SUMMARY AND COMMENTS

Frank Ellis
The Medical School of Wisconsin

December 1971

I think first of all we owe a great debt to Dr. Wilson for his original observation 25 years ago and to him again for letting us come here today and for making possible the discussion of this facility and suggesting that we might be able to use it. I feel that the people here are to be congratulated on the broadness of their views and the general attitude that Dr. Wilson mentioned.

From the point of view of the facility, the most important and probably the most difficult thing in radiotherapy is defining the target volume (knowing where it is and how big it is). Secondly, it is very important to have a uniform dose over the target volume. If that is shown to be possible, heterogeneities and tissue contours can be dealt with, I have just been assured. It is important to know if the beam can be expected to be constant during the treatment although it seems to me from what we have been told about the output that treatments need not necessarily be very long in duration. On the question of uniformity of dose relative to the volume treated, it is important. The isodose distribution shown by the last two speakers seem to answer this problem, although I expect that they are only for the case of water.

The possibility of localization of the target volume was mentioned by Dr. Raju for negative pi mesons; localization might be a little more difficult with protons. It will probably mean very exact measurement from outside rather than the possibility of detecting it from inside, and we have had an indication of the possibility of different field arrangements to get the kind of distribution that we want. This method offers an advantage from the point of view of the oxygen-enhancement ratio and the RBE. One point I'd like to know is whether there will be differences in the action on fibers as compared with cells, because threading of fibers and changes in fibers might be important from an augmatic point of view if the number of molecules is kept down. I have no idea if protons will have a different effect on these from conventional radiation. We have had evidence that it is possible to fractionate with different results; acute dosimetry is possible. I was intrigued by the suggestion of Dr. Todd that it was possible to calculate what the effect would be just from the self-survival curves and the nature of the particles before they went into the body. That may mean that we won't need to carry out dosimetric investigations inside the patient or inside a phantom. From the point of view of practical radiotherapy, it is important that any work that is done should be absolutely immaculate: immobilization of the patient, which may be less necessary if the treatment times are very short, question of the pre-treatment setup and taking the patients in from a setting-up room so that they can be put

straight on the table with a minimum of waste of time inside the treatment room. The treatment setups obviously will have to be very precise, a move room will have to be available, and also, I think, a workshop for the purposes of the radiotherapy unit. I think randomized series are going to be essential; it seems to me that the way in which this will be done is that centers outside will refer patients and the randomization will have to be done in conjunction with them. They will treat one series of patients by conventional methods and the others will be treated in the facility. If that is done, it will be important that everybody keeps the same kind of records, which should be very carefully decided upon first, so that suitable analysis is carried out regularly and reported to and by a board of directors (or whatever they are called) will run the project. I think it's important that if centers agree to send patients, they should honor the agreement. They shouldn't start off deciding to do it and then gradually fade away. It is very important that it should be kept up. It will need a kind of super centralization, because there will have to be agreement to send cases and there will have to be agreed policies. The facility will need a firm and knowledgeable director, and it should not get a name for experimenting on patients. I don't think it needs to do that, because there is enough known for it not to be an experiment on patients. One other possibility is that NAL might want to shut down the apparatus at times for physics purposes. I would like to know whether this would affect running for radiotherapy, in which one

would not want to shut down for too long because of difficulties in dealing with the patients and drawing conclusions afterwards. Transport should be fairly easy, but I expect that there will be some patients coming from long distances and some treatments to be carried out daily, so that some kind of motel facility in the neighborhood might be necessary.

QUESTIONS AND ANSWERS

QUESTION: What sort of treatment times are expected?

ANSWER: I think that depends on what you want to do. You could treat 250 rads in one pulse if you were brave enough. I don't think many people would be. You could take a longer time, one minute or three or four minutes, so that the treatment time will be determined by the medical physicists, physicians, and radiobiologists.

QUESTION: What is the dose rate from a proton beam?

ANSWER: This depends on a number of factors. Let me give you an example. With 1.5 mA of beam for 50 μsec (the linear accelerator can give as much as 100 mA for 100 μsec so my example is a large reduction)--with that beam one gets 250 rads across a 35 × 35 cm field in one minute and you can throw away away 99% of the beam to produce a nice uniform distribution.