"A Vision of the Future"
ALFRED BEETON, PhD

Introduction by Ms. Gorelick:

This morning's session is entitled "A Vision of the Future." We are very fortunate to have two men who co-chair the Science Advisory Board of the International Joint Commission. We need to look to such people to give us input on ways to go. Our first speaker, Dr. Alfred Beeton, is presently director of the Great Lakes Environmental Research Lab which is part of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce. He holds graduate degrees from the University of Michigan. He has served as the Chief of Environmental Research with the U.S. Bureau of Commercial Fisheries. In addition, he has served as Associate Dean of the Graduate School and Associate Director of the Center for Great Lakes Studies at the University of Wisconsin, Milwaukee. He as served as Director of the Michigan Sea Grant and Great Lakes Marine Water Center at the University of Michigan. In 1986, he was awarded the medal of honor for research from the State of Michigan. He holds numerous professional memberships. His publication list is extensive and includes papers he has co-authored with today's other distinguished speaker, Dr. Vallentyne. Please join me in welcoming Dr. Alfred Beeton.

Alfred Beeton, PhD:

Thank you. I was getting worried when I didn't see Jack here until breakfast this morning. I had been worried whether my voice would hold out or whether Jack would need to take over the whole program. Fortunately, Jack is here and my voice is holding out. In thinking about what I should address in terms of a "vision for the future," I concluded we can't look to the future without giving a little more background information. That's part of what I'm going to do this morning: Look at some of the past trends in toxic materials and, most importantly, how the general public's view of environmental problems has changed.

I think that's the most important thing for the future really; the perception of environmental problems and the ecosystem approach. We're here at this particular conference because of the concerns over human health. It's very encouraging to see we now are starting to put that up front. Not just here. Recently the International Joint Commission declared health as an important aspect that should be dealt with. This is coupled very closely with concern over environmental health. When I was approached about speaking here, I was asked to emphasize the connection between human health and environmental health. I think that is really an important step forward.

Of course, we have other concerns, such as fish advisories. This concerns a wide number of people. In fact, people are always shocked when they buy a fishing license for the first time and are handed the guide to fishing regulations which indicates that they shouldn't eat muskies from Lake St. Clair or they shouldn't eat lake trout of large size, and so on. So that is a really important thing that we need to deal with.

Then we continue to have this problem of poor reproduction of a variety of fish-eating birds and more and more reports of deformities of young birds. Not many people know about toxic sediments; a big concern that I'll address. A lot of publicity has been given to fish tumors. Of course there's a general concern

that people have about cancer and if I eat these fish, what is it going to do to me. So first, I'll start out with some background information here.

This first slide gives you some ideas. Several of these slides come from a very nice publication that was put out by EPA, "Environment Canada," and I certainly recommend it to you. I took a few of these out of there. This slide indicates the land use which is very important in trying to understand the Great Lakes ecosystem. In the Northern part of the Lakes, up in the Canadian Shield, you have very thin top soil. It's a forested area with some pasture lands. As you will see in the next slide, the human population level is pretty low. Therefore, you can understand that the run off from these lands is relatively low in pollutants.

If you look in the Southern part of the basin, you see a different kind of land use. In Tennessee, agriculture and rural crops; along the eastern shore of Lake Michigan there's a tremendous fruit belt with its own kind of problems. Certain kinds of pesticides are used there. There are areas in which people are trying to very environmentally sound, using no-till farming. That in turn is generating another kind of problem, because they're using a lot of herbicides such as Atrazine. So, in the Southern part of the basin we have both agriculture and heavy industrialization around Chicago, Milwaukee, and Cleveland, extending over into Lake Ontario and Toronto.

If we look at the distribution of population, the major population areas are all in the Southern part of the basin and therein lies some of the problem, as you will see in a subsequent slide. You can see the main sources of pollutants coincide with the population centers. You can see the lower Lakes are the ones that are considered more nutrient rich or eutrophic, especially Lake Erie and to some extent Lake Ontario. Saginaw Bay and Southern Green Bay are the ones that we have really been concerned about in terms of eutrophication, nutrient enrichment. Those three main areas, Southern Green Bay, Saginaw Bay and Western Lake Erie, received major consideration when we were trying to deal with the eutrophication problem and visible pollution.

You have to realize that much of the material that enters the Lake comes from point sources, the rivers flowing into the Lakes. But non-point sources, such as farming practices and atmospheric transport, are also very important. Because of major concern with phosphorus entering Lake Michigan, at one time I had twenty-one wet and dry fall out stations. We discovered that there was as much phosphorus coming in from the atmosphere as from all the sewage plants combined; that had been ignored in previous models. That's just one example of the extent to which atmospheric transport is very important.

We get much of the air transport coming up from the Gulf, from all the farmlands down along the Mississippi. We have air masses moving from the West and North which bring a lot of materials into the Great Lakes. As was mentioned yesterday, it only took nine days for the air mass from Chernobyl to get across to Canada. Material can move quite rapidly from various parts of the world and bring in all kinds of materials. A lot of materials that we find entering the Great Lakes are materials that are produced and used within the basin. There are certain substances that we know come primarily from outside of the basin which also present a significant problem. It's not surprising, then, to note that a number of substances are found in major concentrations in the Northeastern part of the United States. This is where air masses converge and where you have significant rainfall. Much of this material is deposited in the Northeast. One example is lead, but you could look at many other slides and see a similar presentation.

In the past we have dealt with a number of similar problems, such as typhoid at the turn of the century. That was a major concern especially in the Southern Lake Michigan area. If you looked at articles from public health and quasi-environmental journals, the main concern was about the number of typhoid deaths per one hundred thousand population. It was discovered that, typhoid being a water-borne disease, was a major problem in Southern Lake Michigan where the water intakes were very often not treated and were used raw. In 1900, they opened the Chicago Sanitary Barge Canal to divert sewage away from Southern Lake Michigan along the Illinois River.

You can see on this slide two main things. First, it shows the increase in human population for each of those basins. The other graph shows the long-term increases in total dissolved solids and chemical increase. In 1900, the waste from Chicago was going into Southern Lake Michigan. When it was diverted, it took quite a bit of population pressure off of Southern Lake Michigan, otherwise the population increase

would have been as high or higher than for the population pressure on Lake Erie over the years. But that was the way we solved that problem, just divert the problem into some other water shed, down the Illinois River. That was the approach back then. At that time we weren't aware that this was an environmental problem. There was no indication in the literature that it was considered that way.

Next we dealt with the sea lamprey. We knew the sea lamprey was in the Great Lakes before the Second World War, but preoccupation with the war effort precluded doing anything about it. After the war concern grew about the sea lamprey. That brings up another point. We have only been able to get money into the Great Lakes to correct problems because of a crisis. There was very little research done on the Great Lakes prior to the sea lamprey problem with the exception of the 20's when the Heron Fishery collapsed in Lake Erie. A little bit of money was devoted to do some research at that time, but then that dried up. It wasn't until we had the sea lamprey problem that there was any interest again in doing anthing. The sea lamprey problem was looked upon as a problem the commerical fisherman had; sports fishing wasn't considered that important. Although people were concerned about the resource, the concern wasn't so much that it impacted them in any way. It was more a concern, that "well, we ought to do something about this."

The next problem that came along was the one on eutrophication. The realization finally sank in that the Great Lakes were changing when it was first demonstrated that chemical levels were increasing. For example, when increases in several chemicals in Lake Erie were first demonstrated, a number of the aquatic scientists didn't want to accept or believe it. They later got on board and concluded that the best way to deal with this was to deal with the phosphorus problem. Initially this was looked upon as, "an environmental problem" — not something that especially affects you or me other than bathing beaches were closed or boats got a scummy growth on them. Things like that.

When they negotiated the Water Quality Agreement in 1972, it did not really represent an ecosystem approach. It was dealing with the water of the Great Lakes. That's the name of the agreement, the Great Lakes Water Quality Agreement. It dealt with the water up to the shore. Between 1972 and 1978, we made tremendous strides in the way we looked at these things. The idea became established that the whole basin must be dealt with, the land use, human activity and so on, if we were ever going to do anything about the Great Lakes. That's when we started to move into the ecosystem approach. In 1978 when that agreement was signed, it was a most remarkable document for two countries to sign: a document putting forth an ecosystem approach and dealing with land use, human activity, the whole thing. That agreement was just re-negotiated, re-signed, with a new protocol, about a year ago in Toledo at the IJC meeting.

The other thing that brought about great concern was the tremendous change in the fish population. People have always been concerned about fish and fish resources. This slide shows you what happened in Lake Erie. Pike commerical production was struggling along about ten million pounds a year and all of a sudden it collapsed. The fishery disappeared and that fish is now considered extinct. During the period, fishery biologists took samples of the fish. They examined scales. The interesting thing was that all of those fish were about eleven or twelve years old, indicating that they had not been able to successfully reproduce for that period of time. This certainly demonstrated something about the health of the environment.

At one time there was a native lake trout in Lake Erie. I don't mean to dwell on that, but this kind of concern led to the major effort to spend billions of dollars upgrading our sewage treatment plants, dealing with nutrient enrichment and trying to make the environment better, trying to get it to recover. I would say that we have been really successful. We dealt with the typhoid problem by shifting it away. We did come up with control of the sea lamprey. That alone was a tremendous experiment and it was successful. It was a problem we were able to deal with. The sea lamprey is still there but they're controlling it at around ten percent of the former abundance.

Then we got on top of eutrophication, this nutrient enrichment problem. I would say that the health of the Lakes has gone from what would be considered poor to fair back in the days when this was going on to fair to good today. There are some parts of the Great Lakes where we have seen significant decreases in the phosphorus loadings. Phosphorus levels have decreased and there's been some shifts in the algae, the photoplankton populations. In parts of the Great Lakes some of the native fish have come back like gang busters. In Green Bay, there are some eighty fish that have come back in abundance where they

haven't been for years.

In 1955, I remember as a young fishery biologist, we were sent up to Saginaw Bay to try to understand why the walleye population was collapsing. We didn't find out, of course, and the population collapsed. Just recently they are re-establishing that population. The walleye is doing very well. Evidently that environment has become healthier for them and they're doing really well and likewise in Western Lake Erie. So there are some successes. Although it is a very expensive thing to clean up pollution, both visible and the nutrient enrichment, the public became concerned. I think that was a very important step forward. We started to see in the 60's the environmental movement and a variety of environmental groups forming.

What are we faced with now? Well, things look better in the Lakes but we have a great concern about toxic materials, primarily synthetic, organic toxicants. You will all hear about toxic dumps, material leachates, getting into the ground water. Horror stories of brown gunk flowing across basement floors, people not being able to sell their homes, going to court, fighting their local governments to do something about it for years. I'm convinced now the worst thing a citizen can do is to take legal action. It drags on for so long. Their children are grown up and gone and they still can't get rid of their house. They never get anything for it as far as I can gather. There's got to be a better way. But anyhow, these are the toxic hot-spots that we ought to deal with and some of them are really very hot.

What are we trying to do about some of these things? Within the IJC family, the Water Quality Board, which is made up of representatives from the various state agencies and the provinces, decided that they would designate areas of concern, representing especially degraded environments. These are primarily harbors, river mouths associated with large industrialized population centers, smaller lakes that have some particular unique problems. By and large they represent sites with the synthetic organics. Here we have the areas of concern. There's forty-two of them. We're trying to develop a remedial action plan. I'm very encouraged that most of these, although not all, involve public participation which we're trying to encourage through the IJC. We know that if we don't have public participation, pushing the agencies on, we really won't be getting these areas cleaned up.

Looking at trends, we know that concentations of some pollutants are decreasing. Dieldrin kept going up but then it started coming down again. We don't know exactly why. We know why DDT is going down, we stopped using it, although we still manufacture some DDT in this country. We don't use it here but we send it over seas to use, that's nice. PCBs have been coming down, but you have to remember that perhaps 60% of that material has not entered the environment yet, it's still in transformers and so on. PCBs will be around for a long time and a lot of it is in the sediments. There's a big problem in the sediments in these areas of concern. Here you can see PCB concentrations in bloaters and the PCB load. You see that the loading and the amount that you find in the fish are very closely related. We still have some PCBs coming in from the atmosphere, some coming in directly from the drainage, but there's a lot in the sediment. If those sediments are disturbed there's a good possibility that the pollutant can be mobilized again and put back into the system.

That brings up the next topic; the topic of the future and what might happen with global climate change. A few weeks ago we had a workshop here in the Chicago area about climate and global change. These show the sampling sites around the world in which my agency has been sampling CO2. This shows the trends in CO2 in the atmosphere. It shows a long, upward trend in carbon dioxide in the atmosphere. We also know that there are a number of other gases accumulating in the atmosphere that will also lead to the greenhouse effect of global warming. My agency does not believe that we can demonstrate at this time that there actually has been climate change or general global warming. This kind of information on CO2 increase that we have collected is good, sound information. But it's very difficult to say that there's a general global warming. You just don't have the kinds of temperature measurements on a global scale to demonstrate it at this time. We do believe that there is real cause for concern.

The EPA has been charged by Congress to pull together an in-depth report on what the consequences might be to our country if there was this climate warming. My particular laboratory under contract with EPA prepared three reports. They provided us with three climate change scenarios: one from Princeton University, one from Boulder and one from Oregon State University. We were able to plug these into our

hydrodynamic models, our hydrology models. It appears that these would be possible impacts on the Great Lakes. Now you have to realize these are based upon models. We can't say with any certainty that this is what's going to happen.

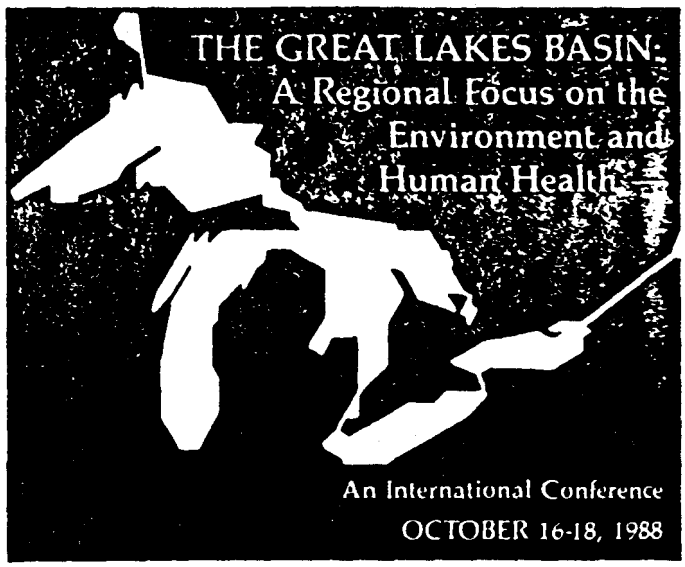
A temperature increase of three to five degrees centigrade might produce a precipitation increase. One model would say zero, another would say an eight percent increase, but along with that would be a significant increase in evaporation. This would lead to a net base and supply decrease. By net base and supply, we're talking about the total amount of water that's falling on the drainage basin. So even though there might be a slight increase in precipitation, the increase in evaporation would produce a net loss. This in turn would have an impact on the Lake levels and decrease the Lake levels by up to one meter.

Well, therein lies the problem and the relevance to this conference. If the Lake levels drop even a half a meter, there's going to be a lot of harbors where people aren't going to be able to get their boats in and out. There's gonna be a hue and cry for a lot of dredging. A lot of those sites are the very sites where you have toxic sediment sitting there. In fact, I know that in Lake Erie and some of its small harbors they're already having trouble getting in and out. They can't get dredging permits, so they have brought in some powerful boats and have just blown the sediments out of the lake. You know things like that are going to happen. There's a good possibility that a lot of the material that had led to a gradual decrease in PCBs in the fish will be remobilized and put back in the system. Who knows, we don't know for certain. The other impact that is important to the Great Lakes, contained in another report that we did for the EPA, showed that the ice cover would be very limited if at all.

A third report indicated that the thermal structure of the Great Lakes might change substantially. In deep areas the water would stay warm so long that the stratification would continue much longer; perhaps long enough so that in some of the deep areas the Lakes may not turn over and circulate all the way to the bottom. Circulation is very important because that brings in oxygen to oxydize the many things in the water. If that doesn't happen you can develop anoxia in the bottom waters which in turn will affect the chemistry of the sediments, possibly mobilizing pollutants back into the system more readily. At minimum, anoxia would certainly limit the habitat for trout and salmon and other cold water fishes. Again, we don't know whether that model has any reality, but these are the kinds of things I think we ought to be thinking about in the future.

Although, I'm taking up too much time here, I want to quickly look at some of the things that are in the Water Quality Agreement. I know the Agreement is available to you but if you're like me, maybe you just haven't bothered to read the darn thing. It is rather tedious to read. I picked out a few high points that I thought you might want to be aware of. The Agreement consists of a number of parts and then it has various annexes. Annex twelve talks about toxicological research on chemicals and reviews research conducted in other countries. Further, it addresses specific research that should be undertaken with significance placed on the effects of persistent toxic substances on human health and aquatic life. Concern is with the interactive effects of residues of toxic substances on aquatic life, wildlife and human health. You can see that human health is right up front here in this document as it should be. The Agreement goes on to say research should be conducted to understand the processes of wet and dry deposition. Here we're talking about the material coming from the atmosphere. Also addressed, the big problem about whether materials are synergistic or additive in terms of health. You heard some of this concern yesterday.

What I'm pointing out here is that this document really is a very sound one. Much of what you were talking about yesterday is already identified in the Agreement. It's a very important document. I think we need to get back to it when we're considering what to do with these problems. We should see that our governments abide by this protocol and the kind of research and undertake the kind of actions called for in the Agreement. I think this is the importance for the future. We need to continually express our concern to our governments to see that this is undertaken. With that, I will close.



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PLENARY SESSION FACULTY

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