Closing Remarks

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Recognizing that this series of Workshops always attracts new participants these Closing Remarks attempt to provide a brief overview of the path along which we have traveled and what we may have gleaned from this experience in trying to move from Art to Science in the development of targets and the products from these targets. So please excuse the somewhat rambling nature of these reflections on this and past workshops.

The initial workshops aimed to describe the state of the art by assembling the current understanding of the entire targetry system from accelerator to the produced radionuclides including all of the components used to achieve this. Efforts were made to even look inside targets as the reactions are actually happening. Probably the most significant practical result of the early workshops was the compilation of all of the materials that were compatible with the chemicals being handled to perform the desired function. In this regard Havar became the metal of choice for most gas and liquid targets due to its relative inertness and strength.

In Vancouver, the round table discussions relating to advanced accelerator technologies, especially the low energy approaches opened up the whole aspect of what configuration of accelerator was truly needed to supply radionuclides to the PET community. Of the machines described or proposed, the tandem cascade accelerator has been built and is in place. For the ^{3}He RFQ machine it has been a long and sometimes frustrating struggle getting to a place where its utility could be tested. Recent results indicate that low energy ^{3}He particles can be source for the production of PET radionuclides.

In-target chemistry is still a continuing issue. I think we probably need to consider looking at this in a didactic or pedagogical way at the next meeting since the number of people who have real training and experience in hot atom chemistry are becoming a real scarcity. In order for us not to re-invent the wheel too many times or stumble around in the dark I think we need some more education in this area.

In Vancouver, two years ago (1995), one of the areas of keen interest was the gas phase methyl iodide system, which in my opinion represents one of the best things that has happened in precursor chemistry in a very long time. This innovation has simplified ^{11}C chemistry enormously and has allowed for improved specific activities with minimal effort. As specific activities improve the environment we work in has moved from micro chemistry to nano chemistry and perhaps in some instances pico chemistry. How much smaller can we go? Can we really take advantage of this miniaturization?

However, we do at times approach the limits of the boundary between what we as a target chemistry society are doing and what is involved in radiopharmaceutical chemistry. There has been some discussion as to whether we are verging too much into radiopharmaceutical chemistry. At this meeting we have been talking about racemic mixtures and chiral separations. Is this more in the realm of radiopharmaceutical chemistry or targetry/target chemistry? I think there is a place in our meetings to discuss these issues in terms of the techniques and technologies that will enable our colleagues in radiopharmaceutical chemistry to take the techniques and apply them to their particular synthesis/preparation. Quite often the synthetic chemist does not have the time or resources at their disposal for innovative approaches to precursor development and improvements in automation.

The issue of specific activity is something that should be considered as an important topic for future meetings as well as a session on 'How do we *really* measure specific activity?' What are the techniques that are being used and how reliable are they?

In my estimation thermal effects are the dominant feature in the operation of targets. I think almost everything else with which we deal regarding production yields are secondary effects. Until we can really grapple with the issue of how we dissipate heat, whether it's a gas, a liquid or a solid target, we will not begin to see the true impact of other effects.

In the morning session Professor Wolf presented a very interesting to talk on ion implantation. At the 2nd Heidelberg Workshop there was discussion about the evidence that aerosols were coming out of gas targets. While there was some discussion about whether we can make use of this phenomenon the concept was never pursued or at least not reported again. When looking at the slides of sputtering associated with ion implantation it was reminiscent of what one could imagine how aerosols could be formed and maybe aerosols are being produced through sputtering phenomena. The energies that are involved in sputtering are well within the energy range inside gas targets during irradiation. Perhaps we need to examine surface effects and make use of the results from the ESCA studies in order to find out what really is happening on those surfaces? Until we really understand what's happening inside the targets we're not going to understand our specific activity or recovery problems from the targets.

Another idea that came up in this discussion is the idea of recoil targets using the techniques of ion implantation to carve away material to make fine grids. Perhaps you can create very porous controlled areas where the recoil product has an opportunity to escape the solid substrate and the targets will release the isotope that you need. This may be extremely important e.g. on the low energy machines such as the ^{3}He RFQ which does not have much of a particle range to begin with for the bombarding ion.

There is still no consensus on the best material for water targets whether it is constructed with titanium, nickel plated copper, pure silver or whatever your favorite material is. Results presented at this meeting indicated very good results regardless of the material for the target chamber or the conditions of the irradiation. This perhaps represents a rather gratifying situation where there is not *a* set way to go about this. However, the highest yields do appear to be produced in targets that have the best thermal properties, for example silver target chambers have been used to produce >2 Ci of ^{18}F-fluoride. What we need to do is to document in a more rigorous way what we are doing so we can begin to make sense of our collective results. Otherwise everything remains as anecdotal information. Which brings up the point that Bob Dahl and others have passed out a record sheet to document what each center is doing. This exercise is part of moving from Art to Science.

Over the years, we have had involvement from our industrial colleagues. It has always come to me as a mixed blessing. The commercial interest should be obvious. They wish to find ways to make the best systems that will provide the most sales of their products. Some attendees have objected to companies profiting from these meetings. I think what's really happening is that the competition amongst the companies, the commercial vendors involved, has in fact improved systems. We are seeing better targets, and better chemistry systems (not through chemistry, but through competition?). But I think industrial involvement has been one of a willingness to share as much as they can, and for the most part they have been open. If anyone feels the companies have not been open enough, then it is our responsibility to challenge them. We are all here at this meeting as participants, and if you want to participate you have to do so in an open manner to both learn as well as provide information. Also we must never lose sight of the fact that these meetings have remained relatively

inexpensive through the generous donations companies have made. For this, all of the organizers over the years are sincerely grateful.

Even though we can not always see the wood because of the trees, we continue our struggle and part of that process of overcoming the obstacles we face in targetry is in the production of the *Proceedings*. Having been involved in the preparation with five of the last six proceedings in a fairly intimate way, I can assure you that this process is a very long and difficult one. So if you were a chairperson and were involved in writing up anything or you have anything to contribute, be prompt. Because it is very frustrating for the community to have the Proceedings arrive long after we remember what the meeting was about. We rarely get them a year before the next meeting. I think one meeting even handed them out at the registration desk. *Proceedings* are only valuable if we get them out and get them out in a timely fashion.

What is next? As most of you by now know the next meeting will be in St. Louis. It will be hosted by Dr. Michael Welch at Washington University. The Workshop will be held during the period of June 23rd to June 27th, 1999. For those of you who are interested, it is after the US Society of Nuclear Medicine meeting and it will be just days before the International Symposium on Radiopharmaceutical Chemistry.

I think we owe Frank and his colleagues, especially Stefan a great deal of gratitude for hosting this Workshop now for the third time. We appreciate the hospitality and excellent venue for these meetings. Targetry Workshop No.7 can be added to the history books, as soon as everyone supplies the needed reports for the *Proceedings*!

Editor's note: The Closing Remarks have been edited from the original oral presentation.