SOME COMMENTS ON HIGH ENERGY DEMOGRAPHICS

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Summary

Considering the drastic changes in the way the experimental part of our field is being carried out and the uncertainties in the trends (availability, training, and size) of the manpower pool; it may be an important time for a new, in-depth manpower survey to be initiated under joint D.P.F./D.O.E./N.S.F. sponsorship. This survey should also include an attempt to illuminate the actual versus ideal role and status of the graduate student in elementary particle physics.

As part of this Workshop there was scheduled an evening session entitled "Sociology" -- or some such other inflammatory title. It fell to the present Chairmen of the User organizations of the various national laboratories (in my case, B.N.L.) to provide the format, some points of departure for discussion, and comic relief. I do not know whether the evening was a success or not; it may go down in history as an opportunity missed. It did have, however, some notable features which should be marked for posterity and future planners of such events. Notably, it was possible to pack a room with present, past and future laboratory directors, experimenters, accelerator experts, itinerant graduate students and itinerant spouses, ply them with beer, occasionally hear some genuine wisdom amid the undigested ramblings, and finally in spite of provocations, have no fist fights and hear genuine good humor and good will from all. That certainly should count for something these days!

The issues which the D.P.F. Organizing Committee had in mind several months previous when they scheduled this "evening of sociology" were real and serious. Many of them grew out of the work and deliberations of the "Trilling Panel." One particular area was that which I refer to as "high energy demographics" which loosely might be described as manpower and what influences its trends in size and composition in the field of high energy physics. In this area, the "Trilling Panel" had made a brave start but had been unable to finish. Through the kindness of Herman Feshbach (MIT and Panel member) and Bob Woods (D.O.E.), I was provided with some of the background material and preliminary work they had done in this area. That material combined with some from a little effort on my part seemed to be shaping up to raise as many questions as it was trying to answer and some of them are potentially important to the field to have answers for. For that reason, I presented a short talk based on that material whose simple point was that we have some incomplete and partially digested data which suggest possible trends inimical to the future of the field and therefore we should try to complete the job by asking the right questions, getting the complete data, and seriously trying to understand it. I sketched up some graphs for use in the transparencies in the talk, but rather than reproduce them here because they are F shbach's and Woods' preliminary data and I cannot vouch for the detailed accuracy, I will just state what the trends seem to be. I think of it as providing a "snapshot" of our present state.

Today's conventional wisdom seems to be that we are headed for an era of much larger collaborative experimental groups working at a smaller number of machines and interaction regions. This is part of the so-called "fewer spigots and bigger detectors" problem. The detectors, accelerators, and experiments are and will be more complex than we are used to in the past and new ideas (implying more R and D) and breakthroughs are needed in every area. We need some predictive power to know if we are entering this era sensibly with respect to facility utilization and university effectiveness in it. Manpower is a key ingredient. Do we have enough of the ("right stuff") kinds of manpower to carry us on through the end of the 1990's?

The "snapshot" we have now, suggests that we might not.

Although the total number of Ph.D.'s employed (about 2000 in 1981) in the field has increased at a moderate rate more or less monotonically for over a decade, the number of graduate students underwent a drastic contraction finally bottoming out in 1973. There have been modest increases in the graduate population since then but only about 120 Ph.D.'s are graduated per year now compared with about 250 at the peak. There is some evidence that the average duration of an experimental students' graduate career is very long -- perhaps over six years. If this is true then the modest rise in total Ph.D.'s may be about to turn over as well. It also would explain why in 1980 we began to find a shortage of experimental post-docs. Preliminary data also suggest that while there has been a modest recovery to about 120 Ph.D.'s per year that we may be dropping again.

If we couple these indications with some of the results found by Sullivan, Shocket, Neff and Wales in their excellent study (D.O.E./ER-0010, "Report of Sub-panel on H.E. Physics Manpower," June, 1978) then we get a picture of our manpower situation which may be fine if it is stable and if it contains the right people.

For example, the Report of Sullivan et al suggests that about one half the persons are lost from the field between somewhere late in their graduate career and the end of their first post-doc. This in itself is not bad -- several people have made the point that it is good to have exported high energy trained people in other fields for many reasons -- however, I would argue that such a scheme only works if our original pool is large enough and that we keep the best people. Two other facts from the Report relevant here are (a) that high energy physics has the highest dependence on post-docs of any science (25% of our Ph.D.'s at any given time), and (b) the age profile of experimentalists shows that by the end of this decade there will begin a very large wave of retirements.

If these pieces of information are fact then we might ask:

Is the field at the "zero population" growth level? The answer would seem to be yes it is just reproducing itself.

A more difficult question is: Is it stable? Several tenuous observations suggest that the answer may be no and it may decrease.

One of these observations was that mentioned above, namely that there is a hint we may be dropping below ∿120 Ph.D.'s per year. Another is that it has been noted in many laboratories that there is a strong correlation between amount of accelerated flux per year and the number of graduate students at the labs. Less well documented are suggestions from faculty and students that short runs separated by long down periods have less salubrious effects on attracting good students into the field than the opposite dwell time. Since we have recently entered a period in which down periods and less flux are a way of life (death?) then we could become de-stabilized.

It is also not just the numbers; are we attracting the best? As someone observed, it is presently very difficult to talk about this intelligently because you quickly discover so much of what passes for information is just anecdotal -- and often not first-hand at that.

Because we are entering what promises to be one of the most exciting and challenging eras in elementary particle physics from both a physics and technological point of view, there will be a premium on sufficient manpower with originality and proper training to meet the challenge. We should make sure we are prepared to pull it off. That is why the question raised is phrased as:

"Should there be a D.P.F./D.O.E./N.S.F. new, in-depth study of manpower to find:

- Statistics
- Any new, recent trends in theoretical and experimental personnel
- Job futures for new people (tenure)
- Role of Post-doc in future

Straight-Forward

- Projections of quantity for facility utilization
- Trends in university participation and effectiveness

Hard

- Are the best young people <u>not</u> entering the field?
- If so why and what can be done about it?
- What can be done by universities & labs to reduce the number of years to get an experimental Ph.D.?

Very Hard

At the least we should encourage the completion of the excellent work begun by the Trilling Panel in this area.