OVERVIEW OF THE CONFERENCE

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This conference is rapidly drawing to its conclusion, so I will be mercifully brief. In part for this reason, I will not attempt to summarize in a few minutes all of the things which you have been listening to for an entire week. However, for those who, later on, wish some guidance in studying the Proceedings, I recommend four invited papers which will give the flavor and essence of the conference. They are those by Blewett and by Judd for flavor, and those by Swenson and by Shreiber for much of the essence. For some years we have been talking increasingly about the applications of linacs. This year, the "applied" linacs seem to me to be more exciting and challenging than the physics machines. However, almost all of the papers were of high quality, perhaps higher on average than some of the earlier conferences.

From among the papers on operating machines, I was particularly pleased to hear that LAMPF has now met all of its design criteria and awaits only a sufficiently powerful target system to operate at full power. As I will point out a little later on, the linac meson-factory is an old dream that has, at last, come true.

From among the papers on new machines, I am particularly pleased to note the one describing the 200-MeV proton injector being proposed for Beijing, because this signals the first time that we have been joined here by our colleagues from the People's Republic of China. The first of these conferences was not in any sense international, but the succeeding ones very quickly became so. We have always had excellent attendance from Europe and from the USSR and more recently from Japan, so now it is most fitting to have our friends from China here, also.

The area of rf superconductivity has had a painfully slow development but at last seems close to being incorporated into operating machines. It is interesting that the major application may be in heavy-ion linacs rather than in electron linacs, as many people expected some years ago.

Real progress in the field comes when the users demand machines whose parameters exceed the capability of our present technology. This year, as always, the users are demanding bigger and bigger machines, but it is important to note that now it is the "applied" machines which are stretching the technology to new limits. Consider the demands placed upon us by PIGMY, FMIT, HIF and the possible use of accelerators for nuclear fuel production. In the PIGMY effort, we are being asked to take a very large, powerful and sophisticated accelerator, and to put it in a very small and inexpensive box in order that it may fit into both the budget and the space available in a hospital. This has led the people at LASL to examine a number of the old truths in an attempt to develop structures with higher gradients and greater efficiency.

The FMIT and HIF devices are simply demanding higher and higher power so that in every respect we are being forced to extend our technologies to meet these requirements. One of the results of these pressures has been the RFQ which is perhaps the most important development that we have heard about this week. Calculations and model tests which have been carried out so far, suggest that this system can solve some of the most vexing problems in the low-beta section of proton linacs. As you know, we have turned and twisted in all kinds of ways over the years in attempting to solve these problems.

The permanent magnet quadrupoles which we have been hearing about, will contribute further to the solution of the problems of the low-beta section. But those of us who are somewhat conservative will continue to worry about having to give up the ability to adjust the transverse focusing, when using devices such as the permanent magnet quadrupoles or the RFQ structures. But surely we will be able to handle these problems in due time. As with any radically new design, such as the RFQ, we are going to have some fun finding out about all of the possible modes by which the beam can interact with the structure, and how to deal with the inevitable instabilities that those interactions will produce. But in order to solve these problems we must build the devices and try them out.

As I listened to some of the papers on new projects, I was struck by the following paraphrase: "Old Linacs never die. They just pass on to somebody else's project." If you think about it, it's true, they just won't go away. I want to give you just two examples: One is the old Harwell 50-MeV PLA. One of the original proton linacs, it has now come back to life to be built into the new 70-MeV Rutherford machine. The PLA did not have to move very far but it has surely changed its purpose a number of times over the years. The other example touched me personally, and is the story of a machine which has travelled very far and wide. Joe Sheehan told us in his paper on the injector for the National Synchrotron Light Source, that there are a couple of sections of linac which were built at SLAC, then were sent to a laboratory in Holland and used there for some years, and now are back at BNL. It seems that some years ago when I was with the AEC, it was brought to my attention that the Dutch were finished with those linac sections and wished to send them back to the United States. I thought I had accomplished a great thing when I talked the AEC, with some difficulty, into abandoning the things in place. But in spite of my best efforts they are back here, anyway.

This conference more than any other has been dominated by one laboratory. By any measure that I can think of, the Los Alamos Scientific Laboratory has been the outstanding performer here this week. They have had about 30 registrants out of 170 attending the Conference. They presented, in one form or another, about 22 papers. One of their papers deserves special mention here because it represents one of several firsts at this conference. Last night you both saw and heard that paper. It is the first time that a laboratory

has brought to the Linac Conference a live demonstration of one of the principles which they are studying. In my newly created role as art critic for the conference, I must observe that Marianne's performance last night was a most convincing demonstration that art and beauty can be very tightly coupled to the acceleration business.

I am sure that you will all agree that it is perfectly clear that this has been a successful conference. But why? In the first place, the material that has been presented here is clearly significant and is relevant to a number of current programs. In other words, the conference is indeed timely. I remember with some amusement, immediately following one of these conferences several years ago, one of our distinguished colleagues assured us that the linac business was all finished and there would be no need for any more of these conferences! In addition to having significant and timely material well presented, the other important feature of a good conference is the instant feedback which occurs between the participants and the authors of the papers. If it were not for this feedback we could just as well publish all of the materials in the first journal that comes to hand. There was a lot of this feedback this week. You could see it and hear it all around you. I want to stress that the size and the ambiance of the conference must be conducive to producing it or the conference will fail. We have been very fortunate this week in that the management of the conference has treated us to a very special affair. This is the first of these conferences that has not been held on a laboratory site, and you are aware there was some trepidation about proceeding in the direction of Gurney's Inn for this conference. I need not dwell on the pleasure of Gurney's, but it is clear that the atmosphere here and the format of the conference have played an important part in our success this week. An early and lengthy morning session followed by a free afternoon worked out very well. There was adequate time during the afternoon both for excellent recreation and for viewing the poster sessions. Then the mercifully short evening session allowed the time necessary to get in a reasonable number of presentations.

Finally, I want to end on a historical note. I have here with me a modest volume which is entitled, "Minutes of A Linear Accelerator Conference, held at the Brookhaven National Laboratory in April, 1961." This was the first of this series of conferences and you won't be surprised to hear that it was organized by John Blewett. Twenty people attended that conference compared with the 170 here this week. So, there has been some growth in the size of the conference. It is interesting to note that 13 of those people are still active in some way or another in the accelerator field. One of them is dead, and six of them have moved into other areas. There are six of us here who attended that conference and, I believe, have attended every one in between. There were 17 papers presented orally at the conference in 1961. The poster sessions had not yet been invented. And for that matter Gurney's had not been invented either as far as Linac Conference was concerned. Of those 17 papers, 4 were on linac structures, 3 each on beam dynamics and engineering aspects, 2 each on performance of operating machines and on power sources and there was one on ion sources and one on a new proposal, and finally, one about cyclotrons.

This week we have managed not to talk about cyclotrons at all! However, I think you will find the distribution of the other papers not significantly different from then to now. It seems clear to me that 18 years later we are still talking about exactly the same subjects that we talked about then. That is not to imply that we have not made any progress in those 18 years, because I think we have made a great deal. There is a scale factor which is the degree of sophistication with which we deal with these same problems. There has been an enormous improvement in the quality of our techniques and the sophistication of our calculations.

The first paper in the 1961 Conference was presented by E.R. Beringer of Yale University. I am going to take the liberty of reading the first paragraph.

> "The Yale University Proposal is directed to a proton accelerator with an output energy of approximately 800 MeV and an output particle current of 0.1 milliampere to 1 milliampere of average proton current and with a high duty circle, i.e., of the order of 5%."

The paper goes on to make it clear that the accelerator under discussion is a linac.

I certainly have found it most gratifying, personally, and I suspect others here feel the same way, to hear at this Conference that that machine, which in fact is LAMPF, has now met all of its design criteria as stated in Beringer's paper.

The 1961 paper is the first printed statement in the U.S. proposing a linac meson-factory. But it is important to keep some historical perspective. This paper, written in 1961, refers to a design study done at Harwell and started in 1953 by Bill Walkinshaw and others. That design study proposes a proton linac of sufficient energy to produce mesons, and of significantly high current. In fact, the Harwell group proceeded to construct the first part of that machine, the old 50 MeV - PLA. Furthermore, they started upon the design of a 400-MHz klystron which was to be the power source for the second section of the accelerator.

So the proton linac meson-factory has been a central theme of these Conferences over the past 18 years. Now as we move ahead, we are looking at ever more powerful and exciting machines. And one of these new machines, I suspect, may similarly be woven into the fabric of future Conferences.