

## CLOSING REMARKS

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Yesterday morning I emphasized the questions we were posing to the workshop - where are the gaps in our current knowledge and what research is needed. We have had an avalanche of needs and problems ever since. One of my concerns was whether those of us in the radiation protection community have been thinking along the same lines as people in the field of toxicology. I think what has been evident in these two days is that indeed the problems and issues are very similar. Very evident common problems are those of extrapolation of observed toxic effects at high doses to predictions of effects at low doses; of the applicability of information obtained from one animal species to another; the public pressures to define risk (perhaps not pressures to define this goal as much as to define what is safe); the problems of multiple exposures; and the lack of money and resources to do all the things that it seems should be done. These are all problems familiar to us in the radiation protection community, so I certainly feel encouraged that we do have a coincidence of interests.

What are the needs that have been identified over the last two days? We started off by emphasizing the need for a systematic approach to define what the problems were. In fact defining the problem was a problem. We worry about the wrong compounds. Today we heard from Dr. Clayson the difficulties in trying to systematize potency; he noted the HERP scheme. We also heard about clean-up from waste sites of chemicals that really should not be great concern.

After defining the problems we have to decide which we can tackle. We cannot do everything; we have to be selective in what we do. We have to find a niche for the research that we carry out in Canada, accepting that we don't have the funds to do everything that we would like to do. One approach would be to focus on what is in the national interest. One specific example given was to look at the resource industries and ask what are their particular interests. Perhaps that is where we should find our niche. Then there was the idea that there is a need to have co-ordinated multi-disciplinary research and we, I think were impressed to hear about how the CIIT is actually managing to get that multi-disciplined approach to its research. Here at Chalk River we looked with envy perhaps at the way the Centre has managed to get the industrial support that they have.

There was a clear plea to maintain the basic research. Here, I find it easier to think of the research that is needed as being "underlying research", i.e., it's not some airy-fairy research because somebody happens to be interested in it, but it does underlie the ultimate needs in the toxicological field. So we can see underlying research being needed as well as the very applied, or what is called focussed, research.

What is the research to be? Knowledge of basic mechanisms, and the need for unifying concepts are high on the list. We heard an example of that from Dr. Hollebone today on the idea of using structure/function relationships. In the light of this, it may well be that when we start to understand mechanisms then we shall have to re-interpret results from the past. We might (and we had again a strong plea) need to look at some of the basic concepts that we've used. We have been warned by Dr. Plaa not to try to explain everything in terms of physics and chemistry, which perhaps some of the physical scientists try to do. Remember it is biology that is of concern here and biological concepts are needed. Perhaps we have to examine very closely concepts of threshold, and of individual variation and variability. We need to look for appropriate ways to quantify total exposure. That, of course, is something very familiar to us in the radiation protection community. The "total dose concept", I think was the term that was used, and certainly that is something that appears feasible. We need to link laboratory observations with field observations: we need to know what actually happens out there in the real world where we find so much variability. One chance of doing this or helping this is to audit past performances, and we heard this very strongly from Dr. Granville several times. Look at what protective actions have been taken in the past and assess what changes (improvements) have actually been made. We have taken lead out of petrol; we have stopped using DDT. Can we look back at actions such as these that were taken on the premise that there were real problems. Have they, in fact, made a big difference to health risk or actual wellbeing.

The importance of modelling has been stressed, and this has come up in a number of issues. Models for the basic mechanisms allow us to interpret data; perhaps, as importantly, they allow us to define what data are needed. In the discussions of mechanisms of action we heard quite a lot about the physiological-based pharmacokinetic models, which we are very familiar with in the radiation protection business. Speakers stressed the importance of coherent and comprehensive models to allow predictions from source all the way to risk to health. Can we decide what is the significance to human health of PCB's spilt on a road? We need to have the capability to make those kind of predictions, predictions that consider movement through the environment, fate in people, and ultimate effect. I think this raises the question of what we mean by toxicology. Our perception is that it is more than just looking at the biological effects; it includes looking at the problem all the way from source to risk.

There is a need for greater efficiency in regulation. This came through very clearly, together with the caveat that the regulators need to be receptive to the advances in understanding so they can adjust regulations appropriately. Better toxicity tests are needed. In particular the societal pressures on some organizations to reduce the use of animals have been noted.

A general need is that the quality of research has to be high; this was said to be a paramount requirement for getting industrial support. I would hope that it would be a paramount requirement for getting any sort of

support from any agency. We have heard specifically of the need for work in biotechnology where the appropriate tests need to be defined. Another look, or a further look, at the carcinogenicity of metals, zinc, selenium, cadmium, and lead was mentioned.

Concerning the importance of and need for public information, a number of points were made. First of all we should emphasize what we do know. I think that this is a "natural" problem since as scientists we are always trying to find out about what we do not know and so we tend to emphasize that the "not knowns" when we talk to the public. Perhaps what we should be trying to do is emphasize the things we do know, and particularly, how well we can assess safety before, as it was pointed out, we get into encouraging the public to demand tests for this and tests for that. It was suggested that we should start informing the public through the schools. This is something we already do in our own organization and we feel it is very important to encourage people to come here from schools. The teacher is a very important contact to educate the public. The point was made that we need to be experts. We do not need to be politicians; we should state the facts and not try to become advocates for particular positions.

We need to do something about funding. Dr. Schiefer mentioned right at the start that what we needed were a few Brinks trucks and we cannot but agree with that. But Dr. Kacew reflected this as well, making the point not only that money is needed for research but also for training. Obviously with a limited amount, we have to be very selective where we do try to put that money.

I note that the Ontario government has defined its 5R program in waste management; we have a need for a multi-R program as well. We need Research that is Relevant to Real concerns and which supports Reasonable Regulations; the onus is on scientists to get the facts Right.

I will conclude by saying that I am certainly encouraged to find that in our community, the radiation protection community, we are thinking along very similar lines to yours in the chemical toxicological field. We certainly look for a greater involvement in mainstream toxicology. I feel that the contacts we have made here with you are going to be very important and a tremendous help to us. We shall be looking for opportunities in conjunction with our university colleagues, government agencies and industry to move ahead into the toxicological field. I thank you for attending and contributing.

In closing I will acknowledge the people who have organized the meeting. The program committee was chaired by David Myers and included Brian Hollebhone, Doug Champ, George Leakey, Sam Kacew and Ken Westaway. I think Dave found that toxicologists were incredibly busy people and getting so many together was a very time consuming task. I think we should thank Dave and his committee for arranging this very useful, lively program. I should also like to thank the local arrangements committee which was chaired by Art Marko and included Donna TerMarsch, Norm Gentner and Christine Yuke, who have been helped here in the meeting by John Jevcak, Jim Young and others, and who have put things together remarkably well. Everybody seems

to be reasonably cheerful and I don't think we have lost anybody on the tours. Thank you all for your efforts and your skill in making sure everything ran so smoothly.