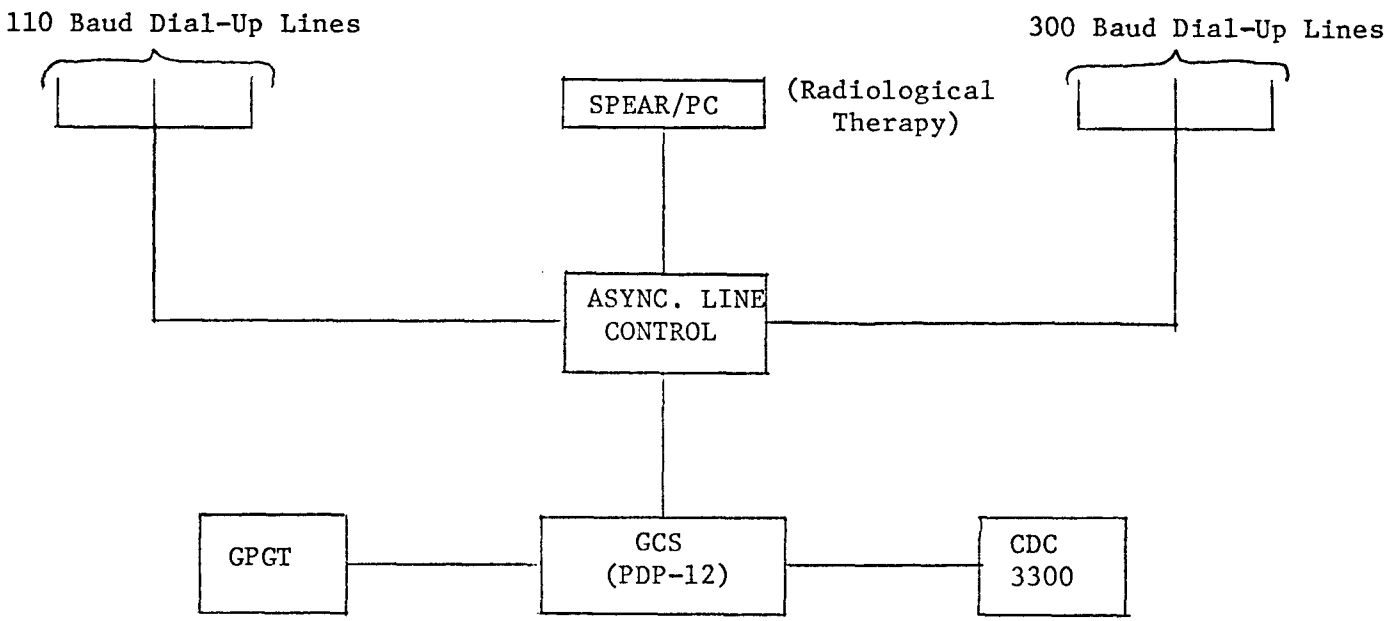

FIGURE 1

HCS NETWORK (Oct. 1, 1972)
(Phase 1)

GENERAL DESCRIPTION OF RESOURCE OPERATIONS

(including both hardware and software) available to local investigators would be increased while, at the same time, access to the HCS facilities would be provided to a wider group.

The facilities provided in Phase 1 are focused primarily on interactive use of the CDC 3300 system. To this end we have developed a subsystem on the 3300 called NETOS. NETOS is based on CRTOS and provides conversational access to essentially all features of the MASTER operating system as well as a text editing facility. As such, NETOS is used primarily from conversational terminals such as TTY's and TTY-like CRT's. However, its structure also allows communication with all other terminal types such as the GPGT and the SPEAR/PC mini-computer. The system, as pictured in Figure 1 has been operational since June, 1972.

Figure 2 shows the expansion of the HCS network planned for 1973. The dashed lines indicate systems which are under consideration but not definitely committed. As can be seen from figure, a major effort has been planned in the area of remote job entry terminals (RJE's). This effort is now just getting underway and we plan to implement the first RJE station early in 1973. The first RJE will communicate directly with the network. However, it is planned that to enable additional RJE stations a separate RJE terminal controller will be added as an integral part of the HCS network. The function of this controller is to reduce, as much as possible, the work load on the remainder of the network including the 3300 and to perform the necessary data conversions to allow a variety of RJE terminal types and communication protocols. The detailed specification of the RJETC is not complete but a further discussion appears in sections III-D and IV-A.

Figure 2 also shows the installation of a PDP-8E system to serve the communication switching function. This was approved in the proposal submitted in 1970 and is required to provide full day network service. The HCS PDP-12 will then be attached to the network as a separate mini-computer system. It will continue to function as the computer controller for the GPGT.

Synchronous communication facilities are also shown in Figure 2. These will find their primary use in communicating with mini-computers.

Other work completed in 1972 and planned for 1973 is discussed in section IV-A. This includes continued development of the backup system, work in performance evaluation, graphics, simulation, language development and mini-computer support.

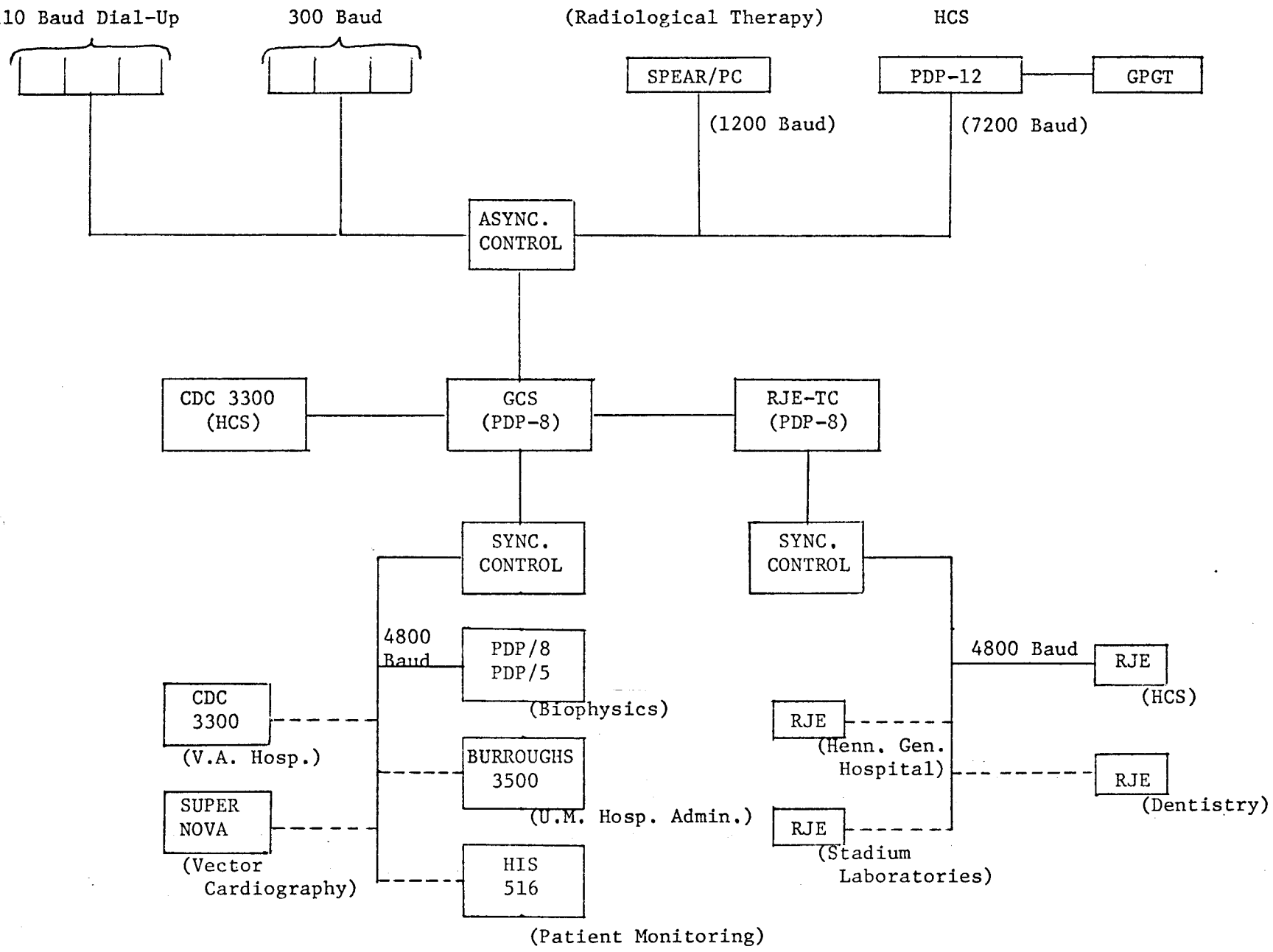

FIGURE 2 HCS NETWORK (Oct., 1973)
Phase 2

GENERAL DESCRIPTION OF RESOURCE OPERATIONS

II-A-9. Collaborative Research

The addition of collaborative research as a separate category in this Annual Report has aided in classification of the research projects using the facility resource supported by RR-267. It has been one of the goals of Health Computer Sciences at the University of Minnesota to encourage the use of computer technology in an expanding group of health-related research projects. Some of these have involved investigators in Health Computer Sciences in a collaborative fashion during the inception of the research program. It has been our intent to offer partial support to such programs until they became able to attract their own grant funds. In most instances, members of the facility staff were so involved that they have continued with these collaborative projects after they became funded by other sources. Collaborative research projects allow the development of new applications of the technological expertise which the Health Computer Sciences has to offer. As this has evolved, new collaborative projects have been started and older ones terminated or moved to services as user applications.

During the last year several major collaborative studies have been funded. Particular note should be made of three of these. The largest involves the collaborative efforts of Dr. Lael Gatewood and Dr. Marcus Kjelsberg, the Director of the Biometry Division of the School of Public Health. They have been awarded a contract by the National Heart Lung Institute for the Data Coordinating Center for a large multi-institutional clinical study originally entitled Multiple Risk Factor Intervention Trial. In the future, this program will also make use of the applications programming and computer services of the facility.

A second new collaborative program to receive federal funding builds upon Dr. Richard Moore's expertise in the area of cell membrane transport. Dr. Moore, in collaboration with Dr. Bo Crabo in the Animal Science Department, has been awarded an NIH grant to apply biotechnology to studies of sperm maturation. The third collaborative project to receive new funding involves studies directed by Dr. Robert Isaacson of the School of Dentistry. He, in collaboration with Mr. Bruce A. Boraas, has received a grant from the National Dental Institute to study mandibular function.

Future collaborative studies as yet unfunded by external sources have been initiated. One group involves Dr. Richard Moore, Dr. Kurt Amplatz of the Department of Radiology, and Dr. Wolfgang Giloi of the Department of Computer, Information and Control Sciences, who plan to apply automated data processing techniques to x-ray film analysis. Another group of collaborative projects will involve Dr. Claus E. Liedtke and several laboratories processing on-line data, particularly those in electroencephalography and electrocardiography. Additional collaborative studies are under discussion with a number of other groups, but are still too premature to detail here.

Attention should also be drawn to four on-going collaborative research projects in which Health Computer Sciences staff are playing a major role. These projects, described in more detail in Section IV, are: the virus epidemic simulation program, the Minnesota Coronary Survey, the Coronary Revascularization Study, and the Menstrual and Reproductive History Project. Such projects are among the major ones, making use of the research resource in Health Computer Sciences at the University of Minnesota made possible by Grant RR-267.

GENERAL DESCRIPTION OF RESOURCE OPERATIONS

II-A-10. Summary of Services

As in 1971 when the major applications programming effort involved the finalized stages of a seven man-year effort in a health care mapping system, the 1972 major effort involved the finalizing stages of a five man-year effort for a production oriented automated Blood Bank System for the Area Chapter of the American Red Cross (see abstract, page). As in previous years, the Applications Programming staff maintained a high level of effort on approximately one hundred health research and health care delivery projects ranging from a few man hours to man years.

These staff members successfully absorbed a significant shift of programming effort in 1972. In past reporting periods, the FORTRAN language has been utilized in approximately ninety percent of their efforts. In 1972, approximately seventy-five percent of their efforts centered around the USASI COBOL language while approximately ninety percent of the projects were programmed in FORTRAN. While the number of health research programming tasks are predominantly scientific calculations, statistical analysis and mathematical manipulations, research investigators are moving toward an effective use of the computer resource in large health care data base and file management endeavors. This shift is complementary to the active movement of HCS computer resources into network capabilities and training, enabling individual investigators to communicate with the computer directly on short scientific calculations yet requesting applications programming staff to design, program and document more involved programming efforts in FORTRAN and the larger data base management systems in COBOL.

This staff continues to develop, modify and document general purpose packages for inclusion in the computer libraries available to all health sciences investigators utilizing the computer systems.

HCS computer operations continues to offer the health sciences community 24 hour computer service five days per week, with requests for specific usage available on weekends. More complete operations service in such areas as multiple part forms, data transmission and remote access via teletype and/or CRT and 7/9 track tape conversions have been significantly increased the latter part of 1972.

Tabulation services continue to augment computer operations. The group maintains tab equipment continuously available to users of the computer systems. In addition, the senior level tab operator has been trained and successfully been functioning as a computer operator when needed. As in computer operations, a dynamic flow of computer user supplies is maintained by the staff.

GENERAL DESCRIPTION OF RESOURCE OPERATIONS

II-A-11. Past, Present and Future

In this part of the Annual Report for the period 1 September 1971 through 31 August 1972, an attempt is made to present an historic overview of the development of the facility supported by RR-267 and to summarize important questions expected to arise in the near future. Original plans for a computer center dedicated to research and training in the health sciences at the University of Minnesota were developed during 1964 and 1965. The intervening years between that time and the present (1972) have witnessed major changes both in computer technology and in computer applications within the health related sciences. At the same time, the facilities and personnel of the biotechnology resource at the University of Minnesota have undergone major shifts in structure and function. All plans currently being considered for the future involve still further changes.

The activities of this research resource from its inception until mid 1969 concentrated on the development of a group of users in the health sciences interested in computer processing primarily in a batch mode. The years from 1969 to the present have seen a major growth and emphasis on remote terminal applications, including most recently graphics. This change has been accomplished while upgrading the quality of the pseudo-batch processing services and applications programming services provided. During the next five years, it is hoped that the as yet embryonic network activities will expand rapidly without a deterioration of the present services. Concomitantly, it is anticipated that there will be an increased focus on graphics and picture processing.

In spite of the changes noted in the preceding paragraph, the original goals and purposes proposed when applying for RR-267 have remained essentially unaltered. In today's terminology, these can be described as facilitating core research, collaborative research, biotechnology training, core systems development, and computer-related services. Initially, all of these were supported by the one grant from the Division of Research Resources. The facility at the University of Minnesota has completed the transition to support of the distributed cost of its service activities by the groups receiving the benefit of these services. In a similar vein, support for much of the training is now being received from University of Minnesota funds. Further major steps have been taken to transfer programs which started as collaborative research to their own support as rapidly as possible. The entire group of activities has remained viable as a unit since the combined cost was less than the sum of the costs of performing the individual functions independently. The facility has also proven viable because many of the programs initiated as core research and development have become user services and training adjuncts.

The facility and the Division of Health Computer Sciences have been strengthened and stabilized by its contacts with numerous other groups both at the University of Minnesota and in the surrounding health sciences community. Perhaps of particular interest to Biotechnology Resource personnel is our relationship with University of Minnesota's Clinical Research Center (also supported by the Division of Research Resources). This latter is illustrated by the abstract submitted by the CRC's director, Dr. F. Goetz, included in the user

abstracts of this annual report, describing one of the core research projects of the CRC.

The past year has seen a strengthening of the ties of Health Computer Sciences both to the Division of Biometry in the School of Public Health and to the Department of Computer, Information and Control Sciences in the Institute of Technology. These augmentations, primarily related to training but also with broad implications for the collaborative research programs, have been enabled by the dramatically increased support from University of Minnesota sources both by the Health Sciences and by the University of Minnesota's Computer Services. Ties also have been dramatically increased with the fellowship and intern program of the Department of Laboratory Medicine as discussed earlier in the subsection on Training.

In spite of these auspicious developments, numerous questions remain unanswered concerning the future. Most immediate is the need for added space. Also of major concern is Dr. Ackerman's desire for an extramural advisory committee which would help in evaluating present and proposed plans relative to national needs. The relationship of Health Computer Sciences to the rest of the Department of Laboratory Medicine requires further clarification. The need noted in earlier annual reports for technical and administrative coordination with the computer facility at the University of Minnesota's Hospitals remains.

Perhaps the most striking of the possible future changes may come about because of the planned creation of an organization called the Minnesota Educational Computer Consortium (MECC). This will probably involve all educational units in the State of Minnesota from elementary school through post-doctoral training, public and private, in a cooperative multi-network effort. Exactly what form this will take remains to be seen. However, it has been decided that in the initial implementation the Health Computer Sciences' CDC 3300 facility, since it is not directly linked to the CDC 6600 facility, will not become part of MECC. (It is anticipated that the link between Health Computer Sciences and the University Computer Services will, nonetheless, remain viable and may even be reenforced by a remote job entry port to the CDC 6600 system and MECC.) It is hoped by the organizers of MECC that it will expand in five to ten years to add other facilities and functions not initially included. Among these are three at the University of Minnesota; namely, the Administrative Facility, the University Hospitals Facility, and the Health Computer Sciences Facility. On the other hand, some health sciences faculty believe that there should be a separate effort in Health Computer Sciences.

It is the hope of all concerned that many of the major questions facing the Health Computer Sciences facility will be resolved during the next report period for RR-267. In the meantime, it is apparent that many past problems have been resolved and that the personnel of Health Computer Sciences have followed the approved plans of the last renewal proposal.

Grant: RR267-07
Activity: Core Research
Period Covered: 9/1/71 - 8/31/72

SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Use (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Ackerman, Eugene (with Laël Gatewood & George Molnar)	HCS	Blood Glucose Regulation	RR267	NIH	320,958	5.0	5.0	.2						2.2			
Ackerman, Eugene (with Alan Rector & Laël Gatewood)	HCS	BRANCHIT: A System for Branching Logic	RR267	NIH	320,958			7.0						75.0			
Diffley, Michael	HCS	System Maintenance	RR267	NIH	320,958			107.0		155.0				200.0			
Diffley, Michael	HCS	General Computing System (GCS)	RR267	NIH	320,958			4.0		545.0							
Diffley, Michael	HCS	HCS Network (NETOS)	RR267	NIH	320,958			31.0		160.0				25.0			
Diffley, Michael	HCS	CRT Operating System (CRTOS)	RR267	NIH	320,958			10.0						40.0			
Diffley, Michael	HCS	HCS BASIC	RR267	NIH	320,958			5.0						15.0			
Diffley, Michael (with E. Ackerman, Lewis Wolfenson)	HCS	MIMO: Minnesota Interactive Modeling Language	RR267	NIH	320,958			17.0						135.0			
Diffley, Michael	HCS	Mass Storage File Backup Run	RR267	NIH	320,958			93.0						60.0			
Diffley, Michael	HCS	Performance Measurement + Eval.	RR267	NIH	320,958	50.0											

Grant: RR267-07
Activity: Core Research
Period Covered: 9/1/71 - 8/31/72

SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Time (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL
Diffley, Michael	HCS	Graphics Terminal	RR267	NIH	320,958			4.0						10.0		
Gage, John (with L. Gatewood)	HCS	Diagnostic System for a Pediatric Renal Clinic	RR267	NIH	320,958			1.0						6.6		
Klee, George (with E. Ackerman & Arnold Leonard)	HCS	Computer Detection of Distorted Aortic Pressure Signals	RR267	NIH	320,958			6.7		15.0				15.7		
Johnson, Eugene	HCS	Multivariate Classification Algorithms	RR267	NIH	320,958	5.0	5.0	11.0								
Moore, Richard	HCS	Membrane Permeability	RR267	NIH	320,958	5.0	5.0	.6		3.5				15.8		
Phyo, Inchol (with E. Ackerman & John Rosevear)	HCS	Simulation & Resolution of Chromatographic Peaks	RR267	NIH	320,958	5.0	5.0	2.4								
Rector, Alan (with Eugene Ackerman)	HCS	MISER: A System for Automated Diagnosis	RR267	NIH	320,958	5.0	5.0	18.9						65.6		
		TOTAL FOR CORE RESEARCH				75.0	25.0	318.8		878.5				665.9		
		TOTAL PROJECTS			17											

Grant: RR267-07
Activity: Collaborative Research
Period Coverered: 9/1/71 - 8/31/72

SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Amplatz, Kurt (with Richard Moore)	Radiology/ HCS	Coronary Revascularization Study	HE-13998	NH/LI	53,000	5.0	5.0			.3				.2			
Crabo, Bo (with R. Moore & Dongyu Jin)	Animal Sciences/ HCS	Study of Sperm Maturation	HD-06695	NIH	45,942	5.0	5.0	.5						2.1			
Elveback, Lila (with E. Ackerman & L. Gatewood)	Mayo Clin/ HCS	Simulation of Virus Epidemics	GB 16164	NIH	35,640	105.0	5.0	35.6						119.3			
Frantz, Ivan (with L. Gatewood)	Medicine/ HCS	Minnesota Coronary Survey	HE09686-04	NIH	640,917	5.0	5.0	149.1						12.4			
Isaacson, Robert (with Bruce Boraas)	Dentistry/ HCS	Quantitation of Jaw Function	IR01 DE-03528-01	USDHA	14,658	151.5	5.0	.6						28.2			
Jacobson, Jim (with Lael Gatewood)	V.A. Hospital	Bilateral Comparison of Average Evoked Potentials				5.0	5.0	3.7						2.3			
Kjelsberg, Marcus (with L. Gatewood & Bruce Boraas)	Biometry/ HCS	Coronary Prevention Project Coordinating Center	72-2971-C	NIH-NHLI	199,405 (68,000 HCS)	50.0	50.0										
Moore, Richard	Rad./HCS	Heart Wall Contraction Pattern in Heart Disease Patients & Normal Subs.		U of M Grad School	2,500	5.0	5.0							25.0			

Grant: RR267-07
Activity: Collaborative Research
Period Covered: 9/1/71 - 8/31/72

SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				Core/Disk Storage Use (Give Units)	
												CPU (Min.)		Terminal Connect (Hrs)			
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Roger, Francis (with Ivan D. Frantz & L. Gatewood)	Medicine/ HCS	Serum LDH Evaluation	HE 09686-04	NIH	640,917	5.0	5.0	6.4									
Treloar, Alan (with E. Ackerman & L. Gatewood)	NIH-NICCHD/ HCS	Menstrual and Reproductive History	PH 43-65-1014	NIH	56,221	5.0	5.0	56.2									
			TOTAL COLLABORATIVE			341.5	95.0	252.1		.3				189.5			
			TOTAL PROJECTS		10												

Grant No. RR-267-07
Activity: User Projects
Period Covered: 9/1/71 - 8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				Core/Disk Storage Time (Core-Hrs.)	
												CPU (Min.)		Terminal Connect (Hrs.)			
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Alter, Milton	V.A. Hospital	Microcephaly and Macrocephaly Study	HDO 1507-06	NIH		5.0	5.0										
Anders, M.W.	Pharma-cology	Stereochemistry Of Microsomal Drug Metabolism		USPHS		2.0	2.0	.1						8.9			
Anderson, V. Elving	Col. Of Biologi-cal Sci..	Human Population Genetics	71-72	URT		2.5	2.0	1.0									
Badalich, J.B.	MPCA	Water Quality Sampling Program Data Storage				3.0	3.0	.3									
Baker, A.B.	Neurology	Biochemical Aspects Of Parkinson's Disease		Norwich Pharm.		5.0	5.0	.7									
Baker, A.B.	Neurology	Cerebrovascular Disease Study	NB-03364-9	USPHS	2,000 comp.	5.0	5.0	7.2									
Baker, Jovita	Anatomy	Insulin Immunoassay				5.0	5.0	.1									
Bandt, Carl L.	Dentistry	Experimental Grading and Proficiency in Dentistry				5.0	5.0	48.2						42.3			

Grant No. RR-267-02
Activity: User Projects
Period Covered: 9/1/71
8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Barber, Donald E.	Environ. Health	Radiation Health Specialist Training Grant	EC00055-11	EPA	54,000			.1									
Blackburn, Henry	Public Health	Co-Op Study of Drugs & Coronary Heart Disease	HE11898-05	USPHS	31,839	5.0	5.0	3.4									
Boraas, Bruce	HCS	Internal Account.	RR267	NIH	320,958	960.4		28.3						2.2			
Boraas, Bruce	HCS	Dev. of 1970 Census Data Base For the Health Sci. Comm.	RR267	NIH	320,958	5.0		2.2									
Boraas, Bruce	HCS	Appl. Programming	RR267	NIH	320,958	6185.2		61.6		8.0				108.3			
Boraas, Bruce	HCS	Prep. of Package Programs for Biometric Studies	RR267	NIH	320,958	5.0								88.3			
Boraas, Bruce	HCS	Remote Key-to-Tape System	RR267	NIH	320,958	5.5		11.2									
Borchert, John R.	CURA	State Land Use Mapping Study				5.0	5.0			.8							
Born, David O.	Health Ecology	Dental Info. Service Center	72-4272	NIH	174,901	5.0	5.0										
Born, David O.	Health Ecology	Comp. Dent. Health Manpower Services Project	University		600	2.0	2.0										

Grant No. RR-267-07
Activity: User Projects
Period Covered: 9/1/71 - 8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Born, David O.	Health Ecology	Dental Practice Location Decision Making				1.0	1.0										
Briggs, Peter	Psychia-tric Lab.	MMPI Box Form Scoring		Univ. Hosp.		136.8	20.0	.2									
Briggs, Peter	Psy. Lab.	MMPI Daily Runs		Univ. Hosp.		8.0	5.0	13.1									
Brudvig, Glenn	Bio-Med. Library	Library Subject Authority File				5.0	5.0	14.6									
Brudvig, Glenn	Bio-Med. Library	Bio-Med. Library Serials & Acquisi-tions System				5.0	5.0	121.8									
Butler, James	Dentistry	Temporomandibular Joint Syndrome		Grad. School		42.5	3.0	1.5						.1			
Carson, George A.	School of Pub. H.	Levels of Polycyclic Hydrocarbons in an Urban Atmosphere	70-2058	NIH-NCI	15,910	1.0	1.0										
Cole, Theodore	PM & R	Community Training Workshop For Spinal Cord Injury	RR267	NIH	320,958	1.0	1.0										

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL
Corman, John E.	M.D.H.	Minn. Dept. Health Clinical Chem. Study	FED 314.0 (PH)	PH	1,959.70	10.3	5.0	21.7								
Croatt, Lee	HCS	HCS Administration	RR267	NIH	320,958			.9								
Dietzman, Ronald	Surgery	Post Traumatic Pulmonary Insufficiency		PHS		1.0	1.0									
Dimick, David E.	Ind. Relations	Simulation of Human Performance Under Varying Reward Structures				1.0	1.0									
Dixit, P.K.	Anatomy	Enzymatic Determinations in Sub-microgram Quantities of Tissues	RR267	NIH	320,958	2.0	2.0	.1	.1							
Dunham, Earl W.	Pharmacology	Studies in Release and Vascular Effects of Prostaglandins	HE 08570	NIH		2.0	2.0	.1								
Ebert, Richard V.	Medicine	Hosp. Cost Survey in the Dept. of Medicine				10.0	5.0	.1								

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage									
						Consulting/ Programming (Hours)		Computer Mode							
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer			
												CPU (Min.)		Terminal Connect (Hrs.)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Engel, Rolf	Peds.	Direct & Indirect Calorimetry Of Newborns	HD04487-06	NIH	25,824	5.0	5.0	.7							
Fahs, Ivan	Ophthal.	Wisconsin Mapping System				268.3	204.8								
Fahs, Ivan	Research Co-Ordin.	Surgeons' Study	Private			1807.9	146.3	22.1		2.0					
Fahs, Ivan	Research Co-Ordin.	Virginia Physicians Study	Private			475.7	115.8	7.6							
Fisch, Robert	Peds.	Child Development Study	Ph43-68-9	NIH	190,000	10.0	10.0	13.4							
Folke, Lars EA.	Periodontics	Influence of Diet On Dental Plaque	71-2376	NIH	68,409	3.0	3.0	.2							
Foreman, Harry	C.P.S.	Sex & Family Life Attitudes of Coeds.				1.0	1.0								
Fowlks, W.L.	Opth.	Movement of Water & Solutes Across The Eye Lens	0705-5201	NIH	130,000	123.9	28.2	3.3						66.1	

Core/Disk Storage Time (Give Units)	
TOTAL	FREE

Grant No. RR-267-07
Activity: User Projects
Period Covered: 9/1/71 - 8/31/72

SECTION IIB
SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				Core/Disk Storage Time (Give Units)	
												CPU (Min.)		Terminal Connect (Hrs.)			
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Frenkel, Albert	Botany	Math. Analysis of Bacterial Photosynthesis Related Chemical Systems				5.5	5.0	1.7									
Garrard, Judith		Longitudinal Study of Curriculum	ME 00109-01 (s-1)	NIH	2,100	5.0	5.0	11.1						4.3			
Gobels, Frederick	VA Cardiology	Coronary Blood Flow	RR267	NIH	320,958	5.0	5.0	14.9	14.9	7.8	7.8			175.9	175.9		
Goetz, Fred	CRC	Clinical Research Center	RR00400	NIH	410,700	288.5	58.8	3.8									
Goldman, Anne	Biometry	Fitting of Contingency Tables	RR267	NIH	320,958	5.0	5.0	1.4	1.4					1.9	1.9		
Good, Robert A	Pathology	Collaborative Studies with Dr. Geo. Todaro	071-2261	NIH	245,581	28.5	25.0										
Gooder, Charles	Peds.	Budget Reports				5.0	5.0	2.9									
Graf, Carl	Honeywell	Medical X-Rays Using Color				12.8	10.3										

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL
Grant, Heather	Educ. Psyc.	The Level of Motivation of Learning Disabled & Normal Child, & The Level Of Motivation Of Their Mothers For Them	None	None		5.0	5.0									
Gurpide, Elio	OB & GYN	Double Isotope Perfusions	HD-05363-01	USPHS	90,620	5.0	5.0	3.0								
Hafner, Jack	Psychiatry	Adolescent Follow-Up Study				1.0	1.0									
Halpern, Daniel	Phys. Med	Studies on Hypertonia		USVRA		5.0	5.0	5.5		3.4						
Hanson, Russel F.	Medicine	Formation of Bile Acids in Man	AM 15077-03	NIH	35,000	5.0	5.0	.1						.8		
Hegre, O.D.	Anatomy	Scan Quantitation	HD 412	NIH	38,155	1.0	1.0									
Heistad, Gordon	Psyc. Res.	Patient Behavioral Index (Nurses Notes)				1.0	1.0									
Herbst, G.H.		Microspec 5	GM114	USPHS	100,416	9.5	5.0	2.1		5.1						

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Hiller, Robert	MSDH	Hospital Services Info. System				1083.8	5.0	24.9						1.1			
Hiller, Robert	MSDH	Vital Statistics Reports				666.3	6.1	93.1						.1			
Holman, R.T.	Bio-Chem Hormel Inst.	Mass Spectra Data	HE 08214-08	USPHS		9.1	5.0	.5									
Keenan, K.	Dent.	Ortho. Clinical Records				345.8	5.0	16.1	7.6					824.5	301.8		
Keenan, K.	Ortho.	Ortho. Billing System				118.5	6.8	5.8	2.5					8.5	7.2		
Keenan, K.	Dent.	Genetic Linkage in Brandywine Population	DE 00179-04	NIDR, NIH	60,000	5.0	5.0	.9									
Keys, Ancel	Pub.H.	Int'l. Heart Disease Epidemiology	HE 04697-12	USPHS	38,153	5.0	5.0	3.5									
Keys, Ancel	Physiological Hygiene	Function & Metabolism	HE 04997	NIH		5.0	5.0	.3									

Grant No. RR-267-07
Activity: User Projects
Period Covered: 9/1/71 - 8/31/72

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL
Keys, Ancel	Physiological Hygiene	T & K Coefficients	HE 04697	USPHS	60,641	7.0	5.0	2.0								
Kim, Y.B.	Microbio.	Molecular Weight Distribution		USPHS	22,000	11.0	5.0	.4								
Kjelsberg, Marc	Biometry	Life Table Tech.	RR267	NIH	320,958	5.0	5.0	.1	.1					.1	.1	
Kline, George E.		Population Changes				1.0	1.0									
Kottke, Frederick	PM & R	Rehabilitation Patient Registry	16-P56810/ 5-10	SRS		129.8	5.0	9.2								
Kottke, Frederick	PM & R	PM & R Staff Directory & Salaries	16-P56810/ 5-10	SRS		5.0	5.0	1.1								
Kottke, Frederick	PM & R	Patient Info. System	16/P56810 510	SRS	1.3 mil	21.0	5.0	188.1		10.7				1271.9		
Kronenberg, Richard	Medicine	Use of Xenon To Determine Regional Ventilation & Perfusion in the Lung		MRHA	7,500	1.0	1.0									
Kronenberg, Richard	Medicine	Effect of Loading on the Ventilation & Perfusion in the Lung		USPHS	15,768	1.0	1.0									

SECTION II B
SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Kubicek, W.G.	Phys. Med	Blood Flow Study	SRS-RT-2	LRS	1,000,-000+	1.0	1.0										
Lazarow, Arnold	Anatomy	Current Awareness Service	PH-43-67-663	NIAMD	27,096	5.0	5.0	86.6						87.3			
Levitt, Seymour	Ther. Radiol.	Therapeutic Radiology Research Dosimetry	CA05190-05	NIH		2.0	2.0	13.0						11.2			
Levitt, Seymour	Ther. Radiol.	Therapeutic Radiology Research Dosimetry	CA05190-05	NIH		24.0	2.0	8.6									
Lifson, Nathan	Physiology	Gut Models	AM06700-10	NIH	22,258	1.0	1.0										
Loewenson, Ruth B.	Neurology	Multiple Sclerosis Study	2R01-NS-060SS-06	PHS	29,866	6.7	6.7	.1									
Loewenson, Ruth B.	Neurology	Prevalence of Multiple Sclerosis in Various Communities	MMF-FSW-371	MMF		61.4	11.8	.3									
Loken, M.K.	Nuclear Medicine	Scintillation Camera-Clinical Studies	Univ. Hospitals			1.0	1.0	7.8									

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				Core/Disk Storage Time (Give Units)	
												CPU (Min.)		Terminal Connect (Hrs)			
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Loken, M.K.	Nuclear Medicine	Scintillation Camera - CBF				1.0	1.0										
Loken, M.K.	Nuclear Medicine	Scintillation Camera Development				1.0	1.0	.6									
Loken, M.K.	Nuclear Medicine	Scintillation Camera - Lune	HEI-3862-03	USPHS	1,300	1.0	1.0	23.8									
Lonnes, Perry	Environ. Research Corp.	Air Pollution Sampling Sampling Techniques	Private			5.0	5.0	.3									
Lykken, David	Psychiatry Research	Inhibitory Control of Sensation	MH18856-01	NIH	35,715	8.0	5.0			2.0							
Mannering, G.J.	Pharma-cology	Biochemical Pharmachology & Drug Metabolism	GM15477	NIH	339,946	10.0	5.0	1.2						37.7			
McHugh, Richard	Biometry	Continuing Education for Laboratory Personnel				5.0	5.0	1.2									
McHugh, Richard	Biometry	Biometry Consulting Laboratory				5.0	5.0	60.8						94.9			

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
McKhann, Charles	Surgery	Obstetrics & Surgery in Family Practice	Private			34.0	7.2	.2									
Meskin, L.H.	Dentistry	Group Interaction Analysis Class	RR-5322	USPHS	80,000	1.0	1.0										
Meskin, Lawrence	Dentistry	Group Evaluation				2.0	2.0	.1									
Meskin, Lawrence	Team	Team Management for Dental Students	DH08011-01A1	NIH	149,125	2.0	2.0										
Meyer, Maurice	Physiol.	Circulation in Teeth & Supporting Structures	DE2212-05	NIDR	21,500	5.0	5.0	4.6						21.0			
Moore, Vaughn	Radiation Therapy	Radiation Therapy Treatment Planning Programs on the PC/PDP12/CDC 3300	RR267	NIH	320,958	45.0	45.0	1.6	1.6					147.1	147.1		
Moore, Richard	Radiology	Evaluation of Myocardial Blood Flow Using Radioactive Xenon Clearance	RR267	NIH	320,958	5.0	5.0	.8	.8					18.9	18.9		
Moore, Richard	Radiology	Enhancement of X-Rays by Conversion to Color Pictures	RR267	NIH	320,958	1.0	1.0										

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Activity: User Projects
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SECTION II-B
SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Moore, Richard	Heart X-Ray	Dev. of Program for Diagnostic Radiology	RR267	NIH	320,958	5.0	5.0							94.0	94.0		
Moore, Richard	Radiology	Heart Wall Contractions in Heart Disease & Normal Subjects		Grad. School	2,500	5.0	5.0							25.0			
Nelson, Kenneth	Pharmaceutics	Physical Properties of Drugs in Pharmaceutical Systems				2.0	2.0	.4									
Nerase, Bruce	Beissel Corp.	FOCAL Experimentation	Private			1.0	1.0										
Nolan, Dennis	Grad. School Res. Cntr.	Conversion of 360 Tapes to CDC 3300	State			10.5	5.0			3.7							
Olin, John	Minn. Pollution Control Agency	Analysis of Air Pollution in Minn.	State			5.0	5.0	62.7						9.8			
Ostenby, Vernon	St. Paul Red Cross	St. Paul Regional Red Cross Blood Inventory Control				3974.2	372.8	74.8						4.8			

Grant No. RR-207-07
Activity: User Projects
Period Covered: 9/1/71 - 8/31/72

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Pflug, Irving	Environ. Health	Spacecraft Sterilization	NGL 24-005-160	NASA	150,000	1.3		1.9		.6				151.1			
Phyo, Inchol	HCS	Simulation & Resolution of Overlapping Chromatographic Peaks				1.0	1.0										
Portoghese, Philip	Pharmacology	Multiple Regression Analysis of Structure-Activity Relationships of Drugs	RR-05634-03	USPHS	33,637	1.0	1.0										
Pozos, Robert	UMD - Medical Education Program	Frequency & Phase Analysis of Parkinsonian Tremor				10.0	5.0			10.0							
Proshek, John	Dentistry	Student Interaction Analysis				5.0	5.0	.2									
Proshek, John	Speech-Communication	Speech Small Group Interaction				5.0	5.0	.3									

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Redman, Robert S.	Dentistry	Diurnal Variations in Feeding Habits Parotid Glands & Blood Corticosteroids of Rats During Their Postnatal Development	DE 03330-02	NIH	7,300	1.0	1.0										
Rios, Angie	Surgery	Tumor Immunology	CA-11605-03	NIH	49,000	74.5	10.0	1.2						.7			
Robertson, D.	Anatomy	Mortuary Science Inventory				6.9	6.9	.1									
Rosenberg, Pearl	Physical Medicine & Rehab.	Medical Students Study		NFME	36,360	1.0	1.0										
Rubin, Rosalyn	Special Education	Educ. & Behavioral Sequelae of Prenatal & Perinatal Conditions	OEG-0-9-332189-4533	HEW	267,937	1.0	1.0	2.2									
Rupprecht, Paul	Health Service	Student Health Screening				253.6	38.3	1.3									
Samuels, Joanna	Dentistry	Socioeconomic Comparisons of Dental Behaviors	DH00183-01	PHS	18,111	1.0	1.0										

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage									
						Consulting/ Programming (Hours)		Computer Mode							
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer			
												CPU (Min.)		Terminal Connect (Hrs)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Sauls, Henry	Pediatrics	Lab Reports - Catecholamines		T.C. Diabetes Assoc.	1,600			.1							
Sayles, Ethel	Mpls. Health Dept.	Vital Statistics				5.0	5.0	.5							
Schmitt, Otto	Biophysics	Analysis of Time Coherent Cardio-vascular Data	HE0757-08	NIH	35,784	1.0	1.0								
Schuman, Leonard	Epidemi-ology	Cancer Mortality Center	PH43-66-919	NIH	243,981	17.0	2.0	1.1							
Shapiro, F.	Minn. Med. Res. Found.	Community Dialysis Center	HSM 110-70-418	HEW	89,000	442.1	15.8	144.6						7.5	
Siegel, Leighton	Otolaryn-cology	Nat'l Registry for Idiopathic Sudden Deafness		John A. Hartford Founda.	50,400	562.3	6.2	3.1							
Spyker, Joan	Anatomy	Methylmercury	FSW-14-71	MMF	7,500	3.0	3.0	.1							
St. Louis, Philip	Laboratory Medicine	Laboratory Veni-puncture System				2.0	2.0	.1							

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Stebbings, James	Epidemiology	Cardiorespiratory Changes in an Employed Population	EC 00547-01	PHS	4,720	205.3	18.6	12.3									
Stebbings, James	Epid.	Respiratory	EC 00547-01	PHS	4,720	6.0	6.0	10.8									
Sundar, Satya	Minn. Sys. Research	Retired Persons Data				4.0	1.0										
Takemori, Akira	Pharmacology	Parallel Line Assay	2PHGM 15477	NIH	372,342	1.0	1.0	.1									
Taylor, Henry	Physiol. Hygiene	Ober Charitable Trust Fund for Cardiovascular Research	Private		Unrestricted	5.0	5.0	.7									
Torres, Fernando	Neurology	Visual Evoked Response & Carotid Compression	RR267	NIH	320,958	611.1	11.4										
Torres, Fernando	EEG & Clin. Neurology	Visual Evoked Response & Carotid Compression	RR267	NIH	320,958	1.0	1.0	7.1	7.1								

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SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL
Wangensteen, O.D.	Physiology	Gas Transport Across the Blood Gas Barrier in the Mammalian Lung		Grad. School	2,000	1.0	1.0									
Ward, Dixon	Otolaryngology	The Determination of Susceptibility to Hearing Loss	NS 04403	PHS	22,929	2.0	2.0	.3								
Warwick, Warren	Pediatrics	Normal Pediatric Anthropometic Data		Nat'l Cycstic Fibrosis Research Found.	12,000	12.7	11.1									
Warwick, Warren	Peds.	Cystic Fibrosis Project		NCFRF	11,500	5.0	5.0	5.8								
Wetlaufer, Donald B.	Biochemistry	Structural Principles in Globular Proteins		Grad. School	2,550	3.0	3.0	.1								
Woodward, Clare	Lab. Med.	Hydrogen Exchange Kinetics Simulation	CA18466	NIH	15,000	5.0	5.0	.6								

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SECTION IIB
SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage										
						Consulting/ Programming (Hours)		Computer Mode								
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Use (Give Units)
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL FREE
Yonas, Albert	Inst. for Child Develop.	Development of Perceptual System in Its Relation to Cell-Mediated Immunity	HD-01136	NIH	127,279	5.0	5.0	.1								
Youdin, Said	Pediatrics	Thymus Dependent Lymphoid System & Its Relation to Cell-Mediated Immunity		Arther-itis Found.	2,750	6.3	5.0							1.3		
			TOTAL USERS			19,444.0	1557.9	1322.5	36.1	54.1	7.8			3317.6	746.9	
			TOTAL PROJECTS		141											

Grant: RR267-07
Activity: Training
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SECTION III-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer				Core/Disk Storage (Core Units)	
			I.D. No.	Agency	Current Annual Amt.							CPU (Min.)		Terminal Connect (Hrs.)			
						TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Abbe, Ernst C.	Botany	Botany 3-990W	RR267	NIH	320,958	5.0	5.0	.1	.1								
Bartsch, Glenn E.	Biometry	PubH.-466 Advanced Biometric Meth. II	RR267	NIH	320,958	5.0	5.0	.2	.2								
Beimborn, Donald A.	Ecol. & Behav. Biology	Comparative Renal Structure & Function in Wild & Domestic Mus Musculus	RR267	NIH	320,958	5.0	5.0	.1	.1								
Bergh, George (with George Klee & L. Gatewood)	Anesthesiology	Aorta Model Studies	RR267	NIH	320,958	5.0	5.0	1.0	1.0	9.7	9.7						
Boen, James R.	Pub. H.	Biom. Consult. Sem.	RR267	NIH	320,958	5.0	5.0	1.1	1.1								
Burkart, John A.	Biometry	Est. or Risk in Alcohol Patients Following Treatment	RR267	NIH	320,958	5.0	5.0	.1	.1								
Das Gupta, Prithwis	Biometry	Math. Demography Pub.H. 5-411	RR267	NIH	320,958	5.0	5.0	.1	.1					.3	.3		
Das Gupta, Prithwis	Biometry	Math. Demography Pub.H. 5-412	RR267	NIH	320,958	5.0	5.0	.2	.2								
Gatewood, Lael	HCS	Training Support Activities	RR267	NIH	320,958			.5	.5					13.4	13.4		

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Activity: Training
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Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage									
						Consulting/ Programming (Hours)		Computer Mode							
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer			
												CPU (Min.)		Terminal Connect (Hrs.)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Gatewood, Laël	HCS	Biomedical Learning Center						.4	.4					22.6	22.6
Gatewood, Laël	HCS	Undergraduate Summer Seminar						3.2	3.2					11.3	11.3
Gatewood, Laël	HCS	Medical Student Instruction	RR267	NIH	320,958			.3	.3					17.5	17.5
Giganti, Joseph R.	Biophys.	Optimization of Spatial Dose Distribution in External Beam Radiotherapy	RR267	NIH	320,958	5.0	5.0	1.4	1.4						
Heath, Richard D	Biometry	Biomedical Computing III	RR267	NIH	320,958	5.0	5.0	4.5	4.5					22.1	22.1
Heath, Richard D.	Biometry	Biomedical Computing I & II	RR267	NIH	320,958	10.0	10.0	13.8	13.8					29.3	29.3
Holz, Howard	Biometry	Multiple Regression on Air Pollution Weather Data	RR267	NIH	320,958	5.0	5.0	.8	.8					.1	.1
Hegre, Orion D.	Anatomy	Test Grades	State			5.0	5.0	.2	.2						
Jeffries, Dorothy	Biometry	Topics in Biometry Pub.H. 5-470	RR267	NIH		5.0	5.0	.2	.2						
Jeffries, Dorothy	Biometry	Topics in Biometry Pub.H. 5.470	RR267	NIH		5.0	5.0	.5	.5						

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SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs.)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Jin, Donggyu	Biophysics	Methods of Anal. of Transport Properties of the Membrane	RR267	NIH	320,958	5.0	5.0	.8	.8								
Johnson, Eugene	Biometry	Biom. Grad. Students	RR267	NIH	320,958	5.0	5.0	.4	.4								
Johnson, Eugene	Biometry	Biom. Misc. for Unanticipated Class Projects	RR267	NIH	320,958	5.0	5.0	5.3	5.3								
Keenan, Kathleen	Biometry	Biom. in Clinical Studies I	RR267	NIH	320,958	5.0	5.0	.7	.7								
Kim, John S.	Biometry	Multiple Regression Anal. of Air Pollution Data	RR267	NIH	320,958	5.0	5.0	.3	.3								
Mattson, Peter	Botany	Math. Anal. of Bacterial Photosynthesis & Related Chemical System	RR267	NIH	320,958	5.0	5.0	1.1	1.1								
McCurdy, Ross F.	Environ. Health	Sydney Air Pollution Study	RR267	NIH	320,958	5.0	5.0	.5	.5								
McIntyre, Judith	Zoology	Biology & Behavior of the Common Loon	RR267	NIH	320.958	5.0	5.0	.2	.2								

Grant: RR267-07
Activity: Training
Period Covered: 9/1/71 - 8/31/72

SECTION - IIB

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage									
						Consulting/ Programming (Hours)		Computer Mode: Batch Processing Computer CPU (Hrs.)		Computer Mode: Dedicated Computer (Hrs.)		Computer Mode: Time Sharing Computer: CPU (Min.)		Computer Mode: Time Sharing Computer: Terminal Connect (Hrs.)		Computer Mode: Time Sharing Computer: Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Menon, K.P.S. (with Mike Diffley)	HCS	Extensions of Interactive Graphics	RR267	NIH	320,958	5.0	5.0			16.3	16.3						
Moore, Alan	Biom/HCS	Automated Calc. of Xenon Clearance	RR267	NIH	320,958	5.0	5.0							208.5	208.5		
Morrill, John G.	Environ. Health	Exponential Solution to a Non Linear Regression Prob.	RR267	NIH	320,958	5.0	5.0	.1	.1								
Nelson, Rodger	Botany	Structure, Function & Dev. in Phodospirillum Molischianum	RR267	NIH	320,958	5.0	5.0			1.2	1.2						
Tucker, Robert	Biophys.	Magnetic Field Calculations	RR267	NIH	320,958	5.0	5.0	2.4	2.4								
Wolfenson, Lewis (with E. Ackerman & L. Gatewood)	Biometry	Computer Systems for Cardiac Catheterization	RR267	NIH	320,958	5.0	5.0	6.3	6.3					124.0	124.0		
Yu, Hong-Jen	Biometry	Plan B Paper	RR267	NIH	320,958	5.0	5.0	.3	.3								
		TOTAL TRAINING				155.0	155.0	47.1	47.1	27.2	27.2			449.1	449.1		
		TOTAL PROJECTS			34												

Grant No. RR267
Activity: Non-Health Projects
Period: 9/1/71 8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode									
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer					
												CPU (Min.)		Terminal Connect (Hrs)		Core/Disk Storage Time (Give Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Berg, David C.	Public Health	SPH Administrative Reporting				5.0	5.0	2.4									
Brekhus, E.H.	Library School	Intro. of Computer Timesharing Systems to Library School Students	330001-0402-320	Office of Educa.		5.0	5.0							42.4			
Dais, Jack L.	Aerospace Engineer.	PRT	3-71	URT		6.3	5.0			1.3							
Dais. Jack L.	Aerospace Engineer.	PRT	3-71	URT		9.5	6.8										
Drehmel, E. Wayne	Med.School Admin.	Comprehensive Budget	CH-1074-04	PHS		5.0	5.0	.4									
Helmick, D. Cary		Interactive Solutions for Equations & Probability Problems	Private			5.0	5.0	.2									
Hummel, Thomas J.	Coll. of Ed. Student Personnel Office	College of Education Record System				5.6	5.0			.3							
Lawver, J.E.	Inst. of Tech.	Automatic Control of Mineral Grinding Circuits				14.0	5.0										

Grant No. RR267
Activity: Non-Health Projects
Period: 9/1/71 8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage									
						Consulting/ Programming (Hours)		Computer Mode							
								Batch Processing Computer CPU (Hrs.)		Dedicated Computer (Hrs.)		Time Sharing Computer			
												CPU (Min.)		Terminal Connect (Hrs)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Lund, Oscar M.	Agri. & Appl.Econ.	Rural Development				6.8	5.0			.8				.1	
Maiwurm, Charles	Student Counsel. Bureau	Statewide Testing Program				5.0	5.0	45.1							
Martin, F.B.	Inst. Agri.	Yield Loss-Wheat Rust		Hatch Fund	27,000	5.0	5.0	.4							
McCollister, R.O.	Med. School	Class Scheduling & Student Profiles	CH1074	PHS		5.0	5.0	5.9						28.5	
Naugle, David L.	Col. of St.Thomas Comp.Cntr.	Convert 9 Track Tape to 7 Track	Private			5.5	5.0			.6					
Nelson, Rodger A.	Botany	Anal. of Far-Red Absorb Bands in Photosyn Bacteria	RO1 A102218-14	NIH	48,300	37.5	5.0	1.3		2.7				56.6	
Rosevear, John	Kallstad Labs.	Kallestad Computer Education	Private			6.0	6.0							48.4	
Rosevear, John	Kallestad Labs.	Document Index	Private			13.3	7.9	.2							
Staples, Sandra	Civil Eng.	Program in Urban Transportation Library Index Listing		URT		5.5	5.0	1.3							

Grant No. RR267
Activity: Non-Health Projects
Period: 9/1/71 8/31/72

SECTION II-B

SUMMARY OF COMPUTER RESOURCE USAGE

Investigator	Dept. Inst.	Project Title	Direct Grant or Contract Support			Amount of Usage											
						Consulting/ Programming (Hours)		Computer Mode: Batch Processing Computer CPU (Hrs.)		Computer Mode: Dedicated Computer (Hrs.)		Computer Mode: Time Sharing Computer: CPU (Min.)		Computer Mode: Time Sharing Computer: Terminal Connect (Hrs)		Computer Mode: Time Sharing Computer: Core/Disk Storage Time (Core Units)	
			I.D. No.	Agency	Current Annual Amt.	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE	TOTAL	FREE
Willard, Ralph	Admin. Data Process.	Program Budget				6.0	5.0			.8							
			NON-HEALTH TOTALS			151.0	95.7	57.2		6.5				176.0			
			TOTAL PROJECTS		18												
		GRAND TOTALS	NUMBER OF PROJECTS														
		1. Core Research		17		75.0	25.0	318.8		878.5				665.9			
		2. Collaborative		10		341.5	95.0	252.1		.3				189.5			
		3. User Projects		141		1944.0	1557.9	1322.5	36.1	54.1	7.8			3317.6	746.9		
		4. Training Proj.		34		155.0	155.0	47.1	47.1	27.2	27.2			449.1	449.1		
		5. Non Health Proj		18		151.0	95.7	57.2		6.5				176.0			
		6. Down Time						710.0						5.0			
		GRAND TOTALS RESOURCE USAGE		220		2166.5	1928.6	2707.7	83.2	966.6	35.0			4803.1	1196.0		

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Serial No.	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
BUSINESS DATA PROC. MOD.	CDC	133	3312	3/ 1/70	5/ 1/70	$1,200		RR-267
FLOATING POINT MODULE	CDC	52	3310	7/11/67	9/ 1/67	20,085**		
MULTI-PROG. MODULE	CDC	27	3311	7/11/67	9/ 1/67	19,680**		
CARD READER CONTROLLER	CDC	163	3447	7/11/67	8/ 9/70	12,000		SPECIAL GRANT
CARD READER	CDC	595	405	7/11/67	9/ 1/67	23,500		FR05385
DISK DRIVE CONTROLLER	CDC	44	3553	6/15/70	7/27/70	***(**)		
MULTIPLE DISK DRIVE	CDC	527	841	6/15/70	7/27/70	***(**)		
MULTIPLE DISK DRIVE	CDC	544	841	6/15/70	7/27/70	***(**)		
MULTIPLE DISK DRIVE	CDC	2567	841	3/15/72	4/ 5/72	41,833		RR-267
PRINTER CONTROLLER	CDC	209	3555-1	5/ 1/70	5/15/70	27,000**		
TRAIN PRINTER	CDC	209	512-1	5/ 1/70	5/15/70	45,000**		
TRAIN CARTRIDGE	CDC		595-3	5/ 1/70	5/15/70	3,000**		
TAPE CONTROLLER	CDC	33	3127	3/21/67	9/ 1/67	14,500		FR05385

- Scheduled to be replaced with a Model 3228 - 10/1/72

*** $124,000 net total for these items; (**) These items are also included in the figure ($274,000) indicated on preceding page.

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Serial No.	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
TAPE TRANSPORT	CDC	131	601	2/21/69	2/ 1/70	$ 8,100**		
			- Scheduled to be replaced with 604's 10/1/72					
TAPE TRANSPORT	CDC	278	601	2/21/69	2/ 1/70	8,100**		
			- Scheduled to be replaced with 604's 10/1/72					
TAPE TRANSPORT	CDC	188	601	3/21/67	9/ 1/67	13,500		SPECIAL GRANT
			- Scheduled to be replaced with 604's 10/1/72					
TAPE TRANSPORT	CDC	303	601	3/21/67	9/ 1/67	13,500		SPECIAL GRANT
			- Scheduled to be replaced with 604's 10/1/72					
PLOTTER AND CONTROLLER	CDC	45	3293	5/26/66	9/ 1/67	7,200		SPECIAL GRANT
CRT CONTROLLER	CDC	120	3290-C	7/11/67	9/ 1/67	19,650		SPECIAL GRANT
CRT DISPLAY	CDC	482	211	7/11/67	8/21/67	4,000		FRO5385
MAGNETIC TAPE CONTROLLER	CDC		3228					
TAPE TRANSPORT	CDC		604					
TAPE TRANSPORT	CDC		604					
TAPE TRANSPORT	CDC		604					
TAPE TRANSPORT	CDC		604					

Scheduled to replace 601 tape transports 10/1/72

32,835†

† The purchase price for these items will be added to the amount we owe Control Data Corporation which is included in the total funding request through 1974.

REPLACEMENT OF MODEL 601 MAGNETIC TAPE DRIVES WITH MODEL 604's

B. A. Boraas, Assistant Director for Services

September 15, 1972

Within the current fiscal year the CDC 3300 computer tape system has been upgraded from four CDC model 601 tape drives and associated controller to four CDC model 604 tape drives and associated controller.

Two of the model 601's were installed in 1966 and two more were installed in 1967. These tape drives have a pinch roller feed, maximum speed of 37½ inches per second (IPS), and the capability of reading and writing at only two densities - 200 bits per inch (BPI) and 556 BPI. Furthermore, there is no backward read capability.

While the reliability of the tape units had degenerated significantly since installation, HCS has continued to experience decreasing maintenance capabilities on the part of the manufacturer due to the limited number of 601's in the field.

The replacement model 604's have a vacuum feed, a maximum speed of 75 (IPS) and a read/write capability at three densities - 200 BPI, 556 BPI, and 800 BPI, as well as backward read.

Higher reliability is expected of the model 604's together with more up-to-date maintenance on the part of the manufacturer.

The 604's are more compatible with the model 841 disk drives, data transfer approaches channel speed limitations, and vacuum feed is less detrimental to tape life expectancy than roller feed.

HCS currently maintains computer services involving over 1500 magnetic tapes - double the number of user tapes of two years ago.

Faster data transfer rates, higher (more common) tape densities, more balanced computer system, significantly increased demand and usage, higher reliability, improved maintenance, and decreased wear on tapes all led to the decision to replace the 601's with 604's.

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Type	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
PDP-12 Computer System	Digital Equip. Corp.		383	7/25/70	9/4/70	$89,665		Grant RR-267

Consisting of the following items numbered 1-32:

1) PDP-12A LINC System, 4096 Word 12 Bit, 1.6 μs Core Memory
2) MC12 Memory Extension Control and 4096 Word 12 Bit Memory
3) MM81 8192 Word Memory
4) RF08 Disk Control
5) RS08 Disk File
6) RS08 Disk File
7) PC12 Paper Tape Reader/Punch
8) TC12-8 DEC tape/LINC Tape Conversion Option
9) KE12 Automatic Multiply/Divide
10) KW12 Real Time Clock
11) H-961C Equipment Bay
12) H-961C Equipment Bay
13) H-961A Equipment Bay
14) BA12 Peripheral Expander
15) DW08A I/O Bus Level Converter
16) DC02F Line Multiplexer
17) DC02G Line Interface
18) DC02G Line Interface
19) DC02G Line Interface
20) DC02G Line Interface
21) DC02G Line Interface w/ M405 Clock M216 Divider — 7/1/71 — 7/15/71 — $500 / 100 / 50 — Radiology

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Serial No.	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
3300 BASIC PROCESSOR	CDC	81	3304	7/11/67	9/1/67	$103,960**		
COMMUNICATIONS CHAN.	CDC	35	3307	7/11/67	9/1/67	5,423**		
COMMUNICATIONS CHAN.	CDC	368	3306	7/11/67	9/1/67	3,700**		
COMMUNICATIONS CHAN.	CDC	378	3306	7/11/67	9/1/67	3,700**		
COMMUNICATIONS CHAN.	CDC	291	3306	7/11/67	9/1/67	3,700**		
COMMUNICATIONS CHAN.	CDC	400	3306	7/11/67	9/1/67	3,700**		
COMMUNICATIONS CHAN.	CDC	478	3306	4/ 1/69	6/1/69	4,987**		
STORAGE MODULE 16K	CDC	143	3302	7/11/67	9/1/67			
STORAGE MODULE 16K	CDC	157	3302	7/11/67	9/1/67			
STORAGE MODULE 16K	CDC	347	3302	8/ 2/68		$186,920**		
STORAGE MODULE 8K	CDC	71	3309	3/29/68	5/15/68			
STORAGE MODULE 8K	CDC	72	3309	3/29/68	5/15/68			
STORAGE MODULE 16K	CDC		1112	1/ 1/72				RR-267
STORAGE MODULE 16K	CDC		1115	1/ 1/72		103,720		RR-267

** $274,000 were supplied from U of M Capital Equipment. The remainder was paid for by RR-267 funds.

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Type	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
PDP-12 Computer System (continued)								
22) BC01A-50 Modem Interface								
23) BC01A-50 Modem Interface								
24) BC01A-50 Modem Interface								
25) BC01A-50 Modem Interface								
26) BC01A-50 Medem Interface						100		
27) KT12 Time Sharing Modification								
28) DM01 Direct Memory Access Multiplexer								
29) TSS 12 Time Sharing Software								
30) Model 10 WANG 7 Channel Tape Transport 37.5 IPS			#145	9/13/70	--	4,200		Hospital
31) Model 10 WANG 9 Channel Tape Transport 37.5 IPS			#133	9/13/70		4,200		Hospital
32) 5091 Tape DATUM Controller				9/13/70		5,300		Hospital
33-ASR-TBE Teletype with Wheel & Handle Kit			240730	8/ 4/70	9/ 4/70	995 50		RR-267
33-ASR-TBE Teletype with Wheel & Handle Kit				8/ 4/70	9/ 4/70	995 50		RR-267
33-ASR-TBE Teletype with Wheel & Handle Kit			359644	1/15/72	2/15/72	1,092		Graduate School
33-ASR-TBE Teletype with Wheel & Handle Kit			369649	1/15/72	2/15/72	1,092		Graduate School
33-ASR-TBE Teletype with Wheel & Handle Kit			357450	1/15/72	2/15/72	1,092		Graduate School

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Type	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
701A Acoustic Coupler	OMNITEC		70654A	8/4/70	9/4/70	$ 325		RR-267
701A Acoustic Coupler	OMNITEC		73904A	8/4/70	9/4/70	325		RR-267
120C6 Modem	ASTROCOM		0116	7/1/71	7/15/71	450		Radiology
701A Acoustic Coupler	OMNITEC		76916A-4	1/15/72	2/15/72	200		Graduate School
701A Acoustic Coupler	OMNITEC		76922A-4	1/15/72	2/15/72	200		Graduate School
701A Acoustic Coupler	OMNITEC		76925A-4	1/15/72	2/15/72	200		Graduate School
113B Data Cabinet with 6 each 113BL1 Data Set	Bell Telephone			8/21/72	9/1/72	$ 175 install $17.50/month each		RR-267
Intercomputer Coupler (ICC) Consisting of following items numbered 1-6:								RR-267
1) 2 each 200 ft. cables, 61 pin connectors	CDC		12234716	1/29/71		$ 528		
2) Misc logic card assemblies hardware and cables	Digital Equip. Corp.					$2,894		
Spare cards				9/15/71		336		
3) Power Supplies	TECHNI-POWER							
LAC 6.0-4.5						55		
LPC 15.0-2.0						55		
4) Intercom Ports, DHCS-built						20		

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Type	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
ICC Items Continued								
5) Power Supplies SCR 25-5, Transistor Devices SCR 25-5, Transistor Devices								
6) Power Supply, LMCC 4P5Y-3005								
Graphics Terminal	Bioengineering Resources Center, U of Iowa	315C	8	10/15/71	2/ 1/72	--	--	--
Graphics Terminal Interface Consisting of the following items numbered 1-4								
1) Power Supply	Universal Electronics	W5-5	7512			$ 54		RR-267
2) Power Supply	"	W15-1	7513			36		RR-267
3) Misc. Logic cards & hardware	Digital Equip. Corp.					$1,353		RR-267
4) Misc. parts	--					277		RR-267
8K x 12 bit Semiconductor Memory	Signal Galaxies	SGMAP/I	Scheduled to be installed 10/16/72			$4,050		RR-267

RESOURCE EQUIPMENT LIST

EQUIPMENT LOCATED IN MAIN RESOURCE AREA

Description/ Identification	Manufacturer	Serial No.	Model No.	Date installed	Date Accepted	Purchase Price	Annual Rent	Source of Funds
KEYPUNCH	IBM	39252	029	2/ 5/70	2/ 6/70		$ 831	RR-267
KEYPUNCH	IBM	11944	029	2/ 5/70	2/ 6/70		831	RR-267
KEYPUNCH	IBM	95015	026	11/24/69	11/24/69		576	RR-267
KEYPUNCH	IBM	93048	026	4/ 1/66	4/ 1/66		576	RR-267
VERIFIER	IBM	22808	059	2/ 5/70	2/ 6/70		918	RR-267
INTERPRETING KEYPUNCH	IBM	K1808	029	4/ 7/71	4/ 8/71		1,198	RR-267
KEY-TAPE	Singer	10534	4311	12/28/71	12/28/71		2,880	RR-267
KEY-TAPE	Singer	10535	4311	12/28/71	12/28/71		2,880	RR-267
REPRODUCING PUNCH*	IBM	28964	514	3/ 1/66	3/ 1/66	$8,500		Rhodes Acct 07-66
DELEAVER	Moore	5878	283A	7/24/72	7/24/72	395		RR-267

* Purchased by Biometry Division; maintained by Health Computer Sciences

SUMMARY OF PUBLICATIONS

In November, 1970, all users were asked to submit titles of publications reporting on research projects that received support from or made use of the biotechnology resource. That list was appended to the Renewal Proposal and an updated list covering the period to September, 1971, was included in last year's annual report.

Following is a copy of the letter sent to each user of the Health Sciences Computer Research Resource on August 31, 1972, after which the publications of this report year are listed alphabetically by principal investigator.

"The National Institutes of Health, which supports the Health Computer Sciences Facility, requires us to submit an annual report detailing for each user: a project abstract, the services used during the past year, and the publications resulting from this usage. We can supply the abstract and usage reports from our files, but our list of publications has not been updated since September, 1971, when we submitted the Annual Report for 1971.

Would you please send us a list of your recent publications reporting research which made use of the services of the computer resource facility (applications programming, tabulating services, computer use, consultation, etc.). The NIH guidelines for this list are stated as follows:

> "List all publications, published during the report period, which will report on research projects that received support from or made use of the biotechnology resource. Do not include papers and other presentations which do not appear in regularly published books or journals."

Please do include any appropriate graduate thesis or dissertations in the list which you send to us.

In addition NIH has asked that future publications resulting from the use of these services credit Grant RR-267, since it enables the presence of the Health Computer Sciences Facility within the Health Sciences Center at the University of Minnesota. This credit line should appear within each published report, even though no direct subsidy was received.

We are very proud of the many accomplishments of those using our computer resource facility. Our continued existence depends upon this type of documentation of the services provided. Please send us this list of recent publications by September 15 so that we can include them with the annual report."

SUMMARY OF PUBLICATIONS

Dr. Kurt Amplatz

1. Moore, R.: Computer calculation of ventricular volume from roentgenograms. Medical Electronics and Data, 2:56-61, 1971.
2. Moore, R., and Amplatz, K.: Computer processing of images of the left ventricle. Proceedings of Symposium on Computer Image Processing. Columbia, Missouri, 1972.
3. Rizk, G., Moore, R., Amplatz, K., and Loken, M.: Computer-aided determination of myocardial perfusion rates in dogs. Proceedings, 3rd Conference on Computer Applications in Radiology. Columbia, Missouri, 1972.

Dr. Henry Blackburn

1. Blackburn, H.: Probability of middle-aged men developing coronary heart disease in five years. Circulation, 45:815-828, 1972.
2. Blackburn, H.: The coronary drug project--Findings leading to further modifications of its protocol with respect to dextrothyroxine. JAMA, 220:996-1008, 1972.
3. Blackburn, H.: Serial electrocardiographic changes in myocardial infarction. Amer. J. Cardiology, 29:767-781, 1972.
4. Blackburn, H.: Coronary heart disease: Overweight and obesity as risk factors. Annals Int. Med., 77:15-27, 1972.
5. Blackburn, H.: Multifactor preventive trials (MPF) in coronary heart disease. In G.T. Steward, C.C. Thomas (Eds.), Trends in Epidemiology, pp. 212-230, Springfield, Illinois: 1972.

Dr. John Borchert

1. Stinchfield, J.: A statistical evaluation of the Minnesota Land Management Information Systems Land Use Study. Thesis, University of Minnesota.
2. State of Minnesota Land Use Map and write-up (Minnesota Land Use - The Minnesota Lang Management Information System)
3. Region I Report - "Land Management Information in Northwest Minnesota" The Beginning of a State-wide System, Report Number One.

Mr. Glenn Brudvig

1. Grosch, Audrey N.: Biomedical library computer applications at the University of Minnesta. In SUNY at Stony Brook Conference on Information Systems for Health Sciences Centers. Proceedings. Stony Brook, State University of New York, 1971, p. 1-16.

Dr. Lars Folke

1. Gawronski, T.H., Staat, R.H., and Folke, L.E.A.: Quantitation of human dental plaque by turbidimetry. In press (J. Dent. Res.).
2. Folke, L.E.A., Gawronski, T.H., Staat, R.H., Harris, R.S.: Effects of dietary sucrose on quantity and quality of plaque. In press (Scand. J. Dent. Res.).

SUMMARY OF PUBLICATIONS

Dr. Lars Folke (Cont.)

3. Staat, R.H., Gawronski, T.H., Zaki, H., Harris, R.S., and Folke, L.E.A.: Effects of dietary sucrose level on the quantity and quality of human dental plaque. I. Quantity and microbial composition of 4-day old plaque. In press (Caries Research).
4. Gawronski, T.H., Staat, R., Harris, R.S., and Folke, L.E.A.: Effects of dietary sucrose level on the quantity and quality of human dental plaque. II. Polysaccharide metabolism of 4-day old plaque. In press (Caries Research).
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SUMMARY OF RESOURCE EXPENDITURES

	BRB Allocation			Total Resource Expenditures		
	1971 Budget	1972 Budget	Estimated 1973 Budget	1971 Budget	1972 Budget	Estimated 1973 Budget
1. Personnel:						
a. Salaries & Wages	$323,604	$ 315,619	$330,746	$410,906	$404,136	$447,053
b. Fringe Benefits	32,434	36,170	42,654	41,450	47,208	58,947
Subtotal	356,038	351,789	373,400	452,356	451,344	506,000
2. Consultant Services	187	--	--	187	--	--
3. Equipment:						
a. Main Resource-Rented	1,200	10,074	11,580	1,200	10,074	11,580
b. Main Resource-Purchased	174,674	141,946	157,755	178,604	141,946	157,755
c. Supporting Equipment	4,974	6,087	5,017	4,974	6,087	5,017
d. Equipment Maintenance	37,771	43,375	47,648	37,771	43,375	47,648
Subtotal	218,619	201,482	222,000	222,549	201,482	222,000
4. Supplies	7,732	27,300	36,400	7,732	27,300	36,400
5. Travel	2,000	2,200	3,000	3,000	2,500	3,000
6. Alterations & Renovations	2,239	2,500	1,000	2,239	2,500	1,000
7. Publication Costs	1,316	2,250	3,000	1,316	2,250	3,000
8. Other						
a. Computer Services	--	176	500	--	176	500
b. Other	8,063	4,768	4,700	8,063	4,768	4,700
Subtotal	8,063	4,944	5,200	8,063	4,944	5,200
9. Subtotal - Direct Costs	$ 596,194	$592,465	$ 644,000	$697,442	$692,320	$776,600
10. Indirect Costs						
a. 1971 @ 37.4% of S&W	107,654			140,306		
b. 1972 @ 46.54% S&W		129,490			169,003	
c. 1973 @ 47.0% S&W*			155,450			210,115
*approved 6/16/72						
11. Total Costs	$703,848	$721,955	$799,450	$837,748	$861,323	$986,715

EXPENDITURE DETAILS
Direct Costs Only

	Budget Period 1972				Estimate For Budget Period 1973			
	% of Salary from BR Grant	Amount	% of Time or Effort	Amount	% of Salary from BR Grant	Amount	% of Time of Effort	Amount
1. PERSONNEL:								
1. Prof. & Director Eugene Ackerman	4.4	$ 1,387	100	$31,636	9	$ 3,000	100	$33,057
2. Professor Eugene Johnson	0	0	30	4,100	0	0	30	4,200
3. Associate Professor Richard Moore	34	6,896	100	20,250	23	4,760	50	21,064
4. Asst. Professor & Asst. Director Laël Gatewood	61	12,050	100	19,750	10	2,107	100	21,064
5. Asst. Professor Claus E. Leidtke	--	--	--	--	40	6,752	100	16,880
6. Instructor David Juncker (6 months)	--	--	--	--	0	0	25	4,000
7. Research Fellow & Asst. Director Bruce Boraas	75	14,437	100	19,125	100	20,036	100	20,036
Michael Diffley	100	19,075	100	19,075	50	9,967	100	19,934
8. Systems Programmer Richard Heath	50	7,956	100	15,912	0	0	100	16,674
Lawrence Ozga	100	12,875	100	12,875	100	13,614	100	13,614
Aloysious Chu (6 months)	100	6,000	100	6,000	100	12,330	100	12,330
Mahesh Pondicherry (4 months)	100	3,553	100	3,553	100	10,209	100	10,209
Gertrude Juncker 50% (2 months)	100	1,134	100	1,134	--	--	--	--

EXPENDITURE DETAILS
Direct Costs Only

	Budget Period 1972				Estimate For Budget Period 1973			
	% of Salary from BR Grant	Amount	% of Time or Effort	Amount	% of Salary from BR Grant	Amount	% of Time of Effort	Amount
1. PERSONNEL: (Cont.)								
9. Applications Coordinator								
Patricia Percy	100	$11,750	100	$11,750	100	$12,330	100	$12,330
10. Digital Systems Engineer								
Arnold Nelson	100	18,275	100	18,275	100	19,163	100	19,163
11. Electronic Laboratory Supervisor								
Alan Moore	100	13,400	100	13,400	100	14,076	100	14,076
12. Project Leader								
Wayne Rasmussen	100	13,344	100	13,344	100	13,982	100	13,982
Janet Rider (80%)	100	10,675	100	10,675	100	11,185	100	11,185
Timothy Dickinson	100	11,225	100	11,225	100	13,000	100	13,000
Richard Schroedel (3 months)	100	2,809	100	2,809	--	--	--	--
13. Programmers								
Dennis Buffington	100	8,004	100	8,004	0	0	0	0
John Pearson	100	9,855	100	9,855	100	10,616	100	10,616
Jolene Hart (6 months)	100	4,596	100	4,596	100	9,445	100	9,445
John Rueter (6 months)	--	--	--	--	100	4,365	100	4,365
Warren Johnson (4 months)	100	2,512	100	2,512	100	7,743	100	7,743
Keith King (5 months)	100	3,910	100	3,910	--	--	--	--
Edward Hwang (1½ months)	100	1,225	100	1,225	--	--	--	--
Katherine Kornhauser 50% (6 months)	100	3,000	100	3,000	--	--	--	--
Mary Boyd 50% (7 months)	100	3,454	100	3,454	100	6,165	100	6,165
To Be Appointed	--	--	--	--	100	9,564	100	9,564
To Be Appointed (4 months)	--	--	--	--	100	2,581	100	2,581

EXPENDITURE DETAILS
Direct Costs Only

	Budget Period 1972				Estimate For Budget Period 1973			
	% of Salary from BR Grant	Amount	% of Time or Effort	Amount	% of Salary from BR Grant	Amount	% of Time of Effort	Amount
1. PERSONNEL: (Cont.)								
14. Data Processing Sup. Leallan Croatt	100	$11,672	100	$11,672	100	$12,430	100	$12,430
15. Sr. Computer Operator Gayle Annis (8 mos. during '73)	100	9,750	100	9,750	100	6,897	100	6,897
16. Computer Operators Mike Dent	100	9,012	100	9,012	100	9,445	100	9,445
John Rouen	100	8,328	100	8,328	100	8,328	100	8,328
17. Keypunch Supervisor Karen Widman	100	7,236	100	7,236	100	7,743	100	7,743
18. Keypunch Operators Joan Anderson (4 months)	100	1,934	100	1,934	100	5,450	100	5,450
Gail Wasilk (6 months)	100	2,371	100	2,371	--	--	--	--
Mary Young (½ month)	100	201	100	201	--	--	--	--
19. Administrative Officer James C. Nelson	21	3,256	100	15,606	40	11,442	100	16,350
20. Principal Secretary Margie Henry	100	6,994	100	6,994	100	7,448	100	7,448
21. Sr. Clerk Typist Colleen Brewster	100	5,978	100	5,978	100	6,356	100	6,356
Janet Pearson	20	1,112	100	5,616	81	4,769	100	5,881
22. Sr. Account Clerk Elaine Anderson	100	6,994	100	6,994	100	7,448	100	7,448
Subtotal		278,235		363,136		304,746		421,053
Misc. Help		37,384		41,000		26,000		26,000
Subtotal		315,619		404,136		330,746		447,053
Fringe Benefits		36,170		47,208		42,654		58,947
TOTAL PERSONNEL		351,789		451,344		373,400		506,000

EXPENDITURE DETAILS (continued)

	1972 Current Budget Period		1973 Estimate for Next Budget Period	
	BRB	Total	BRB	Total
2. CONSULTANT SERVICES	--	--	--	--
3. PERMANENT EQUIPMENT				
Main Resource - Rented				
1. BDP Module	$ 1,200	$ 1,200	$ 1,200	$ 1,200
2. Core (2 months lease prior to purchase conversion)	8,874	8,874	--	--
3. Disk Drive	--	--	10,380	10,380
Subtotal	$ 10,074	$ 10,074	$ 11,580	$ 11,580
Main Resource - Purchased				
1. CDC-3300, RJE Term., PDP-8 system*	137,886	137,886	157,755	157,755
2. 8K Memory PDP-12	4,060	4,060	--	--
*See Budget Notes				
Subtotal	$141,946	$141,946	$157,755	$ 157,755
Supporting Equipment				
1. Tab Equipment	4,932	4,932	5,017	5,017
2. Deleaver and Disk & Tape Storage Cabinets	1,155	1,155	--	--
Subtotal	$ 6,087	$ 6,087	$ 5,017	$ 5,017
Equipment Maintenance				
1. Contract for CDC/PDP-12	42,975	42,975	45,648	45,648
2. Emergency Service	400	400	2,000	2,000
Subtotal	$ 43,375	$ 43,375	$ 47,648	$ 47,648
Total Equipment	$201,482	$201,482	$222,000	$222,000
4. CONSUMABLE SUPPLIES				
(Group by Major Category)				
1. 3300 Computer Supplies	16,000	16,000	24,000	24,000
2. Electronic Parts & Supplies	1,200	1,200	1,300	1,300
3. PDP-12 Supplies	500	500	1,000	1,000
4. Tab and Supporting Equip. Supplies	1,100	1,100	1,400	1,400
5. Telephone (line charges, etc.)	6,500	6,500	6,500	6,500
6. Office and Clerical Supplies	2,000	2,000	2,200	2,200
Subtotal	$ 27,300	$ 27,300	$ 36,400	$ 36,400

EXPENDITURE DETAILS (continued)

	1972 Current Budget Period		1973 Estimate for Next Budget Period	
	BRB	Total	BRB	Total
5. TRAVEL				
1. Ackerman, E. San Francisco, California "Health Care Delivery for 1980"	$ 192	$ 192		
2. Diffley, M. Palo Alto, California Evaluation of GPGT	280	280		
3. Pittsburgh, Pennsylvania Computer Graphics In Medicine	276	276		
3. Gatewood, L. San Francisco, California "Health Care Delivery for 1980"	205	411		
4. Moore, R. Bal Harbour, Florida "Engineering in Medicine & Bioengineering"	428	428		
5. Ozga, L. Duluth, Minnesota FOCUS Conference	170	170		
6. Other Anticipated Travel	649	743		
Subtotal	$ 2,200	$ 2,500	$ 3,000	$ 3,000
6. ALTERATIONS & RENOVATION				
1. Secretarial Office (See M. Blumsack's 1/14/72 approval)	1,728	1,728	--	--
2. To be used for office renovation	772	772		
3. Minor Renovation for installation of RJT	---	--	1,000	1,000
Subtotal	$ 2,500	$ 2,500	$ 1,000	$ 1,000
7. PUBLICATION				
1. Manuals, Monthly Newsletter, Documentation and Publication Expenses	2,250	2,250	3,000	3,000
Subtotal	$ 2,250	$ 2,250	$ 3,000	$ 3,000

EXPENDITURE DETAILS (continued)

	1972 Current Budget Period		1973 Estimate for Next Budget Period	
	BRB	Total	BRB	Total
8. COMPUTER SERVICES				
6600 University Computer Center				
1. CPU				
Rate $9.00/min.	$ 40	$ 40		
4.5 min. used				
2. PPU				
Rate 1.25/min.	31	31		
25 min. used				
3. Supplies	105	105		
Subtotal	$ 176	$ 176	$ 500	$ 500
9. OTHER EXPENDITURES				
1. Xerox Expense	1,300	1,300	1,500	1,500
2. Outside Xerox & Duplication	1,900	1,900	2,000	2,000
3. Office Machine Maintenance	385	385	400	400
4. Plant Service, Fees, etc.	811	811	800	800
5. Outside Keypunch Service	372	372	--	--
Total - Other Expenditures	$ 4,768	$ 4,768	$ 4,700	$ 4,700
GRAND TOTAL - DIRECT COSTS	$592,465	$692,320	$644,000	$776,600

SUMMARY OF RESOURCE FUNDING

SOURCE OF FUNDS	Actual For Budget Period 1971	Budget Period 1972	Estimate For Budget Period 1973
Service Charges (see page for approved rates)			
Consulting/Programming	$146,771	$137,000	$145,000
Peripheral Equipment & Supplies	14,523	23,000	23,000
Computer Equipment	110,314	165,000	190,000
University Computer Facility Support			30,500
Subtotal	$271,608	$ 325,000	$388,500
Institutional Funds			
Direct University Support	2,389	37,000	51,800
Waived Overhead or Charged to Other Grants and Obligations Carried Forward	100,224	115,510	159,015
Subtotal	$102,613	$ 152,510	$210,815
Other Support			
1. Hill Foundation	26,555	24,600	21,188
2. G.T. Evans	4,511	3,000	4,015
3. PHS (GRS Funds)	10,562	7,500	8,438
4. University Hospital Funds	6,850	--	300
5. PHS (Menstrual History Grant)	16,195	2,525	1,990
6. Minnesota Medical Foundation	3,430	--	--
7. Biometry Training Funds	8,450	7,960	9,502
8. Radiology	3,734	10,125	12,007
9. PHS Funds	14,925	2,196	11,265
10. Graduate School	4,927	--	--
11. Coordinating Center (PHS)	--	4,949	12,095
Subtotal	$100,139	$ 62,855	$ 80,800
BR Support			
Amount of Current Award:	$271,167	$267,465	$255,500
Supplemental Award (4/24/72)	4,539	--	--
Plus Indirect Costs	57,241	53,493	51,100
Adjustment from prior periods			
1. Bal. Carried Over From 1970	10,500	--	--
2. 1970 Obligations	19,941	--	--
Total BR Support	$363,388	$320,958	$306,600
TOTAL FUNDING	$837,748	$861,323	$986,715

BUDGET JUSTIFICATION AND EXPLANATORY NOTES

1. Rates

The rates for services provided by HCS are as follows:

SERVICE	RATE	BRB AUTHORIZATION
Computer		
3300	$90.00/hr.	5/22/72 Approval from Martin B. Blumsack
PDP-12	$17.00/hr.	These rates were outlined in Dr. Ackerman's 1/18/71 letter to Dr. Patrick Guiteras and Mr. Martin Blumsack.
PDP-12 Time-Sharing	$ 4.25/hr.	
Block Charge	.005/output block	5/22/72 Approval from Martin Blumsack
CRT Connect Time	$ 4.25/hr.	8/15/71 approval from Martin B. Blumsack
Tab Services		
Keypunching	$ 4.25/hr.	7/21/71 letter from Martin B. Blumsack
Verifying	$ 4.25/hr.	
Card Sorting	$ 4.25/hr.	
Card Reproduction	$ 4.25/hr.	
Card Interpretation	$ 4.25/hr.	
Consulting	$28.50/hr.	8/26/71 letter from Martin B. Blumsack
Applied Programming		
Project Leader, M.S. or Faculty	$12.50/hr.	4/27/70 letter from William F. Raub
Programmer	$10.00/hr.	
Programmer-Technician	$ 7.50/hr.	
Data Processing Asst.	$ 5.00/hr.	

2. BRB Allocation

The amounts allocated against the BRB column on the budget sheets represent those expenditures covered by the Resource Budget Account which includes as its source of funds, not only the direct BRB support but the service income.

3. Salary Increases

Although the actual amount approved for salary increases will not be known until the State Legislature meets early next year, we have used an average increase of 5.5% in computing proposed salaries for 1973. This percentage increase is within the Federal guidelines and is the percentage increases included in the University's request to the Minnesota State Legislature.

4. Fringe Benefits

Although our fringe benefit rate is in a state of being finalized for next year, the recommendation of our Central Research Administration is to use a rate of 14% of full-time salaries for projecting the fringe benefit costs for 1973.

5. Indirect Cost Computation

During the previous reporting periods, the University approved overhead rate was computed against only the dollar amount of the full-time regular salaries and wages, and the dollars spent for Miscellaneous part-time help was excluded from this computation (note the 1971 and 1972 overhead amounts). The University's Central Research Administration has advised that in accordance with University policy, this overhead rate should be computed on the total salaries and wages. In projecting the budget for 1973, this policy was adhered to, which in turn, increased the amount of the waived overhead accordingly.

6. Computer Operator

Our Sr. Computer Operator will be on maternity leave during part of 1973. To adequately cover this activity, we have included $4,000 in our "miscellaneous help" dollar projection for 1973 to enable us to hire and pay for a temporary replacement.

7. Equipment

A breakdown of the $157,755 allocated for equipment purchase is as follows:

Payment to CDC -	$ 75,755
RJE Terminal - (to be added by April)	22,000
PDP-8E Systems - (to be added by April)	50,000
RJE Terminal Controller/2 - (to be added in 3rd quarter)	10,000
	$157,755

The addition of the RJE terminal, controllers, and the PDP-8E system is in accordance with the schedule outline and approved in our Renewal Application. Approval of our grant application was granted by W.F. Raub's 6/23/71 letter to Dr. Eugene Ackerman.

8. We will continue to charge and collect the negotiated and approved overhead rate of 10% on our full time applications programming groups.

9. Operating Level

Direct Costs totalling $635,500 for 1973 was set forth in our competing renewal application and approved by the council. Our projected budget for 1973 projects direct costs (allocated for the BRB column) in the amount of $644,000, which is $8,500 in excess of the approved level. In 1971, Mr. James C. Nelson was added to our staff as the Administrative Officer for our Resource. Although there were some changes in the personnel staffing which helped offset the total additional cost of adding Mr. Nelson, the addition of his salary produces a net increase of $8,500 to the budget level bringing the total level to $644,000.

The funding for this increase will be obtained from other income sources and will not affect BRB's total contribution for 1973.

This budget note requests your approval to increase the approved level to $644,000.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Eugene Ackerman (with Lael Gatewood, George Molnar): Blood Glucose Regulation

The following summary is from an article being prepared for publication entitled "Models of Disappearance Curves of RII and IRI in Normal and Diabetic Humans." by Eugene Ackerman, Lael C. Gatewood, George D. Molnar, and P.J. Palumbo.

Mathematical models were used in a further analysis of the blood glucose and insulin levels following the rapid infusion of pharmacological doses of bovine IRI and simultaneous tracer doses of bovine RII. It was found that an extended linearized model with two insulin compartments was adequate to describe either the RII data or the IRI and blood glucose data. The models were used to test whether differences existed between the insulin distributions and clearances of normal and diabetic subjects with negligible insulin antibody binding capacity. It was found that an overlap of parameter values existed; these studies suggest one must look elsewhere for the causes of diabetic instability. The extended models were also used to investigate whether bovine RII could act as a tracer for bovine IRI under in vivo conditions. It was concluded that this was, at most, true in a qualitative fashion.

It was further found that the extended models reduced to the basic model discussed in earlier publications under the conditions of a glucose tolerance test. The extended model was able to predict the occurrence of the blood glucose nadir in normal subjects during a slow insulin infusion test at a time earlier than predicted by the basic model referred to above. However, the extended models had more parameters than could be evaluated uniquely by the available data.

This led to the suggestion of two types of additional experiments. One type would be concerned with evaluating and more critically delimiting the range of application of the extended models. The other type of additional experiments are concerned with testing hypotheses regarding the nature of diabetic instability. Thus these model studies have played an important role in the overall studies of diabetic instability.

Eugene Ackerman (with Alan Rector, Lael Gatewood): BRANCHIT: A system for branching logic

A number of computer centers are working with and have developed author languages of varying degrees of complexity and capability. BRANCHIT is perhaps unique in combining the simplicity of FOCAL and MUMPS and the power of FORTRAN subroutines with the interactive capabilities of CRTOS and NETOS.

This system has progressed to the point where it is being used routinely by medical and paramedical students in the Biomedical Learning Center for computer-aided review. Several features have been added to increase usability, including a HELP verb and HCS Network compatibility. Interest the past year concerned the applicability of this group of routines to studies in diagnostic decision making and to a dietetic interview program.

These programs should also give us the longer range capability of supplying services for continuing medical education and physicians references throughout the Health Sciences Center.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Michael W. Diffley (with L. Ozga, G. Juncker): System Software Maintenance

Software maintenance on the HCS computers continues to require significant amounts of time. USASI COBOL continues to present major problems, although Control Data representatives have been very cooperative in tracking down problems. Many other problems seem to appear as a result of changes in the way the system is used, such as the changes in system loading due to network activity.

The philosophy of the Division is to remain at the 3.0 level of MASTER in order to minimize the number of problems introduced by subsequent versions of operating systems. However, individual features of subsequent versions are examined and, in some cases, implemented on the HCS system.

Michael W. Diffley (with A. Moore, A. Nelson): General Communication System (GCS)

Phase 1 of GCS was implemented on the PDP-12 and has been operational since June, 1972. As currently implemented, communications support is provided for several 110 baud and 300 baud dial-up lines, a 1200 line to a mini-computer in Radiological Therapy, a general purpose graphics terminal (GPGT), and the CDC 3300 computer. Initial use has verified the reasonableness of our approach, although it is still too early to give a complete evaluation. Use to date has been somewhat hampered by the competition for access to the PDP-12 from TSS-12 and"hands-on" users. The current schedule provides communication services from 8:00 am to 11:30 am and from 6:00 pm to 10:00 pm with the remaining hours available for TSS-12 and hands on use.

Phase 2 of GCS will be implemented in 1973 and will consist of a PDP-8E facility which will take over the GCS function from the PDP-12. The PDP-12 will then be attached to the network over a 7200 baud line and will continue to be used as the controller for the GPGT.

The primary reason for selecting a PDP-8E system is software compatibility. The present GCS was implemented on the PDP-12 using only PDP-8 mode features. Thus the software conversion effort will be minimal. We recognize, however, the limitations implied by using a minimal system and several larger capacity systems were considered. The limitations occur primarily in CPU capacity for data transformation as data are switched between systems on the network. It was concluded, however, that the current need for full day operation was the most critical one and that a minimal PDP-8E configuration could be operational by early 1973, while a larger system would require at least one additional year to implement. It is expected that the described system will be sufficient until mid 1974. Various approaches exist for expansion at that time with the appropriate one depending primarily on the usage patterns that develop. One approach would be to add a second PDP-8E as a concentrator for all asynchronous lines thereby freeing a significant part of the CPU capacity for additional data transformation and additional synchronous lines. Another would be a higher capacity system based on a larger computer. It is planned that the annual report for 1973 will present a proposal for this subsequent expansion.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Development of remote job entry capability on the HCS network is underway. Several groups have expressed interest in such access and major efforts are planned for the next year. An HCS RJE terminal will be implemented early in 1973 which will communicate directly with the HCS network. Subsequent RJE terminals will require the addition of an RJE terminal controller (RJETC). The position of the RJETC in the network is shown in Figure 2 of Section II-A-8. The major reasons for adding the RJETC include:

- reduction of the complexity of the RJE terminals
- capability to handle a variety of protocols to allow compatibility with some currently existing RJE's
- reduction of the load on the 3300 and on the network controller.

Michael W. Diffley (with L. Ozga, R. Heath, G. Juncker): Network Operation System (NETOS)

NETOS development was completed during the report period and has been operational since June 1972. This system provides the interface between network users and the facilities of the CDC 3300 and consists primarily of a command processor and a text editing facility. The design of NETOS was based on CRTOS and hence many systems can be operated from either. File formatting compatibility with MASTER was maintained so that batch jobs can be processed under NETOS and many interactive jobs can be run under batch. The current system allows up to six network jobs to be concurrently active.

Extensions to NETOS are underway to allow remote job entry (RJE) capability on the 3300. The design philosophy is to minimize the load on the 3300 and place responsibility for data conversion and special line protocols with the RJE terminals and the network controller. Thus it is planned that NETOS will transmit and receive data in the form of standard MASTER blocks. It is expected that the capability will become operational early in 1973.

Michael W. Diffley (with G. Juncker): CRT Operating System (CRTOS)

No major changes were made to CRTOS during the report period. The system continues to be successfully used on a variety of applications and proved to be an excellent model upon which to base the design of the NETOS system. A major updating on the CRTOS User's Manual has been accomplished during this report period.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Michael W. Diffley (with R. Heath, D. Juncker): BASIC

HCS BASIC continues to be used as a major educational tool. Work during the past year involved completing the CARD/BASIC system, continued maintenance, and rewriting the user's manual. Access to CARD/BASIC has been made available to TTY users over the HCS network. Interactive BASIC for NETOS use is under development.

Michael Diffley (with E. Ackerman, L. Wolfenson): MIMO: Minnesota Interactive Modeling Language

This discrete analog simulation language, developed as a class project in Health Computer Sciences, has proven to be a useful modeling tool during the past year. Developments including further debugging and interaction with the General Purpose Graphics Terminal have enabled student use both in didactic classes and informal seminars. One thesis project has evolved around the use of the language as an on-line data display and manipulator, where multichannel analog information has been digitized into long record blocks. A preliminary version of a MIMO manual has been written, with continuous user feedback resulting in numerous revisions. Further developments expected to occur in the next year will give more user adaptability via interactive graphics.

Michael W. Diffley (with J. Figen): Mass Storage Backup

Major extensions to the mass storage backup system were made during the year. The system continues to be run on a daily basis to backup on-line files and the extensions were made to increase efficiency and to give greater flexibility to users in defining and running their own backup procedures. A user's manual has been written.

Michael W. Diffley (with E. Johnson, M. Pondicherry, R. Heath): Computer Performance Measurement and Evaluation

Major efforts are underway in the area of performance measurement and evaluation of the HCS computer facilities. The need for these efforts has become increasingly apparent as the computing load changes both as a result of increased usage and as a result of the changes in the type of use due to

the increased emphasis on interactive access.

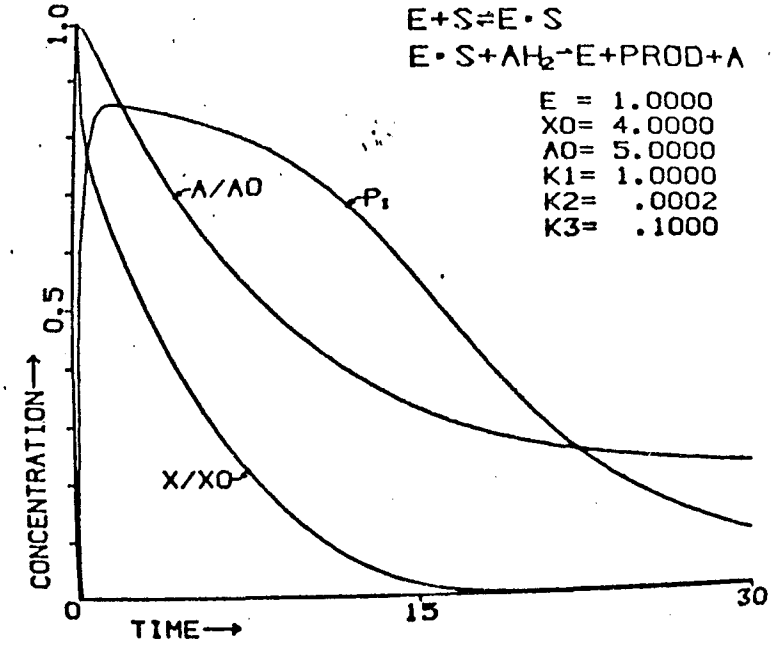
The major initial goal is the identification of bottlenecks which can cause deterioration of service under moderately heavy loading conditions. A variety of software recording mechanisms are being considered. One specific problem area that has been identified is the scheduling algorithm. Conditions have been identified which can cause a few tasks to effectively block the progress of all others. Various approaches to solutions are currently being evaluated. One which shows promise would dynamically modify task priorities and CPU time quanta based on CPU utilization and frequency of user interaction. The desired result would give short commands high priority while commands with high CPU requirements would be given lower priority but a larger quantum to reduce swapping overhead. GPSS is currently being used to implement a model of the current system and will also be used to evaluate proposed modifications. A second major area of concern is the use of the disk I/O channel and we plan to evaluate its effectiveness and the possibility of some means of optimizing disk head movements.

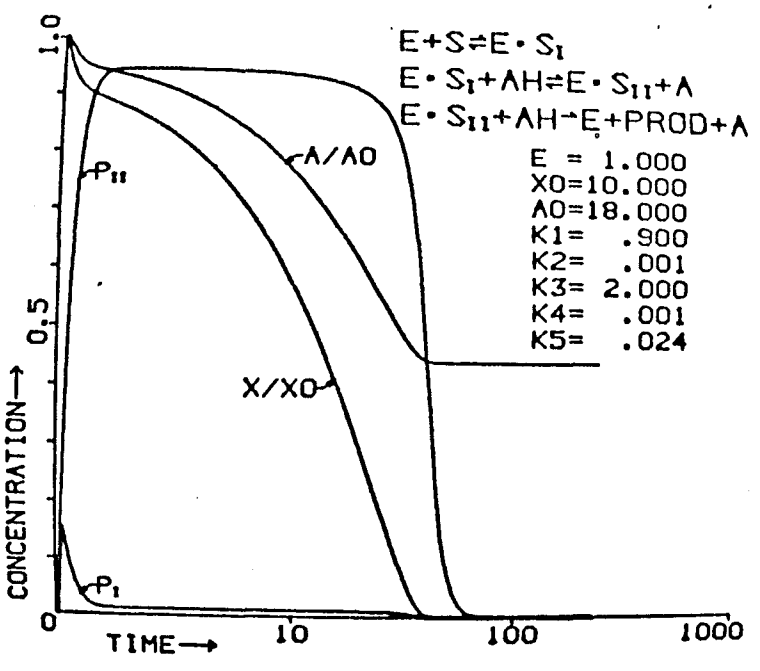
Michael W. Diffley (with G. Juncker, K.P.S. Menon, A. Moore, A. Nelson):
Graphics Terminal

Efforts in computer graphics during the report period were directed toward bringing the 315C General Purpose Graphics Terminal (GPGT) to operational status. Hardware development of the interface between the GPGT and the PDP-12 was completed early in the year. Initial software developments provided diagnostic routines and drivers to allow use of the GPGT from the PDP-12 in the stand-alone mode of operation. Second level software allows the use of the GPGT from the CDC 3300 over the HCS network. This software includes a GPGT handler within the GCS system on the PDP-12 and a set of FORTRAN callable routines for the 3300 which transfer display information to the GPGT over the network. The display information is generated using the standard CALCOMP plotter routines and hence, hard copy of GPGT displays can be routinely generated on the CALCOMP plotter. This software thus treats the GPGT as a CALCOMP-compatible, easily erased, soft copy plotter. The MIMO system has been extended to allow the use of the GPGT in simulation studies. One such use is the study of the kinetics of enzyme reactions and the attached figures show examples of the displays generated. The figures were reproduced from negatives of photographs of actual GPGT displays.

Third level software currently under development will allow the GPGT to function as a truly interactive device allowing character and graphical input as well as graphical displays.

During the next report period we plan to continue to develop the GPGT as a truly general purpose interactive graphics device within our network setting. We also plan to continue to examine the problem of delegation of responsibility between a computer and the graphics terminal. Our experience


E+S⇌E·S
E·S+AH₂→E+PROD+A
E = 1.0000
X0= 4.0000
A0= 5.0000
K1= 1.0000
K2= .0002
K3= .1000
A/A0
P₁
X/X0
CONCENTRATION→
1.0
0.5
0
TIME→
15
30


E+S⇌E·S₁
E·S₁+AH⇌E·S₁₁+A
E·S₁₁+AH→E+PROD+A
E = 1.000
X0=10.000
A0=18.000
K1= .900
K2= .001
K3= 2.000
K4= .001
K5= .024
P₁₁
A/A0
X/X0
P₁
CONCENTRATION→
1.0
0.5
0
TIME→
10
100
1000

has indicated that remote interactive graphics work is enhanced if the graphics device includes some local computing capability which provides fast computer response to certain activities. For example, use of a joy stick to "draw" pictures on the display unit is best accomplished if it can be done at the terminal without involving the distant timesharing computer. However, the optimal delegation of responsibilities between the timesharing computer and the graphics terminal itself is less obvious in most cases and appears to be quite application dependent.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

John Gage (with Lael Gatewood): Diagnostic System for a Pediatric Renal Clinic

The intention of the Kidney Computer Project is to conveniently collect, store, retrieve, and analyze the data for a large number of parameters which are routinely followed for patients of the Tuesday afternoon Pediatrics Renal Clinic. As a first stage in implementation of KCP, I have been mainly working on the collection system for the specific diagnosis. In general, the philosophy is:

1. The work of collecting should be made easy enough to be carried out by a person with minimal specific training and no medical knowledge other than a course in recognizing the terminology.

2. The physicians staffing the renal clinic should be required to invest a minimum amount of their time in KCP related activities. These activities should be of a type that augments the routine to which these physicians are already accustomed.

3. The correctness of each diagnosis to be stored should be checked by the doctor who made the diagnosis.

So far the following steps have been accomplished or are in the last stages of readiness before testing the collecting system:

1. A fairly complete and extensively cross-referenced codebook of renal diagnoses has been prepared. It was tested for useability on a weekly basis for a period of about four months by collecting and coding lists of actual patient diagnoses from the Tuesday Renal Clinic. The codebook now appears to be in a state where consistent coding of sufficient accuracy is possible.

2. A computer program has been written which provides the capability of conveniently checking the correctness of the coding. The coded diagnoses are punched on IBM cards which are read and interpreted by this program. A printout which identifies the patient and the doctor and lists the diagnoses corresponding to the codes is returned to the doctor for additions and corrections. This program does a number of other operations, including:

A. It checks the diagnosis for specificity. If, for example, the diagnosis is "urinary tract infection" the program automatically prints a question asking the doctor for the name of the etiologic organism. In other instances the program will list a whole group of related diagnoses to allow the doctor to indicate any that weren't written initially but which may apply. Such a list of related diagnosis is called the 'clarification set' of the original diagnosis.

B. The program allows diagnoses to be collected and listed for eventual storage which because of their rarity or non-renal nature are not in the codebook.

C. It allows comments (non-diagnoses) to be printed and eventually stored.

D. It identifies coded and non-coded diagnoses as (1) firm, (2) probable, or (3) doubtful.

3. A program has been written which will print a hard-copy of the codebook. It prints the following sections:

DETAILED DESCRIPTION OF RESOURCE PROJECTS

A. An alphabetical, cross-referenced listing of diagnoses followed by their code numbers.

B. A listing in order of all the code numbers. Each code is followed by the listing of places where that code appears in the alphabetical codebook.

C. A double list of (1) code numbers in the codebook which are not in computer memory and (2) code numbers in computer memory not in the codebook.

D. A printout of the codebook outline showing the relationships of the code numbers.

E. An introduction to the codebook and to each section describing its usefulness and procedures to be followed in making corrections, retrieval choices, etc.

4. The computer-memory codebook correction program is operated from the CRT. The logic has to make decisions about changes in diagnoses that the non-medical operator has insufficient knowledge to make. The basic decision is whether to include the new diagnosis in the clarification sets of other diagnoses. This is either done completely by the computer or a question is printed that would have to be referred to one of the clinic doctors for an answer. The program also deletes obsolete diagnoses and again must make corrections in clarification sets (fully automatic).

George Klee (with Eugene Ackerman, Arnold Leonard): Computer Detection of Distorted Aortic Pressure Signals

The following is the abstract of an article submitted to IEEE Bioengineering Transactions:

A method for the automated detection of distortion in arterial pressure waves due to air bubbles or blood in catheters is proposed, which uses the mathematical concept of curvature for measuring the sharpness of the pressure changes in the signal. Frequency response curves show that when a catheter contains blood or air bubbles there is a damping of the signal by removal of the higher frequency details. As the fine details of the signal are smoothed out there is a progressive decrease in the curvature of each segment of the curve. The sum of the curvature over all the segments on a typical pulse beat is a quantitative index of this fine detail. The sum of curvature method has been used with dog and human subjects, and a common threshold for distinguishing distorted signals has been found.

Eugene Johnson: Multivariate Classification Algorithms

The implementation of classification and clustering projects has many ramifications. These include the study of the techniques themselves as well as specific clinical studies. The computing algorithms are characterized by time-consuming, iterative procedures. They require a large data base for learning. Every effort should be made to increase their efficiency. Many of these techniques have common aspects. To the extent possible the development

of the entire package should be modular so that well-planned sub-programs can be combined for different uses. Many aspects of these techniques have yet to be thoroughly investigated from the theoretical point of view. The mathematical statistical aspects of their characteristics are very difficult. No exact distribution theory is available in some cases. Almost everything that is known about the procedures is based upon Monte Carlo experiments. More of these are needed and are planned.

The clinical usefulness of these ideas and procedures is being tried in three separate settings. The applications depend upon large data bases involving many patients with a variety of diseases, each patient providing the same set of multiple observations. Such projects take a long time and require the co-operation of many individuals. They are usually very expensive since multiple observations are made on each subject, for research purposes alone, not for the purpose of diagnosis and treatment.

1. With Clinical Chemistry in the Department of Laboratory Medicine, we began with thirty clinically measured variables but have decreased this number to about fifteen. We are examining normals and diseases which present an initial clinical picture similar to myocardial infarction.

2. In the Vectorcardiogram Laboratory in the Department of Medicine, we are trying to determine the ability of a classification rule based upon VCG data. We want to classify patients into diagnosis classes which are determined upon the basis of catheterization, biopsy and other more direct but expensive methods.

3. We expect to establish a working relationship with the new Department of Family Practice where these techniques can be tried in a routine screening setting. This will be a multivariate screening for normality.

The following lists the publications based on these activities in the past year:

"Concepts of Definition and Discovery of Clusters or Taxa," 8th International Congress on Clinical Chemistry, Copenhagen, June 1972, the Scand. J. of Clin. and Lab. Invest., Vol. 29, Suppl. 126, p. 20.1, 1972.

"Some Applications of Profile Analysis and Clustering Techniques Based Upon Clinical Chemistry Data," 8th International Congress on Clinical Chemistry, Copenhagen, June 1972, the Scand. J. of Clin. and Lab. Invest., Vol. 29, Suppl. 126, p. 20.3, 1972.

"Some Distribution Free Properties of the Asymptotic Variance of the Spearman Estimator in Bioassays,"(with Chang, P.C.) Biometrics, Vol.28,No.3, p.882, 1972.

Laboratory Data Analysis System: Section I-Introduction and Over View (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 177, 1972.

Laboratory Data Analysis System: Section II-Analytic Error Limits (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 182, 1972.

Laboratory Data Analysis System: Section III-Multivariate Normality (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 188, 1972.

Laboratory Data Analysis System: Section IV-Multivariate Diagnosis (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 201, 1972.

Laboratory Data Analysis System: Section V-Trend Analysis (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 208, 1972.

Laboratory Data Analysis System: Section VI-System Summary (with Grams, Benson) Amer. J. Clin. Path., Vol. 58, No. 2, p. 216, 1972.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Richard Moore: Cellular Membrane Permeability

The basic biological problem explored is the mechanism of the movement of water through the membrane of living human erythrocytes. This study involves the kinetics of water transport and employs a stopped-flow spectrophotometric technique. Comparative studies of membrane permeability as a function of the biological history or treatment of the cell have shown a significant difference in the permeability of erythrocytes from leukemic patients. Further studies are planned to develop a procedure for mass screening patients and/or for monitoring the progress of treatments for leukemia. Several small grants have been received from the University of Minnesota Graduate School and the Minnesota Medical Foundation for these studies.

The computer was used to fit values for the osmotic filtration coefficient of cells to experimental data gathered with the stopped-flow apparatus. This year, the work led to a paper given at the 4th International Biophysics Congress in Moscow entitled, "Application of Stopped Flow Instrumentation to Measurement of the Effects of Radiographic Contrast Media on Red Blood Cells."* A manuscript based on this work will be submitted for publication. A second manuscript is being written on differences found in values for the membrane permeability of cells from normal subjects compared with cells from patients with acute lymphocytic leukemia.

*These studies indicated that the toxicity of contrast media can be explained in part by the hemolysis that results on injection.

Inchol Phyo (with Eugene Ackerman, John Rosevear, and Lael Gatewood): Simulation and Resolution of Chromatographic Peaks

The following summary is from an article being prepared for publication entitled "Estimation of Descriptive Parameters of Overlapping Chromatographic Peaks: A Simulation Study" by Inchol Phyo, Eugene Ackerman, Lael Gatewood, and John Rosevear.

In this study, the characteristics of a non-linear optimization technique for resolution of overlapping chromatographic peaks were examined. For illustrative purposes, a modified Meiron-Marquardt method was used. The estimates of the parameters of overlapping peaks in simulated chromatograms were investigated to indicate the limitations of present mathematical methods and, hopefully, to improve their ultimate utility. Gaussian shapes as well as exponential-Gaussian convolutes were used to simulate the chromatographic peaks. Effects on the overall performance of varying relative heights, widths, and separation of two peaks were determined. Random, additive noise and base-line drift were also simulated.

The performance of the parameter estimation techniques was expressed in terms of relative errors in estimating the second (or smaller) peak's area, height and location. Under the easiest conditions simulated, i.e., peaks with equal

heights and widths in the absence of noise or base-line drift, accurate resolution of the two peaks was achieved provided their separation was at least one half width. Introduction of relatively small amounts of noise, skewness, and base-line drift tripled the minimum separation required for adequate peak resolution. Unequal heights of the two peaks caused further deterioration in the resolution which could be achieved.

The implications of these results for the design of chromatographic systems is discussed. Also various limitations of the methods used, such as converging to a local minimum, are described. In spite of these limitations, the results presented indicate the relative importance of noise, skewness, height and width ratios and peak separation on the maximum resolution achievable by numeric methods in an automated chromatographic system.

Alan Rector (with Eugene Ackerman): MISER: A System for Automated Diagnoses

Alan Rector is a fourth-year medical student who undertook the development of a computer language to facilitate teaching and research in diagnostic decision making. The following is his description of the current version of the system.

It has frequently been noted that medical students receive almost no training in strategies for developing efficient approaches to diagnostic problems during their training, and are left to pick up much of this essential skill intuitively. Various investigators have suggested that this explains at least some of the needless multiplicity of laboratory and other diagnostic procedures often encountered. Recently, various techniques for studying the diagnostic and decision-making process have become available using different combinations of Bayesian, multivariate, and utility theory models. At least two projects have developed programs based on specific models for teaching the "best" strategies or allowing the student to test various strategies. This project attempts to adapt and develop these techniques. We are particularly interested in developing the ability to incorporate some concept of cost (be it "real cost," out-of-pocket cost, days in the hospital, or risk-discomfort) into the considerations. Such a program serves the double function of providing a laboratory for testing ideas about diagnosis and decision making within a somewhat restricted framework, and at the same time providing the medical students with a valuable training experience in considering aspects of medicine often glossed over elsewhere. Despite difficulties with any analytical model of such a process, the experience of Octo Barnett at Harvard suggests that sufficient accuracy can be attained to make such programs a valuable learning tool.

The essential requirements are an adequate interactive branching logic program for the framework, sufficient computer and file handling capacity for manipulating the data, and an adequate data base from which to work. Support from the clinical faculty is essential at many stages. The branching logic program must allow for the inclusion of rather elaborate subroutines.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

We have, at this point, developed the file manipulation and basic diagnostic and test-evaluation programs and tested them on a limited problem on abdominal pain. The results suggest that we can achieve reasonable test selection using either of two techniques for establishing costs without extensive tree-searching, although we have not yet developed as flexible a system of manipulating and evaluating various aspects of costs as we would like. The branching logic program has been extensively modified and is proving entirely adequate to the task. We are planning more extensive tests using data on thyroid disease from the University of Wisconsin, a subset of the data on pleural effusion developed by A. Ginzberg of Rand.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Kurt Amplatz (with Richard Moore): Coronary Revascularization Study

This project is partially supported by grant HE-13998 for personnel and equipment from USPHS during this past year.

Myocardial blood flow rates for normal humans and for dogs with and without occluded coronary arteries have been calculated from Anger camera data. Special hardware and software have been developed to deal with the computational burden of this research work. These developments have resulted in the following publication:

> Rizk, G.; Moore, R.; Amplatz, K.; and Loken, M.: Computer-Aided Determination of Myocardial Perfusion Rates in Dogs. Proceedings, 3rd Conference on Computer Applications in Radiology, Columbia, Missouri, 1972.

Our instrumentation-computation system was found to have the sensitivity and precision to be able to detect a difference of 10% in myocardial or renal blood flow rate, which is suitable for our purposes. Quantitative components of variation were separated in the determination of myocardial flow to allow correction of laboratory and other manual errors. The results of vasocilator or vasoconstrictor drugs on myocardial blood flow were determined from dog studies, which laid the foundation for extension of similar studies in humans. These studies are being prepared for publication under the following titles:

> Rizk, G.; Moore, R.; Loken, M.; and Amplatz, K.: The Effect of Acute Segmental Artery Occlusion on the Regional Renogram.
>
> Moore, R.; Rizk, G.; and Amplatz, K.: A Graphical Means for Fast Estimation of Regional Perfusion Rate Using ^{133}Xe.
>
> Moore, R.; Rizk, G.; Loken, M.; and Amplatz, K.: Reproducibility of Scintigraphic Measurements of Canine Myocardial Perfusion.
>
> Moore, R.; Rizk, G.; Loken, M.: and Amplatz, K.: The Effect of Occlusion on Regional Myocardial Blood Flow.
>
> Moore, R.; Rizk, G.; Loken, M.; and Amplatz, K.: The Effects of Papaverine or Isoprel on the Regional Distribution of Myocardial Blood Flow in the Dog.

In addition, Alan Moore, a graduate student in Biometry, wrote two Plan B papers based on building an analog/digital graph reader for this project, and writing some of the computer programs needed for data reduction using this device.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Bo G. Crabo (with Richard Moore and Donggyu Jin): Study of Sperm Maturation

This project is supported by Grant HD-06695-01 from NIH to Dr. Crabo in Animal Sciences. The following is the abstract from that grant proposal.

Sperm maturation within the epididymis and after ejaculation is of great importance for fertility. With a better knowledge on the mechanism behind this maturation, it would be possible to find new male contraceptive compounds specifically inhibiting sperm maturation and it would also be possible to improve fertility in animals and man. There are indications that the properties of the sperm membranes undergo changes during the posttesticular sperm maturation. The permeability of the membranes is proposed to be investigated for water, electrolytes and protein molecules (enzymes) in spermatozoa from different levels of the epididymal duct and in the ejaculate. Boars will be used due to the size of the boar epididymidis. Comparison will be made with human epididymides. A stopped-flow apparatus will be used to measure osmotic swelling of spermatozoa in contact with hypotonic fluids. The permeability for electrolytes will be investigated with use of radioisotopes, and the permeability of macromolecules with determinations of intracellular enzymes in the extracellular medium. Alpha-chlorhydrin and related componds are supposed to inhibit sperm maturation over epididymal function. The detailed mechanism of action of alpha-chlorhydrin is unknown. In order to elucidate it, studies on the excretion and metabolism of this compound in the epididymis are proposed. Radioactively labelled alpha-chlorhydrin will be used. The effect of alpha-chlorhydrin and related compounds on the sperm membranes will also be investigated both after addition of the compounds in vitro and after administration in vivo.

Lila R. Elveback (with Mary Boyd and Eugene Ackerman): Stochastic Simulation of Virus Epidemics

This project is supported by grant GM-16164 from NIH to Dr. Lila Elveback at the Mayo Clinic.

This project is a continuation of a study abstracted in the previous annual report. That abstract presented the past accomplishments and long-term goals of this simulation study. The following two paragraphs are quoted from that abstract.

"Computer programs simulating virus epidemics within a structured population have been developed. Queuing techniques and human engineering goals have been used to optimize both computer storage requirements and the investigator and computer time needed to debug and run each program. The program variables include characteristics of the viral agents under study as well as of the population structured into several overlapping mixing groups. The response variables are the characteristics of the resultant epidemics such as duration, number of cases, and attach values. Simulation of IF ... THEN ... statements concerning new hypotheses and alternate parameter levels can be validated by comparison with actual data from field experiences and serological studies."

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"These studies are designed to simulate the behavior of specific viruses and of the population members upon introduction of a few cases into the community. Public health measures, such as immunization with live or killed virus vaccines, school closing, early case detection and isolation, and limitation of public gatherings can be tested to quantitate their effect upon the observed epidemic characteristics. Previous work with enteric viruses such as Coxsackie and polio virus investigated the extent of the role of the interference phenomenon in limiting epidemics when a person is vaccinated with one live-virus strain during an epidemic of the other virus."

During the past report period work on this collaborative project has proceeded. Papers have appeared in journals based on this work and a paper to be presented by Dr. Elveback has also been completed.

Simulation studies have been divided into two types. First are those concerned with Influenza A virus epidemics. Here effects of school closing, vaccination procedures, and other public health measures are being simulated. The computer program have been modified to report age specific attack rates and secondary attack rates for ease of comparison with observed epidemiological data. Provision is included to compare several alternate definitions of secondary attack rates.

The second group of simulations are sensitivity studies. In these the sensitivity of the model to the various pseudo-sociological structures is investigated as well as the relative effectiveness of the numerous age and pseudo-sociological mixing group specific contact, susceptibility, and excretion rates. It has been found for example, that the present model structure results in greater interference effects between two competing viruses.

During the next year, it is planned to expand and continue the studies of vaccination regimens for Influenza A. This will include different schedules of vaccination, different types of vaccine, and alternative patterns for acquiring partial and total immunity. It is also hoped to assign a significant portion of the effort on this project to extended sensitivity studies.

Ivan D. Frantz, Jr. (with Laël Gatewood): Minnesota Coronary Survey

This project is supported by grant HE-09686-04 from NIH to Dr. Ivan Frantz in Medicine.

The Minnesota Coronary Survey project is being carried out in six mental hospitals and a nursing home in the State of Minnesota, to determine if a diet low in cholesterol and saturated fats will reduce the incidence of myocardial infarction and stroke. Approximately 2400 men and women are currently under observation. These have been randomized into two equal groups, one of which is maintained on an ordinary American diet and serves as a control. The study is being conducted according to a double-blind design.

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Coronary events are detected in three ways: 1) by routine electrocardiography on all subjects every six months; 2) by serial electrocardiograms and serum enzyme studies on all acutely ill subjects whose illness is at all suggestive of myocardial infarction; and 3) by careful post-mortem examination.

The project maintains a staff of food service workers in each of the seven institutions. These employees, under the direction of a dietitian, are responsible for insuring that the subjects receive the proper type of food, according to their dietary assignment. Technicians employed by the project are responsible for the collection of blood samples, the recording of electrocardiograms, and the submission of data to the University. These data are continually monitored for errors and collection trends which may need to be altered. Periodic analyses are performed to examine different subsets of the population and to evaluate some of the risk factors pertaining to coronary disease.

Robert J. Isaacson (with Bruce A. Boraas): Quantitation of Jaw Function

This project is supported by grant DE-03528-01 from USDHA to Dr. Robert Isaacson in Dentistry.

This project is to refine and initiate production of data quantifying mandibular function in three planes of space. A working system has been demonstrated during our current year of design and construction despite the fact that grant support has only been in effect for 5 months (grant period May 1, 1972 - April 30, 1973). Our system has been modified from the original proposal to employ three light emitting diodes attached by clutches to each jaw. The light beams are stereoscopically imaged by a system of mirrors on to photographic film. The film is digitized to magnetic tape for entry into computer systems for analysis. Jaw function can then be expressed independent of head movement with the entire clutch system weighing about 6 grams. Cephalometric radiographs are to be used also to enable expression of jaw movement at any point i.e., condyle, molar, etc., with a high degree of accuracy.

This system and method will permit quantitative evaluation of function in previously described facial skeletal and occlusal growth patterns. It will also permit the quantitation of the functional changes or lack of changes produced by orthodontic and dental procedures.

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Jim L. Jacobsen (with Laël Gatewood): Bilateral Comparison of Average Evoked Potentials

One of the ongoing projects in the Higher Cortical Functions Laboratory at the Minneapolis Veterans Administration Hospital involves the use of Averaged Evoked Potentials (AEPs) to study brain damage in patients on the neurology wards. Small evoked potentials arise from cortical structures following light, sound or somatosensory stimulation. The evoked potentials are buried or hidden in the background EEG but can be extracted from the random EEG background by averaging several epochs of EEG following the stimulation. The EEG epochs (or segments of EEG) are EEG samples of a fixed time interval (i.e., 500 ms). As the segments of EEG are summated the stimulus-correlated evoked potential builds up geometrically while the EEG noise builds up arithmetically. The result is an averaged evoked potential (AEP). Our preliminary experimental work with brain damaged neurological patients has shown that the distribution of AEPs over the scalp on the side of the brain damage differs from the AEP distribution of the non-brain damaged side. Control patients without brain damage do not show differences in AEPs from one hemisphere to the other hemisphere. The structures also correlates with the locus of brain damage as diagnosed using conventional brain scans, neurological examinations, angiograms and other methods which serve to localize the site or locus of brain damage. This preliminary work was carried out using a Model 6 electro-encephalograph, a 7 channel FM tape recorder, a Model 1052 Fabri-Tek signal averager, and a Hewlett-Packard Model 135 X-Y Recorder. Doing AEPs with this equipment configuration, although accurate, has been very time consuming. It has required 20 hours per patient of a clerk's time for data processing and making charts, but statistical processing of differences in AEPs between hemispheres has been virtually impossible. Tim VanEgeren of the Biophysical Monitoring Group at the VA Hospital has written a program to analyze the EEG data on the Control Data 3300 at the VA Biophysical Monitoring Laboratory but a Calcomp or digital X-Y plotter is not available at that location. The Health Computer Sciences Center at the University of Minnesota offers both hardware and software facilities that are ideally suited to test out the use of a computer controlled digital plotter for our AEPs. The need for large scale, accurate computer controlled plotting becomes readily apparent when one considers that each experiment with each patient produces 120 to 240 separate AEPs. The AEPs will be plotted separately for the left and right hemispheres, and then plots will be made of the AEP of the left hemisphere superimposed on the right hemisphere. A statistical study will be run using a series of T-tests of the differences between mean digital values of each ordinate in time of the left versus the right hemisphere and a plot of these T-test values will also be made. Sets of plots will thus be present for the AEPs over each hemisphere, the differences of the AEPs for the left versus the right hemisphere at points along the plot. If the project using the Health Computer Sciences facilities seems feasible, we will use them as a customer until the V.A. Hospital Biophysical Monitoring can purchase a digital plotter and develop the necessary software packages.

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Marcus Kjelsberg (with Laël Gatewood, Bruce Boraas, and Michael Diffley):

Coronary Prevention Project

A contract was awarded to the Division of Biometry at the University of Minnesota by the National Heart Lung Institute to coordinate all data processing activities for a new clinical trial, beginning with screening in the Fall of 1973. The following is taken from the Request for Proposal for the Coordinating Center.

A coronary risk factor screening program will be conducted to identify approximately 12,000 middle-aged men without pre-existing disease who are in the upper percentiles of risk for developing coronary heart disease. In half of this group, a five-year prevention program will be designed to lower serum cholesterol, reduce diastolic blood pressure, and decrease cigarette smoking. The incidence of fatal and non-fatal coronary disease will be examined in both groups during this period of observation. Data will be coordinated from twenty clinical centers, and central EKG and Clinical laboratories. Reports will be generated monitoring screening and followup, editing this information, and summarizing patient, center, laboratory, treatment group and trial experience. Analyses will be performed on data from this and other clinical trials concerned with coronary prevention.

Richard Moore: Heart Wall Contraction Pattern in Heart Disease Patients and Normal Subjects

Ciné angiograms and ciné ventriculograms will be chosen of normal subjects and of patients with myocardial pathology (akinesia, dyskinesia, and paradoxical contraction). Measurements will be made of wall position versus time, and the data will be analyzed to examine the feasibility of use of the Fourier Analysis to help distinguish between normal and abnormal heart wall movements.

Francis Roger (with Laël Gatewood, Ivan D. Frantz. Jr., Eugene Johnson): Serum LDH Evaluation

The following excerpts from the Masters' thesis submitted to the University of Minnesota Graduate School by Francis Roger, a post-M.D. student from Belgium. A number of articles are being prepared for publication and will be detailed in the next Annual Report.

The discovery that enzyme determinations provide an easy way for diagnosing lesions of organs and tissues has brought about a stormy development in clinical enzymology. Among the numerous enzymes thus far introduced into medical practice, lactate dehydrogenase enzymes (LDH) occupies an exceptional place. This special position is due mainly to the fact that enzyme activity increases in the serum of patients presenting a variety of disorders that occur frequently, such as heart diseases, malignant tumors and diseases of the liver and the bile ducts.

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As the number of victims of ischemic myocardial disease is particularly large, improvement and refinement of its recognition is undoubtedly of great importance. The Minnesota Coronary Survey, a five year project devoted to testing the effectiveness of a low cholesterol and saturated fats diet in reducing the incidence of coronary disease, provides an excellent opportunity to validate serum LDH activity. In order to detect coronary events in this survey, serial total-LDH and heat-stable LDH determinations were performed following Strandjord's method on 1228 acutely ill subjects from September 1966 to December 1971 in seven Minnesota state mental hospitals. In addition to these measurements, serial electrocardiograph were taken during the same acute illness episode in the same subjects, and postmortem examinations were performed on 222 of these patients. Also a computerized medical record was kept for all illnesses occurring in this population.

It was these considerations that led to the choice of this enzyme as the subject of the present study, which was undertaken with two main objectives in mind:

1. to investigate the validity (specificity and sensitivity) of total-LDH and heat-stable LDH isoenzymes in patients with acute myocardial infarction confirmed by autopsy or diagnosed by electrocardiography.
2. to examine the usefulness of these enzyme assays in confirming several other diagnoses made in the population at hand.

Serum total lactate dehydrogenase (LDH) and heat-stable LDH serial measurements were performed from the first hours to 10 days after the onset of an acute illness in these patients. The best single indicator of acute myocardial infarction was found to be maximum heat-stable LDH activity above 350 I.U when determined following Strandjord's method, with a specificity of 98.13% and a sensitivity of 75% in an autopsied series. This cut-off point also allowed detection of an equivalent proportion of true positives and to reject as large a proportion of true negatives when the electrocardiogram was considered as the diagnostic test in the non-autopsied population. Maximum total LDH and maximum LDH ratio (HS-LDH/TOT-LDH) showed a slightly lower specificity with regard to the diagnosis of acute myocardial infarction. Both total LDH and heat-stable LDH appeared to lack specificity in detecting other diagnoses.

Alan Treloar (with Eugene Ackerman, Laël Gatewood, Prithwis Das Gupta): Menstrual and Reproductive History

This study is carried out under contract with the National Institute of Child Health and Human Development at NIH. The following three paragraphs outline three separate studies currently being carried out under PH 43-65-1014 on the data base consisting of over 38,000 woman years of menstrual and reproductive history.

Model Studies of human reproductive patterns. A woman's reproductive life consists of a number of cycles each of which involves three time periods in the

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following sequence: (1) the waiting time for a conception, (2) the gestation period, and (3) the postpartum amenorrhea period. Assuming arbitrary time independent probability distributions for these intervals, Perrin and Sheps (1964) and Das Gupta (1970) have presented stochastic models of human reproduction that have never been adequately tested by using real data. The primary objective of the proposed research is to examine these models in the light of the excellent data bases that are available to us. Attempts are first being made to give specific forms to the arbitrary probability distributions mentioned above, and estimate the parameters involved therein from the available data. The data would also provide us with the opportunity to study numerous derived characteristics of fertility, such as the distribution of intervals between two livebirths, the distribution of number of livebirths in a fixed period of time, the pregnancy and fertility rates, and the distribution of open birth intervals. In case the basic distributions are found to be dependent on factors such as age and parity of the woman, these characteristics would be studied using stochastic simulation.

Possible genetic determiners of menstrual characteristics. An area of investigation which is being re-examined is to quantitate the possible correlations in menstrual and reproductive characteristics between mothers and their daughters, or between sisters. The main purpose of this sub-study is to look for evidence of any resemblance or association of certain menstrual characteristics (e.g., age at menarche, cycle length, cycle variability, gestational interval, etc.), and if so, whether it is indicative of any possible "inheritance" from mother to daughter. Currently, there are available data from approximately 400 mothers and 600 daughters to help investigate these possible associations.

Cohort analysis of various population differences. To search for possible bias in the collaborator panels, a study will be made of all the women who enrolled in this study. Information about menstrual characteristics and age is available on Primary Record Forms, which were filled out by the women before submission of the first yearly record. These data will be grouped by form type and record status of each woman, i.e., Never Active, One Year Only, and Several Years of Activity. Frequency distributions should then serve to identify any possible areas of bias for further study if necessary. Records from the University of Minnesota's Student Health Service covering the same time period are available for computer processing. These records could help to resolve conflicts suggested by the data base by offering for comparison a random sample of women attending the University during the past forty years.

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M.W. Anders: Stereochemistry of Microsamal Drug Metabolism

A portion of this problem consists of a kinetic analysis of the hepatic metabolism of optically active drugs. These studies will be conducted in vitro. Other studies will extend these observations to the clinical situation involving human volunteers. Again a kinetic analysis of the results will be required as well as statistical processing. The HCS facilities will be used for processing this data.

David O. Born: The Dental Information Service Center

The Dental Information Service Center (DISC) is a program for Minnesota dentistry which extends computer technology and information systems approaches to the health manpower sector. As such, a major goal is to provide dental administrators and health service planners with comprehensive, reliable and up-to-date manpower reports appropriate to the requirements of decision-making, policy development, and long-range planning. An equally important goal is to address as effectively as possible the information needs of individual practitioners and their auxiliaries.

The Dental Information Service Center is under the direct supervision of the coordinator and functions as a research and service arm of the School of Dentistry. Both the Minnesota Dental Association and the Board of Dentistry serve in advisory roles.

The DISC operation is designed to analyze the functional manpower information needs of dental practitioners, dental administrators, and dental educators. These are the individuals who are actively involved in the decision-making situations which comprise the dental manpower "problem." It is their decisions which directly influence the supply, demand, and distribution of manpower.

Among the services presently being developed are the following: auxiliary personnel placement services, practice location search services, continuing education monitoring services, and program announcements in continuing education. Other services relating to economic development and practice management are also planned.

Funds for the development of the DISC project have been provided by the School of Dentistry. Implementation and operations funding is being provided under NIH Contract 72-4272 (BHME-DDH). A descriptive article appeared in Northwest Dentistry, Jan.-Feb., 1972.

Bruce A. Boraas: TSS User's Manual

The Timesharing User's Manual currently includes twenty-three documented general purpose library programs. In addition to local dissemination, requests for copies have been honored from over thirty health care agencies and related institutions across the nation.

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Peter Briggs: MMPI Box Form Scoring

Health Computer Sciences applications programmers developed and implemented a computer system for scoring MMPI's (Minnesota Multiphasic Personality Inventory). This computer service now maintains the scoring program for the MMPI. This program scores all tests given for service and research purposes by the University Psychometric Laboratory. In addition, the program stores the test data for later recall by research workers.

The second function of the program is to maintain a file of all testing and of the testing activities of the Psychometric Laboratory. These data are used for the study of our service program and for research purposes.

Glenn Brudvig : Bio-Medical Library Serials Control System

The use of the DHCS computer facility by the Bio-Medical Library was initially geared to one application--that of serials management. This application included the following:

1. Daily transactions for new journal arrivals, volumes to be bound, volumes returned from bindery, lost issues, subscription renewals, and claiming issues not received.
2. Production of listings of serials, arranged by the title, abbreviated title, and call number.

This system provides full information for all serials, the most heavily used library materials, and remains today one of the most comprehensive systems of its type in any library in the U.S.

Additional applications were developed to support acquisitions and cataloging of library materials after the Bio-Medical Library became an independent unit within the Library system. The acquisitions system handles the following:

1. Complete listing of all materials which have been requested, ordered, received, and cataloged.
2. Printing of purchase orders.
3. Accounting.

A machine readable Subject File has also been developed to assist in cataloging operations.

The serials management and acquisitions systems are programmed in FORTRAN (CDC lower 3000 series) and require the CDC 3300 computer facility. Card reader, tape, disk, and printer are required peripheral equipment.

The Subject File application is programmed in COBOL and uses the same CDC 3000 hardware as above. All developmental work and programming was handled entirely by our own staff members.

The above projects have improved service to all health science personnel by providing easier and faster access to information. In addition it has

provided innovative approaches to the control of medical literature which are readily applicable not only to other medical libraries but to libraries in general.

This project, which initially ran on an uncharged basis, now performs substantially the same operations on a paying basis.

Prithwis Das Gupta: Two-Sex Models of Population Growth

A general two-sex model has been presented in my paper, "On Two-Sex Models Leading to Stable Populations." This paper has been accepted for publication in Theoretical Population Biology. This was also read at the Annual Meeting of the Population Association of America in Toronto, Canada, in April, 1972.

The general model, as described in the above paper, uses a functional which is the effective population corresponding to men of age a and women of age a! This functional depends on the age-sex distribution of the population. Further research is needed in order to specify the form of this functional based on how men and women actually interact with respect to their relative ages.

I would propose a particular form of this functional and apply that specific model to the U.S. population for all the years 1940-1971. A comparison of the results so obtained with the already existing results from the one-sex model would enable us to judge the merits of the proposed model.

R. Dietzman, R. Ponto: Post Traumatic Pulmonary Insufficiency

Evaluation of pulmonary function using an Anger scintillation camera and radioactive xenon gas.

Earl Dunham: Studies on the Release and Vascular Effects of Prostaglandins

An investigation is being carried out in which the release of prostaglandins into the circulation from various vascular beds is being measured. This involves extraction of blood, subsequent purification, and finally measurement of the prostaglandins using bioassay techniques. The low amounts of prostaglandins recovered necessitate usage of a bioassay system rather than a chemical assay. Adequate interpretation of the bioassay results is

accomplished by application of statistical treatments described by FINNEY (1964). A FORTRAN program, devised by Dr. E.A. Johnson, is being used for the statistics. In addition, the program is being used for analysis of dose-response curves in experiments concerning the vascular effects of prostaglandins and the modification of these effects by other agents.

Richard V. Ebert: Hospital Cost Survey in the Department of Medicine

Hospital costs of patients admitted to the Department of Medicine will be broken down into room and nursing, pharmacy, dressing and supplies, laboratory, radiology, operating room, other services, miscellaneous, diagnostic radiology professional fees, therapeutic radiology professional fees, nuclear medicine professional fees, cardiology-adult professional fees, and total hospital cost. The mean, median, and total cost will be obtained for each category, in addition to costs per hospital day.

Ivan Fahs: Study on Surgical Services for the United States

This study is an attempt to learn how surgeons allocate their day. A survey form is being developed so that the sample of 12,000 may be able to describe how they spent one specific day.

Listing of Goals:

1. Concrete data on a specific surgical activity (can be correlated with a variety of factors).
2. Relation of operative non-operative work loads between certified and non-certified surgeons.
3. Factors associated with discrepant rates of various operations in different groups (geographic, income groups, etc.)
4. Performance as related to urbanization of population.
5. Performance as related to educational quality.
6. Performance as related to age, experience.
7. Performance as related to size and support structure of hospital.
8. Performance as related to physician's practice arrangement.
9. Performance as related to type and method of patient contact.
10. Performance as related to miscellaneous social factors.

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Greg Foley: Air Quality Monitoring

Beginning in June, 1968, through contractual arrangement, a statewide air sampling program was undertaken for the Minnesota Pollution Agency. This program collected several types of air quality measurements from sites located through the state. The program was later expanded and updated to use telemetered data and computer sorting and calculations to define the Air Quality over Minnesota. Originally, the program was to report to the 1969 session of the State Legislature. Thus, instrumentation used was limited to that available. Many dust fall samples, for example, formed the basis for the network. The more detailed sampling, necessary to define specific localized problem areas, was installed later.

A second reason for monitoring is to record trends in air quality. A certain amount of data is necessary if available funds are to be allocated to personnel and equipment to achieve the maximum benefit. Knowledge gained of the problems throughout the state will prove valuable in the future air pollution control operations of the Pollution Control Agency.

A third reason for monitoring is to provide supportive data for initiating and monitoring emergency episodes. The instruments then either confirm the National Weather Service HAPPA reports, or independently trigger action by the Pollution Control Agency.

A final reason for conducting a sampling program of this type is that it brings the concept of air pollution control to the attention of a number of local officials throughout the state. The "public relations" benefit must not be overlooked, especially by an agency that is seeking to develop programs and regulations affecting directly or indirectly a very substantial portion of the population.

This program is presently operating in the above mode but additions and modifications are now being studied and will probably be implemented during the next calendar year.

F. C. Goetz: Clinical Research Center

The General Clinical Research Center is available to a variety of investigators studying carbohydrate, fat, and protein metabolism. We are using the CRC program for hormone assays, including insulin and growth hormone, which are the principal activity of the immunoassay laboratory. A new immunoassay program has recently been converted and is currently being evaluated. It is hoped that use of this new program will enable more direct comparisons between results obtained here and at other centers across the nation where this same program is also being run.

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J. Grosz: Physical Medicine and Rehabilitation

This project has been set up to be an on-line problem-oriented medical record system with the ability to retrieve and print out data for evaluation purposes. This includes the physician and the allied health professional's clinical data and patient charge information.

Robert Hiller: Vital Statistics
Minnesota State Health Department

Listed below are Health Department projects which involved the use of the HCS facilities.

1. Statistical studies from the vital records files including births, deaths, marriages, divorces, and population.
2. Editing of and statistical studies from public health nurse activities report.
3. Production of monthly statistics from venereal disease case reports.
4. Statistical analysis of a dental health survey of mercury levels in dentists' offices.
5. Production of monthly statistical analysis of sanitarian activities reports.
6. Develop file and produce reports concerning local health officers.
7. Statistical study of mycobacteriosis records from the medical laboratory.
8. Develop file of licensed well drillers information in Minnesota.
9. Statistical study of rheumatic fever case reports.

Robert Hiller: Hospital Services
Minnesota State Health Department

In connection with hospital services, the following projects involved use of the Health Computer Sciences facilities:

1. Development of health care facilities system. Production of routine reports. Statistical studies from the health care facilities file.
2. Monthly statistics concerning medicare provider certification.

Health Computer Sciences facilities are utilized by the Minnesota State Department of Health on a regular basis to maintain an inventory file of health care facilities and services for aid in analyzing health care needs and trends within Minnesota.

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K. Keenan: Orthodontics Billing

Bills for payment on contracts for Orthodontic treatment are prepared by computer, and records of contract amounts, payments due and payments made will be maintained. A convenient, accurate system has resulted, which now runs on a production basis.

K. Keenan: Orthodontics Patient Records

Clinical records for Orthodontic patients are maintained and updated by computer, utilizing CRT input, and summary reports are prepared. Data is input by Orthodontics clerical personnel, and reports are requested as needed via hardwired CRT located in the Orthodontics offices.

Arnold Lazarow: Current Awareness Service

A current awareness bulletin, the DIABETES LITERATURE INDEX, is produced by the staff of the Diabetes Literature Retrieval Project and distributed by the National Institute of Arthritis and Metabolic Disease. Recipients of this index are diabetes research investigators, medical practitioners, libraries and other interested parties. The diabetes-related bibliographic citations are extracted from MEDLARS (Medical Literature Analysis and Retrieval System) magnetic tapes furnished by the National Library of Medicine. A series of computer programs written for the Control Data 3300 is used to organize the publication material. Citations are arranged, read by author, by keyword in title, and by hierarchal subject classification. Final editing is accomplished by a medically-trained editor with the aid of the Control Data model 211 CRT terminal. The final published index is produced with the aid of the LINOTRON phototypesetting system at the U.S. Government Printing Office directly from a magnetic tape provided by the Diabetes Literature Retrieval Project.

Vaughn C. Moore: Radiation Therapy Treatment Planning Programs on the PC/PDP-12/CDC 3300

Recently, the SPEAR PC computer in Therapeutic Radiology was connected to the PDP-12 and will eventually be connected to the CDC 3300. At the present time, the PC will act as a remote teletype, and it is possible to use the TSS/8

time-sharing system on the PDP-12. As the degree of communication capabilities increases between the PC/PDP-12/CDC 3300 systems, we will begin to utilize the systems to develop programs for handling various patient-oriented radiation therapy treatment planning programs. At present we have several programs which operate on the CDC 3300 alone which we wish to access with the PC. We will also develop more programs as the necessity arises.

Rodger A. Nelson: Spectral Peak Analysis of Far-Red Absorption Bands in Photosynthetic Bacteria

In applications where quantitative information must be derived from recorded spectra, it is convenient to fit spectral lines with Gaussian or Lorentzian functions and to calculate the desired quantities from the function parameters. This method also enables one to resolve overlapping Gaussian Curves and to quantitate the area, etc., under each component curve in a spectra.

We intend to analyze overlapping far-red absorption bands in the photosynthetic bacteria utilizing a digital method of spectral peak analysis. This should provide us with better data regarding spectral shifts, quantitative differences, etc., between individual components in the spectra we observe under various experimental conditions.

We are also interested in obtaining digitally computed plots of higher-order differentials of our experimental data. From these plots we can better determine the number and size of component curves in an overlapping far-red absorption spectrum.

V. Ostenby: St. Paul Area Chapter American Red Cross Automated Blood Bank System

The automated blood bank system is designed to maintain a current inventory on all blood units circulated by the St. Paul Regional Red Cross. The system is designed to provide a complete and current daily inventory and accompanying management summary, as well as monthly operating and activity reports. In addition, the system will develop and update various historical files, recording the dispensation of all units of blood entered into the system.

As of the end of September, the Automated Blood Bank System has been operating in a daily production mode for six months. During this time, all system programs have been run, in production, and have run successfully. The normal day-to-day processing is handled entirely by the computer room production staff who have maintained the rigid Red Cross time schedule with only two or three exceptions, with those exceptions caused generally by hardware malfunction.

They have, in fact, exceeded expectations in utilizing the error recovery procedures in July and August when the disk difficulties, which have since been corrected, frequently disrupted the runs. In addition, all planned production reports have been generated and accepted by Red Cross.

The system documentation, consisting of eleven volumes plus a general description, is complete and corresponds, as of the September update, with the current operating system. The documentation modification procedures of collecting modifications until the additions and changes warrant distribution has eliminated much duplication of effort otherwise involved in maintenance of the large number of volumes in different physical locations, while maintaining reference accessibility.

The in-depth backup procedures designed for the system have been shown to be both necessary and complete. These procedures, backing up personnel, hardware, input, files and programs, have been successfully used under production conditions during the last six months. It is expected that these procedures will continue to be adequate in the future.

With the exception of the difficulties with the annual programs, and the recent updating of the documentation and program files, maintenance has been a minor, although constant, task. The policy of having a maintenance programmer, other than the two project leaders, has proven effective, especially in providing consistency in the program corrections and ensuring the presence of a knowledgeable person when trouble arises.

The system has shown itself to be easily modified when necessary. Red Cross has officially inquired about modifications three times and has accepted the resulting cost estimates twice. Both modifications were accomplished below estimated cost. One or two changes, such as respacing the annual blood report, have been made in response to unofficial requests during other maintenance. To increase efficiency, the job DAILY3 and YEARLY2 have each been broken down into two jobs causing minimal system interruption.

Paul Rupprecht: Student Health Service Questionnaire Data Storage and Reporting System

The Student Health Service Questionnaire Data Storage and Reporting System consists of five programs written explicitly for this system together with several applications of the available library routines, organized into five production runs called jobs. These jobs manipulate nine magnetic tapes and communicate between each other through a small disk control file. The three jobs associated with storing the questionnaire data are run on a weekly, quarterly and yearly basis. The job which produces a report listing students whose questionnaire answers fulfilled specified criteria is run upon request of the Health Service. The remaining job is used to restore the control file in the eventuality that it is lost due to machine or human error.

Collection and digitization of the questionnaires is done by the Student Health Service and the Student Counseling Bureau. The Student Health Service distributes the questionnaires quarterly to incoming students and sends the questionnaires to the Student Counseling Bureau as it collects them. Approximately once a week, the Counseling Bureau reads the questionnaires on their optical scanner, producing a 7-track magnetic tape containing the questionnaire data. This tape is then delivered to the operator in the HCS computer room and the older of two previous weeks' tapes is picked up.

When the Student Health Service wants a report from the accumulated data, listing the names of students who answered from one to ten questions within specified ranges, a brief form is completed and delivered to the HCS I/O room. The report is produced by the computer operators and held for pickup by Student Health Service personnel.

F. Shapiro: Community Dialysis Center

The purpose of this project is twofold:

1) Establish a data base of information relating to patients currently active in the dialysis program at the Community Dialysis Center. This data base will contain financial, clinical, and demographic information.

2) The data base will be used for improved patient care and statistical research.

The files for all Dialysis Clinical patients are now complete. The information from these files is currently used by the Clinic doctors for information regarding patient care. The collection of data is an ongoing project and it is hoped that the data collected can be utilized for research in Health Care Delivery. Current plans call for expansion of the system to provide more on-line access either within or without the Health Computer Sciences Center.

Leighton G. Siegel: The National Registry for Idiopathic Sudden Deafness

Sudden deafness can be defined as an abrupt severe loss of sensorineural hearing. It is estimated that every year in the United States, over 40,000 people develop an idiopathic sensorineural sudden deafness. This statistic does not include large numbers whose sudden hearing losses are attributed to known causes, such as Meniere's Disease, Otoxic Drugs, Acoustic Trauma, etc. In spite of the high incidence of idiopathic sensorineural sudden deafness, little is known of the cause or causes and as a result, no standard effective

treatment can be administered. Current forms of treatment depend mainly upon the attending physician's particular bias as to etiology plus the fact that approximately half the patients seem to recover some of their hearing spontaneously irrespective of treatment. There is no way of knowing which of the current therapies, if any, would result in a higher recovery rate.

A National Registry for Idiopathic Sudden Deafness has been established in the Department of Otolaryngology at the University of Minnesota through a three-year grant from the John A. Hartford Foundation, Inc. The Minnesota Regional Hearing Center will serve as a central repository for reporting of such problem cases in the United States. Because no single physician or clinic sees enough cases of sudden deafness to do a significant analysis and study, it is desirable to pool and coordinate the experience of many.

A letter explaining the project will be sent to all otolaryngologists in the Uni ed States in an effort to obtain their participation. Those who participate will be sent diagnostic, therapeutic and follow-up protocols in addition to a comprehensive patient questionnaire for use on patients with idiopathic sensorineural sudden deafness. These, when returned, will be subject to analysis and revision. Specific studies may change during the three years contingent upon the analysis or other new information.

By systematically collecting and analyzing data from physicians in other parts of the country it is likely that diagnostic efforts and treatment modalities can be assessed. It is hoped that patients with idiopathic sudden deafness will eventually be treated with a standard and effective regime. This will follow from a better understanding of etiopathogenic factors which evolve from a comprehensive diagnostic approach to the problem of idiopathic sudden deafness which is the main objective of this study.

Fernando Torres: Visual Evoked Responses and Carotid Compression.

Responses to light flashes recorded from several scalp electrodes of patients with cerebrovascular disease and of normal control subjects at rest (baseline) during alternate compression of the carotid arteries in the neck will be analyzed. It is expected that differences will be found in response characteristics between patients and controls both at rest and during carotid compression. These differences may serve as indicators of localized areas of cerebral anoxia. In addition, detailed analysis of responses of normal subjects and their possible changes during carotid compression may contribute to the understanding of physiological mechanisms in the production of visual evoked responses.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

D. B. Wetlaufer: Structural Principles in Globular Proteins

Our plan is to build simplified three-dimensional models of the twenty or so proteins whose three-dimensional structure is known and to attempt, by inspection, to discover generalizations which have escaped others. We plan to build bent-wire models which trace the contour line connecting the alpha-carbon atoms of the peptide chain. We have an instrument (designed by Rubin and Richardson at Duke University) which can put a series of bends, with specified dihedral and bend angles, into a continuous piece of straight wire. We need computational assistance in converting three-dimensional coordinates of the alpha-carbon atoms into a series of bend and dihedral angles. Other possible analytical uses of the computer service may arise before completion of this project.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Donald A. Beimborn: Comparative renal structure and function in wild and domestic Mus Musculus

Two strains of laboratory mice are being compared with wild Mus musculus with respect to renal structure and water usage. The problem is a basic ecological one, investigating alterations in the laboratory forms which are related to the captive situation along with the remarkable adaptations of the wild mouse to living in buildings with men.

The project has reached the point where some statistical work must be done. No new programs will be written and it is anticipated that computer time required will be less than thirty minutes.

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George Bergh (with George Klee, Lael Gatewood): Aortic Model Studies

George Bergh is a medical resident who has been working on a Masters of Science degree in Anesthesiology. He has continued a project begun by George Klee, a student in the MD/Ph.D. program in Biometry, who wrote the following project description.

Cardiac output is an important parameter for the clinical monitoring of patients in intensive care situations. The computerized monitoring system at the University uses a "windkessel" model to predict cardiac output from the pressure waves. A series of comparisons have shown that there is substantial disagreement between the cardiac output predicted by this model, and the output measured by indicator dilution or electromagnetic flowmeter methods. The areas of major disagreement are when there are "bouncy-double peaked" pressure waves or whenever there is considerable blood loss.

Various linear network models have been considered to improve the estimation of cardiac output and to predict instantaneous blood flow. The parameters of these models have been computed using least squares fitting procedures. The parameters were determined first by a least squares fitting over diastole-assuming zero flow, and also by a least squares comparison of the pressure waves to the flow waves measured with an electromagnetic flowmeter. Good representations of the flow were obtained when the parameters were determined by the second method; however, there does not appear to be a consistent way of predicting the parameters.

Experiments on the placement of catheters have shown (at least on one dog) that the "bouncy-double peaked" pressure waves are an artifact due to recording of the pressure in the subclavian artery. Simultaneous recording of the pressure in the descending aorta showed smoothly decaying exponential pressure during diastole. Two procedures are being investigated to try to overcome this distortion effect. The first procedure is a consideration of clinically inserting the catheters into the femoral rather than the brachial artery. However, since this is much more inconvenient, an attempt is also being

considered to numerically replace the pressure during diastole with the best fitting exponential and to use this pressure wave to predict cardiac output.

At this time it is our opinion that in order to accurately predict blood flow or cardiac output, more information is needed than simply a pressure wave measured at one point in space. Studies are now being considered to try to improve the prediction of cardiac output by monitoring more parameters. Three methods have been discussed. The first is to measure both venous and arterial pressures and to assume that the arterial pressure during diastole is decaying toward the venous pressure rather than towards a fixed constant. The second method is to use the pressure differential between two points in the aorta to help improve the prediction of peripheral vascular resistance. The third method is the possible use of catheter tipped flowmeters.

James R. Boen: Biometry Consulting Seminar

Initially, a file containing biographic, demographic, treatment, clinical, and follow-up variables is to be established. Appropriate selection of variables related to follow-up outcome will be considered. The final selection of variables will be used in conjunction with multiple classification schemes to determine the risk of being in the follow-up categories at a specified time. The procedure will be tested on a new set of patient variables to check for validity.

Joseph Giganti: Optimization of Spatial Dose Distribution in External Beam Radiotherapy

The use of computers for optimization in radiotherapy requires (1) a suitable method for generation of a variety of radiation beam fields, (2) programs capable of superimposing such beam fields and (3) a judgment algorithm by which resultant superimpositions can be evaluated. The optimum way to represent a beam for this purpose will have to be investigated as will the elements which ultimately bear upon the "judgment" of a generated treatment plan.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Richard Heath: Biomedical Computing

The course consists of three quarters of lectures and actual computer usage. Each quarter the student receives 3 credits but plans are to increase the number of credits to 5 per quarter. Students with no background in computers are expected to start with the fall quarter in this series of courses. Those with computer background may omit the fall quarter and begin with the winter quarter class.

During the fall quarter the students spend the first week being introduced to computers; they learn some history, some differences between analog and digital computers, how digital computers handle values and how they are instructed to perform the elemental tasks such as "load" or "add to accumulator." But of most importance and, therefore, most of the first week, time is spent in acquainting the student with the uses of computers in the health sciences. Examples, such as data analyses of tests in clinical laboratories, patient information systems, medical teaching programs, simulation techniques, and patient monitoring are discussed.

Keeping in mind that the students taking this class will probably not become professional computer programmers, we turn to the higher level languages and then select BASIC for the remaining nine of the ten-week fall quarter. BASIC has been chosen because of its simplicity to learn and its wide acceptability and accessibility in the United States. BASIC, *per se*, is not taught; we merely use it to discuss and illustrate many examples of computer programming in the health sciences, which include:

1) Reading, labeling data, creating tables
2) Elementary statistical analysis
3) Storage and retrieval of data
4) Sequential mass storage file management
5) Linear regression and curve fitting
6) Sorting data
7) Concepts of random number generation and their uses
8) Compartmental simulation
9) Simulation of patients waiting for medical care and its implications
10) Digital plotting of functions, experimental data, isodose curves.

Beginning winter quarter we introduce the FORTRAN language, and its use in more advanced biomedical applications. Programming and statistical packages and terminal use through the CRTOS operating system are examined. Many examples from fall quarter are again used but are discussed in more detail. In the spring, topics include data quality control, file processing, computer network philosophy, computer-aided instruction in medical science, interactive graphics, and on-line data processing via small computers.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Howard Holz: Multiple Regression on Air Pollution Weather Data

This project is a Plan B paper for PubH 5-450 sequence. The subject is multiple regression using the weather parameters from the air pollution data that was collected here at the University. By doing this project, I hope to learn more about the multiple regression technique and the use of the TYPE other statement.

Donggyu Jin: Methods of Analysis of Transport Properties of the Membrane

The project involves calculation of several properties of the membrane of the cell. The values from the same input data using alternative methods in the literature will be compared. Statistical tests will be performed on results of sets of experiments.

The results will be used to establish permeability profiles for normal cells to evaluate the effects of treatments (as by radiation or by drugs) on these profiles. It will be applied as an approach to the detection of leukemia and the evaluation of the effects of anti-leukemic drugs.

Alan Moore: Automated Calculation of Xenon Clearance

An inexpensive digitizing device for converting ink recording coordinate values to digital input will be developed. Using the PDP-12 analog-digital converters, and operating under TSS-12, programs will be written to:

1) test effectiveness, accuracy, resolution and convenience of the digitizing device
2) furnish paper tape-based data for statistical analysis for patients on a day to day basis, using FOCAL or BASIC.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

Lewis Wolfenson (with Eugene Ackerman, Lael Gatewood, Donald McQuarrie, and Fred Gobols): A Computer System for Cardiac Catheterization

The following is the abstract from the Ph.D. thesis by the same name submitted to the University of Minnesota Graduate School by Lewis Wolfenson.

A computer system was designed, implemented, and evaluated for the cardiac catheterization laboratory of the Veterans Administration Hospital in Minneapolis, Minnesota. First, a system analysis was performed on the manual procedures employed by the laboratory. It was found that the information flow followed a constant, straightforward pattern. The analysis indicated that the computer could reduce the delay between ordering a catheterization and receiving the results, as well as produce a more accurate report. A formal model was defined which could be used to better understand the reasons for the delay. The analysis served as a guide for the design of the computer system.

The computer system consists of two disjoint subsystems. The patient-care subsystem uses a Control Data 3300, the MEDLAB operating system, and some of the Salt Lake City cardiac catheterization algorithms. It features real-time data analysis of blood pressure waves and on-line return of pressure values. It is able to operate simultaneously with the manual system. The results may be modified at any time and are printed as a report at the end of the catheterization procedure.

The research subsystem features real-time data acquisition of three analog channels from the catheterization laboratory. Flexible data analysis is provided by MIMO, the Minnesota Interactive MOdeling language, which runs on a Control Data 3300 under the MASTER operating system. The researcher has a powerful language at his disposal in which he may specify his problem easily. He uses a CRT terminal to communicate with the program during execution and may display results as tables or graphs. The system is being used in a study of left ventricular contractility.

Several evaluation studies were carried out. A study of data quality used the differences between paired readings of the computer and the technician. It employed analysis of variance statistical techniques to identify factors contributing to high or low differences. The factors of staff physician, cardiology fellow, rest or exercise condition, choice of amplifier, and amplification range do not appear to be important contributors to the difference. Catheter location, pressure type, and patient or day-to-day variation are important contributors. The study succeeded in identifying weak algorithms and problems in the design of the system.

A cost study measured the amount of time taken to compute pressures by both the manual and the computer systems and multiplied these by estimates of the respective distributed costs per unit time. These costs depend critically on the algorithms selected to distribute the expenses. By and large, the distributed costs of the two systems are similar.

The research application was examined. The contractility index computed by machine appears fundamentally sound. The computer-calculated index may be

superior to the hand-calculated index in that the computer uses a mathematical derivative while the technician uses a less accurate electronic derivative.

A number of recommendations were presented. Among the more important are the following: The data-collection loop must include the physician. The need for a real-time system must be determined. The system should be expanded to include additional analyses. The Bio-Physical Monitoring group at the VA should facilitate the use of a problem-oriented language. Increased support must be provided to the project.

Thus, a computer system design, implementation, and evaluation was performed for the cardiac catheterization laboratory of the Veterans Administration Hospital in Minneapolis, Minnesota. It was a significant step in the adaptation of computer technology to the needs of the laboratory, It initiated an on-going program of automation whose goals are to refine and expand the computer system.

DETAILED DESCRIPTION OF RESOURCE PROJECTS

E.H. Brekhus: Introduction of Computer Time-sharing Systems to Library School Students

If a library is to make effective use of a computer system it will be necessary to operate it on a time-sharing basis. While housekeeping chores and printed catalog production may be batch processed, access to a time-shared terminal system will be necessary to effectively update and query the collection's files. An introduction to this process will help to prepare the library school student for his role in providing tomorrow's library service.

Jack L. Dais: Personal Rapid Transit System

Project is to analyze ridership, cost, benefits, and power requirements for a Personal Rapid Transit System.

Rodger Nelson: Analysis of Far-Red Absorption Bands in Photosynthetic Bacteria

In applications where quantitative information must be derived from recorded spectra, it is convenient to fit spectral lines with Gaussian or Lorentzian functions and to calculate the desired quantities from the function parameters. This method also enables one to resolve overlapping Gaussian Curves and to quantitate the area, etc. under each component curve in a spectra.

We intend to analyze overlapping far-red absorption bands in the photosynthetic bacteria utilizing a digital method of spectral peak analysis. This should provide us with better data regarding spectral shifts, quantitative differences, etc. between individual components in the spectra we observe under various experimental conditions.

We are also interested in obtaining digitally computed plots of higher-order differentials of our experimental data. From these plots we can better determine the number and size of component curves in an overlapping far-red absorption spectra.

John Rosevear: Kallestad Computer Education

The use of the HCS computer facilities covered by this application will be for the education of the staff of Kallestad Laboratories, Incorporated, in the effective use of a modern computer facility. This education will aid the staff of Kallestad Laboratories, Incorporated, in their efforts to contribute to improved health care and its delivery through clinical laboratories.