

*Artificial
Organ*

June 24, 1964

Dr. Ralph E. Knutti, Director
National Heart Institute
National Institutes of Health
Bethesda, Maryland

Dear Dr. Knutti:

For sometime I have been puzzling why an artificial heart has not yet been made available as a fruit of our technicological developments. A number of my colleagues joined in some extensive discussions on this topic and would join in the conclusions I present here. I am sure you have given considerable attention to this problem and I would be grateful for your thoughts as well as for your constructive action on some of my suggestions.

I believe the problem is technically difficult but easily managable within the framework of our present scientific knowledge and technical proficiency. We have, however, permitted it to remain a subject of fragmentary scientific studies rather than of a unified engineering program. On balance it should be of the same order of complexity as designing a sophisticated instrument in spacecraft, this of the order of \$100,000,000, and quite unlikely to overreach the requirements of a system like the supersonic transport ten times that figure.

Traditionally, health research is not exploited at techniques of systems development that have been elaborated for military defense and space flight. We are fortunate to have been able to reserve what we could for the viability of basic research. But we do ourselves a great disservice to neglect the opportunity of a systems response to what is now a well-defined technical problem, which is so much a matter of engineering design, material development, and empirical testing, and should not be confused with the basic research that was needed at its foundations.

To jump right on to the brass tacks, I would propose that you take the initiative in exploring the technical possibilities with this development with industry, especially the aerospace industry. There are a number of possible routes that I could command to your attention:

1. Informal conference with the R&D Vice-Presidents, separately or in a group session.

KNUTTI
NHI

June 24, 1964

2. Your issuance of a Request for Proposals for an Introductory Systems Study. This might have to take about 20 man-years to cover the situation properly, i.e., about \$1,000,000 - and some of the initial funding would, to be sure, be relatively inefficient because of the cost of familiarization.
3. Consult with your opposite numbers in NASA or the Air Force how they would evaluate the problem and meet it.
4. Even ask these agencies to do the job on your behalf. Since a surrogate heart could play an important role in supporting strenuous life in challenging circumstances other than medical emergencies, they would have legitimate reasons in joining such an effort.

I realize how constrained NIH's experience has been with industrial contracts, and suspect that this is one of the obstacles to a rational solution to the heart problem. But these precedents, or lack of them, should not confuse the issue: how to harness an efficient technicological system for humanitarian purposes at a time when this is almost too abruptly relieved of its call for national defense purposes.

You may well wonder how I happen to concern myself with this issue which is not in my own field of research. Anecdotally, from the consideration of the probable success of tissue transplantation over the next few years, hearts will be transplantable too, but the problem of equitable access to a very narrow supply seems insoluble. Artificial surrogates could bypass what would otherwise become a very serious social stress. But machine development also attracts a parallel concern. There should be a minimal delay between the first and generally available implantable pumps. Many other factors have to be taken into account; but it would be very unfortunate if we have to face a frenetic selection of contractors and hasty tooling up for production only after the first feeble successes.

I am discouraged to think that many academic investigators now actually working on this problem would probably shout down the more concentrated approach that I recommend. I would by no means wish to displace academic research from its creative role in this story, but these laboratories should be concentrating on more basic issues than designing and testing the pumps. I am sure a much more fruitful allocation of talent will evolve analogous to the interplay between government, industry and the academic laboratories in the construction of space launch vehicles, the design of spacecraft and the implementation of experimental goals in space research. Parenthetically, I should say that my own experience in this area (exobiology), has given me an experience and understanding I might otherwise lack of the connection and the contract between academic science and industrial technology.

You may ask whether one of the other parties to these concerns should not take the initiative, for example to apply to you for study contract rather than for you to take the first step. If there were already better communication between industry and the NIH this letter would probably be unnecessary. Meanwhile, I think we are in an illogical impasse; one which you could most readily resolve. I know that there are many competent firms, certainly in California, who could and would readily undertake such an assignment, but to redirect their interest requires some top level inducement and encouragement such as you could most readily furnish.

I am sure you are sensitive to the need to cope with the solutions as well as the substance of these problems. Indeed, I detect in some of my friends, even in my own thinking, some latent resistance in moving ahead for this reason. But it should be far better to have some plans and sense of policy as we escalate to these problems of the "brave new world". The alternative is no happy status quo ante, rather chaotic advances whose lack of balance and forethought ~~near~~ly aggravate the ~~po~~ complexity.

Sincerely yours,

Joshua Lederberg,
Professor of Genetics

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