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Dr. Paul Harper
Argonne Cancer Research Hospital
University of Chicago
950 East 59th Street
Chicago, Illinois 60637

Dear Dr. Harper:

I was hoping that I could send you more specific information regarding our potential visit to the Argonne Cancer Research Hospital, but a number of factors have interfered with my getting the material together. What we would like to do is see your electron beam therapy facility and talk to a few people who have attempted to use it. We are more interested in the exposure setup than we are in the accelerator. Briefly, our problem is as follows.

Los Alamos is in the process of designing and building a linear proton accelerator capable of unprecedented intensities of 800 Mev protons. We are talking in terms of beam currents of 1 milliampere. The real purpose of this machine is for the study of meson physics. It seems well substantiated by theory and calculation that this facility would enable one to irradiate tumors of up to 10 centimeters in diameter with negative pi mesons at the rate of 100 rads/minute of high LET alpha particles. Although I am sure you are probably aware of it, when the negative pi meson comes to rest, it interacts with carbon, oxygen, and nitrogen nuclei in the tissue, releasing approximately 30 Mev in the form of alpha particle and proton stars. These alpha particles, of course, have very limited range in tissue and, in essence, a Bragg peak effect is produced at the end of the pi meson range. The dose in the Bragg peak region appears to be some 2 to 5 times higher than the entrance dose. In addition, the average LET in the peak region is probably greater than 20 kev/μ, while the LET in the plateau is probably nearer that of 200-KVP X rays.

The proposed Los Alamos meson facility will be able to produce pi mesons with variable kinetic energies all the way from about 50 to about 350 Mev, making it possible to irradiate tumors at essentially any desired depth. Hopefully, the potential of the negative

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pi meson for therapy may be considerably better than any other known radiation for the following reasons: lower entrance dose of low LET, and higher tumor dose with high LET. The high LET in the Bragg peak region may result in an RBE approaching 3.0. It may also result in a low oxygen enhancement ratio of the order of 1.5 as compared to 2.5 to 3.0 for high-energy X rays. This low oxygen enhancement ratio could conceivably augment the killing of anoxic tumor cells.

The question is, therefore, whether plans should be made to utilize the Los Alamos meson facility for experimental cancer therapy and radiobiological investigations. We have about decided that such plans should be made and that we should submit budget requests for funds to adapt the facility to our needs so that the construction of our biomedical addition can be phased in with construction of the accelerator. A very important feature of the accelerator is that it is possible to position more than one target vault along the beam channel, making it possible to do biological work at the same time the physicists are doing experiments, provided, of course, we have a target vault at the exposure facility independent of theirs.

As you might expect, there are many physicists and engineers available to advise us on beam control, target vault construction, and all the other engineering and physics aspects of the problem. We have no one to advise us on what supporting facilities are needed to permit use of the beam for experimental therapy when the exposure setup will be 1-1/2 miles from our medical center. Our situation is very much like that Berkeley faces in using the 184-inch cyclotron. We went to Berkeley last week and actually watched them treat three ambulatory patients with high-energy alpha-particle irradiation of the pituitary. They were able to help us a great deal but, as you probably know, their activities are confined to head irradiations only with high-energy particles.

I would like to visit you with two of the Laboratory's engineers merely to let them get an idea of what is involved in the way of facilities and equipment for exposure of patients to particle beams. We are endeavoring only to get very preliminary drawings of what should constitute such a facility in order that we can make cost estimates for budget request purposes. We must do this by April 1 in order to get preliminary budget requests into the FY 1969 budget. If you think such a visit would be helpful to us, I would appreciate

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the opportunity of coming to see you sometime around the week of March 5. In fact, March 6 would be a good date as far as I am concerned. I am sure we would require no more than half a day of your time, and we would appreciate talking to anyone who may have ideas on this subject. I am thinking specifically of Lester Skaggs and perhaps Dr. Melvin Griem. You may be able to suggest others.

I would also appreciate an opinion from you and Dr. Jacobson, as well as others, on the more philosophical question of whether 2 or 3 million dollars should be added to a 55-million dollar physics facility to make it a potential experimental facility for the biological and medical sciences. We have already more or less reached the conclusion that we should at least give it a try. I would be very interested, however, in hearing your opinion.

Please let me know whether March 6 is a suitable date and, if not, please propose an alternative. The next best date for me would be February 28; I will be in Oak Ridge on the 27th. Please accept my apologies for this imposition, but rest assured that any help you can give us will be greatly appreciated.

Sincerely yours,

Wright H. Langham
Group Leader
Biomedical Research

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