MAY 1 0 1972

DATE: May 9, 1972

To : Dr. Joshua Lederberg
Executive Head, Department of Genetics

FROM : Dr. Donald C. Harrison
Cardiology Division

SUBJECT: The proposal for a new research computer facility for Stanford
University School of Medicine.

Following the meeting which you called to discuss the
characteristics of a research computer system for Stanford Uni-
versity School of Medicine and your plans for submitting an
application for such a facility to the Biotechnology Resources
Branch of the NIH, I have discussed in some detail how the
Cardiology Division could relate to your plans. In addition to
discussing this with members of my staff, I have met with
Dr. Elliott Levinthal and Mr. Ron Jamtgaard to discuss what kind
of contribution we could make to the overall grant proposal and
how it would fit into my own long-term plans for computer
activities in Cardiology.

Following all of these meetings I would like to express to
you my wish to participate actively in this proposal. A number
of members of my staff and our future plans for computer develop-
ment in Cardiology can, I believe, make a major contribution to
the overall program and I am certain that the program will be
very useful to us. At my meeting with you on Wednesday I will
outline in some detail the proposals which we would like to see
incorporated into the final grant proposal. I have discussed
these with your other staff members and will work with them to
develop the necessary detail for a grant application, if you
approve of our participation.

Our Present Assets

In the Cardiology Division we shall be adding a full-time
faculty member in September to take over direction of all of
our computer related activities. This is Dr. Robert Stenson
who has been with us earlier and helped develop our cardiac
catheterization system. He has a degree in electrical engineering
and an extensive background in computer sciences. In addition,
Mr. William Sanders, Director of our computer programming group,
and two graduate students from the Engineering Department are
presently actively working on computer applications in Cardiology.
Dr. Edwin Alderman, Dr. Richard Popp, and I are also actively
participating in the use of computers in Cardiology and for
medical research.

We have recently applied to the National Library of Medicine
for a training program for medical doctors in computer sciences.
This has been reviewed by the Study Section and has been
recommended for funding beginning July 1, 1972. We must await
approval of the Council for funding. However, fellows have been
recruited for a computer training program in 1972-73. As part
of this program we are cooperating with Dr. Edwin Parker of the
Department of Communication and plan integrated teaching
activities for our trainees and his trainees in hopes of getting
individuals to work on medical data storage and retrieval systems.
In addition, we are working with Dr. William Fairbank in the
Department of Physics and Dr. James Meindl of the Integrated
Circuits Laboratory in applying advanced technology in Cardiology.
Both of these projects, which have been funded by NASA and the
National Science Foundation, will require computer facilities
at a later date.

Our present computer assets include two dedicated Hewlett
Packard systems with disc operating systems and the ability to
collect and interpret data from the coronary care unit, from the
cardiac catheterization laboratory, from an ultrasound laboratory,
and from electrocardiograms. We are presently planning the
addition of a third dedicated system in late 1972.

Programs Which Would Relate to the Research Computer System

1.   Interaction of Small Computer Systems

At present our computer systems are used for real-time data
analysis from the cardiac catheterization laboratory, from
the cardiology intensive care unit, from the gamma camera
located in the x-ray department, and from our ultrasonic
laboratory. Much program development remains to be completed
and small machine support from a larger system for our
continuing development activities could be useful. In
addition, data are being accumulated on individual patients
who are studied in several of these units at different times.
The data from each small dedicated computer system provides
the basis for performing highly sophisticated calculations
on the performance of the heart if the data from each com-
puter system can be integrated and manipulated by a larger
machine. This will require the interaction of each small
system with a big computer system. Much research remains
to be done in relationship to our dedicated computer systems
in each of these areas, but tying the outputs from each
system together into an integrated program would represent
a major step forward for us and for our research efforts.

Clearly, much of our work in this area is in an early developmental stage. If after several years, we are successful in our efforts these sophisticated programs would be used on a day-to-day basis for patient care. For that purpose we would expect to transfer our work from the research computer system to the proposed medical school utility system which by that time should be operational. However, for the present time a research system would admirably meet our needs.

2. Computerized Analysis of Heart Images

The interpretation of changes in wall motion of various parts of the heart and changes in volume distribution within the heart is extremely important to cardiologists for assessing the heart function in health and in disease.

Recently we have developed a light-pen-computer-video disc method which has received widespread attention. However, this method is limited because of the inability of our small computers to directly process the video images. With the availability of a larger computer system our plan would be to move to computerized videodensitometric methods similar to those under study at the Mayo Clinic for analyzing video images, and use techniques developed by NASA Ames Laboratory for making three dimensional reconstructions of the heart. While some work has been done in this area, clearly, a major research effort by a group such as ours is indicated.

> The use of computers to analyze images of the heart generated by ultrasonic echocardiography is a newer field of research which shows great promise. Presently, Dr. Richard Popp of our staff, Mr. Michael Hirsch from electrical engineering, Dr. James Meindl, and I are working on new techniques for computerized echocardiographic analysis. Mr. Sanders and Mr. Hirsch have succeeded in collecting echo signals in real-time. They are now attempting to implement a real-time analysis of these signals. As far as we know, we are the only individuals who are attempting to do this at this point. Ultra-high speed A-D conversion, perhaps some input preprocessing, the availability of large file storage, and a fast computer with adequate core would make it possible for us to extend our work with image processing in this area. As a non-invasive method for evaluating cardiovascular function, echocardiography has a great deal of promise. Dr. Popp is one of the leading

investigators in this area and has recently received a
research career development award to continue his work.
We hope to build an array of ultrasonic transducers which
could be activated by the computer control and the
complex return signal analyzed by computer technique.
This would lead us to developing ultrasonic imaging as
a substitute for radiographic procedures now performed
on the heart.

Clearly, much work in the Mars photo analysis program which
you direct would be of immense help to us in our image pro-
cessing. I have discussed this at some length with
Dr. Levinthal and he has indicated that a collaborative
venture with some of your group would be possible.

In all of our uses involving patients, we have an adequate
backup system. Since all of this is research application
it will not require minute-to-minute or day-to-day computer
use. We would, however, wish to schedule higher intensity
use of the computer at various times. The details of this
could be worked out easily among the various groups sharing
the research computer facility.

3. Needs of the Cardiology Division

Our needs can be expressed as follows:

a. We need a great deal of programming help at the central
    computer and would hope that our programmers could work
    closely with the staff of the larger computer facility.

b. We have a need for large core and large disc files for
    much of our work.

c. Support for interconnecting our small computer systems.
    We need compatibility with the Hewlett-Packard computer
    line and would require this for our interactive small
    systems to be attached to a larger computer. I believe
    it would be wise to have compatibility with more than
    the Digital Equipment line in any case.

d. Ultra-high speed input for video and ultrasonic echo
    signals, plus a sophisticated interaction CRT display,
    and graphic hard copy output devices would also be needed
    for image analysis research.

e. Interaction terminals, preferably CRT-keyboard units, for program development and retrieval of information deposited by the interconnected small computers.

f. We would like the help of the overall group in trying to influence the utility system which is developed at Stanford to be compatible with the work we are performing on the larger research system.

Other specific needs and our relations to the system could be worked out in detail with Ron Jamtgaard when he is putting together the final application. I hope that you will choose to have us join you in this grant application and I look forward to discussing it with you Wednesday afternoon.

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cc Dr. Richard Popp
    Dr. Edwin Alderman
    Dr. John Schroeder
    Mr. William Sanders
    Dr. Robert Stenson
    Dr. Elliott Levinthal
    Mr. Ron Jamtgaard