Nobel Voices Video History Project, 2000-2001

Interviewee: Werner Arber
Interviewer: Neil Hollander
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[Note: The volume level of the interviewer's microphone is extremely low, at times inaudible.]

HOLLANDER:

Professor, could you please introduce yourself and tell us exactly what it is you do.

ARBER:

I'm Werner Arber. I live in Switzerland and work at the University of P__, where I teach molecular microbiology.

HOLLANDER:

What is it that you've done to win the Nobel?

ARBER:

Well, in my early research assistant time, I was working on a program for studying radiation effects for the effects of different type of radiation on living organisms; and for this purpose I was preparing special strains of bacteria to do these studies with bacteria and with their viruses, and in doing this, I ran into a phenomenon which had been described but not explained; and in a few experiments I was successful in identifying that the phenomenon was heavily determined by properties of the DNA which were not genetic but epigenetic. That means that some modification was brought to the DNA, which made it different from if this modification wasn't there; and it was then clear that each bacterial species gives its proper type of modification in different orders of nucleotides—that means in different sequences of nucleotides—so that there is a mark of identity for the DNA of the cell in which it's produced which other DNA molecules will not process; and, if you want, this is a kind of simple immune system that there is a possibility to recognize "own" from "foreign" and, as you may know, sometimes viruses or other means can transport fragments of DNA from one cell to another, and sometimes that DNA which is transferred is foreign, and bacteria are able to identify that. They will break it down, and I interpret that, that the purpose of that is indeed to *reduce* the natural transfer of genetic material from one type of bacteria to another type. It's not completely zero. There is a limited possibility still to do that because that control is relatively slow so that sometimes segments of DNA can incorporate into the new host.

HOLLANDER:

Are you still working in this field?

ARBER:

Yes. With this and many other experimental approaches I have studied until now, molecular mechanisms of the evolution process, of biological evolution, in microorganisms.

HOLLANDER:

Has winning the Nobel made your life easier or more difficult?

ARBER:

That's very hard to evaluate, because I have no data control, as you may imagine. [Laughs] I always claim that it hasn't changed much my life, but it did to some degree, certainly. I have more opportunities, and some of these opportunities were very welcome. And actually I was involved in other things, which I had not considered before just because I have been asked after being a laureate of the Nobel Foundation.

HOLLANDER:

Can we go back, way back, to when you decided to become a scientist, and was there some event, or person, or thing, or object, or some moment in time when you decided "I'm going to become a scientist," rather than become a truck driver or—

ARBER:

Well, as many young people, I had several options. One of the options was actually theology, and I also liked very much working in biology. I had, in my schools, started to learn Latin. I had missed the right moment to start also the old Greek, which is required in our universities for studying theology, and I had then decided to catch up with that Greek, and I felt it was a heavy burden, and the other matters suffered. So I then decided, "It doesn't matter. I will give up theology and go, rather, into natural sciences."

HOLLANDER:

A rather interesting combination here.

ARBER:

Yes. Indeed it is, because, as you may know, often ethical questions come up in today's biology, and I do them with much reflections, I must say.

HOLLANDER:

When ethical questions do come up, and obviously there is with DNA and so forth, you're getting into the ethics of life itself.

ARBER:

Yes.

HOLLANDER:

What, if I can sort of phrase this—I'm not quite sure how to phrase this. What is your world view? What are you using as a background or as a frame of reference to find these ethical answers to these ethical questions?

ARBER:

Well, this is the kind of deep, complex question, actually, on which I do work. I mentioned before that I studied molecular mechanisms of evolution, and in doing so with bacteria, which have the longest past of evolution—almost four billion years—I just look at the bacteria as they are today, and I conclude, if they have passed that long evolution, there must be mechanisms today present in these cells. Still, to favor evolution, what can it be? We know that evolution depends on genetic variation, and it depends on natural selection.

So, most probable, there is something in these bacteria which favors genetic variation, and indeed, if you look, you'll see enzyme systems, and enzymes are actually products of genes. So, therefore, you can conclude that in the genome of these bacteria, there are genes which are there in order to help bacteria to evolve rather than to help each individual cell to go from one cell cycle to the next. So, I call these evolution genes, and I do believe that for our world view, knowledge that nature takes itself care of the evolution of life, it's a very important aspect.

HOLLANDER:

But for life itself, when you take a theological point of view, obviously this is of great importance to you.

ARBER:

Yes.

HOLLANDER:

What view are you taking? Is this a religious perspective?

ARBER:

No. I would say this is a natural science perspective with a biocentric view, and I would think that we should not speak too much with the old anthropocentric view, although I, of course, I do know that there is something special with us human beings, but from the biological point of view, I think it is good to have a biocentric view. And if I say life, I mean life on that planet Earth and whatever life there is. There are microorganisms, there are plants, there are animals, and finally human beings.

HOLLANDER:

Where are we or you—it's a difficult questions. Where are we looking to say, "This is right and this is wrong"?

ARBER:

Well, this is another interesting question which you do see in the process of biology, because if I claim that our genes which favor genetic variation, you may ask, are these genetic variations—or we call them mutations—are they by purpose helping that particular cell to cope better with the conditions of life which it finds around itself? And the answer is, in general, these systems are more random. They may cause little mutations in one cell; in another cell, a neutral mutation; in still another cell, rather rarely, a beneficial mutation. So, these are not planned. The living organisms have no sense to know what kind of mutations should occur in themselves. These systems, which favor mutagenesis, in fact, do it more randomly.

HOLLANDER:

One of the things that [unclear] in the popular press is biologists having a choice, of taking this preferred path or that preferred path—

ARBER:

Yes.

HOLLANDER:

And part of it has to do with coming back, as you say, to an ethical decision.

ARBER:

That's true. This I have taken once in while, really, what I wanted to do with my capacities with my life—go back to the very early professional decisions when I have finished my studies in natural sciences. In fact, I had an experimental work in physics and not in biology, although I had also lectures and courses in biology. At that moment, I had two offers. One was an offer in a metallurgic firm and the other was going to work on an e__ microscope; and I took the second one because I had a little bit the idea that this first offer which I had was serving warfare, you know, constructing guns and so on. So, this I did not want to do. I went into e__ microscopy

and started to look at bacteria and viruses, and that brought me in these studies all my life long with these microorganisms.

HOLLANDER:

[unclear] about warfare and such, do you continue this interest in anti-warfare or outside of—

ARBER:

I do firmly believe that the international collaborations between scientists, natural scientists—biologists, physicists, chemistry—helps very much to a peaceful development of this world, because if we have good colleagues in any other nation which may be not in very good relations with the nations in which I live, I'm still interested to talk with these scientists if they are good, qualitatively good, and they are interested to talk with me, because mutually we can learn more for the basis of principles of nature. And in having these contacts, we become finally friends, and I think this is an important issue of natural sciences, to help the nations to go along with each other and mutually benefit from each other.

HOLLANDER:

What specific things have you done in this direction?

ARBER:

Well, I have been in my recent years, very active in science politics. The last three years I was president of the International Council for Science, which is the head organization of all international scientific unions and international scientific academies; and with that, we have given much thoughts to these collaborations worldwide and particularly with the developing world, also.

HOLLANDER:

Any specific things that you could point out that you've done?

ARBER:

Well, together with Professor Frederico Mayor [phonetic], in my function as the president of [unclear], he being the director general of UNESCO, we organized last year in June a big conference in Budapest on which the principles of science and all different types of impact of science on society, good or bad impacts, were discussed between scientists, politicians, and other members of the human community, and I think this helped a lot really to bring science into the debate with the rest of the public.

HOLLANDER:

Are there any, though, concrete instances that you can see of this having an effect?

ARBER:

Well, we work now on the follow-up on that conference, and it is too early to say which of the proposals will eventually be successful, and which not. It will take a few years, I think. But there are a number of follow-ups which are considered.

HOLLANDER:

[unclear], when you're teaching, do you use humor very much?

ARBER:

I didn't understand it.

HOLLANDER:

Do you use humor?

ARBER:

Sometimes I can do that. I don't plan it, in fact, I think. Yes, I know it's good, but it's not my strength.

HOLLANDER:

Professor, have you ever been embarrassed?

ARBER:

No.

HOLLANDER:

Professionally?

ARBER:

Not really, no.

HOLLANDER:

What is your favorite science joke? Or do you have one?

ARBER:

[Laughs] Well, I have probably some jokes, but they're not really—

HOLLANDER:

They can't be told?

ARBER:

Yes. Right. [Laughs]

HOLLANDER:

What I'm trying to get at, in your relationship with your students, do you ever find yourself wrong?

ARBER:

Yes. Actually, I'm very happy if a collaborator or a student comes to me, asks some question, and then we debate and finally I turn out to be wrong, and he says, well, yes, he got the feeling that I was wrong. I appreciate that. That shows that the debate is very good between us. And I must say I had for quite a long time a young Japanese collaborator in my laboratory, who was very open-minded against the general belief that in Japan you don't think to criticize your superior. But he did, wonderfully, and I appreciated that so much.

HOLLANDER:

And he was right?

ARBER:

He was right. Yes, of course. He knew that he was right, and I accepted he could show me that I was wrong. [Laughs]

HOLLANDER:

Professor, where do you think science is going at this time, natural science? What do you think are the frontiers there?

ARBER:

Well, the trend today is to push natural sciences more and more into immediate applications, and I think this is the wrong attitude. We should have the freedom really to do our own choice. Some people like to be close to the applications. Some other people like to be a little bit further. And what is important, I come back to my early development, there I had a task to study effects of

radiations on living beings, because human society wanted to use atomic power for gaining energy, and it was clear that one needed some assessment of the radiation effects.

We did that, but we found this other aspect which I mentioned, which led to the discovery of restriction enzymes and, therefore, gave an important tool for developing, as we know, genetic engineering and working on the molecular level with DNA. So, would I not have taken the freedom there, I would not have found these aspects.

HOLLANDER:

When you did these studies on radiation, what exactly were you studying? Were these studies on the effects on humans?

ARBER:

No, no, no, no. These were on bacteria and on viruses, X-ray and UV radiations, and so on.

HOLLANDER:

Professor, if student comes to you, wants to enroll with you, study with you, what kind of characteristics or attributes are you looking for in a prospective student?

ARBER:

Yes. I do first look at the records of his performance in the early part of the studies, and then if these are fine, I interview him. I look at his motivation; try to find out his motivation. I ask him what his ideas were, where he wanted to work later on, after having finished his studies, and in such a personal dialogue I think one gets, also, a feeling whether that person fits with you and with your group or not, and I must say I was usually quite successful.

HOLLANDER:

Returning to the Nobel to put this in perspective, now having won the Nobel and all, what do you think is the significance of the Nobel Prize?

ARBER:

Well, there are many prizes. Nobel gives prizes since now a hundred years, but there were other prizes already at that time. It's a mystery to me why the Nobel Prize is considered worldwide as one of the top prizes for natural sciences. Perhaps it has to do with the very careful work which the committees do in Stockholm in their choice of the laureates. In general, the decisions, which come from Stockholm, are widely accepted by the scientific community as correct. So, I'm not sure whether this helps, but I think it has gained that halo already a long time ago and persists still.

HOLLANDER:

I'm sure that people have asked you many times but, do you feel that having won the Nobel, there is nothing left to do?

ARBER:

[Laughs] No, contrary, it gives you a stimulation. Now, I mentioned that I moved into international science politics, and I think I could have done it without Nobel Prize. But having the Nobel Prize, I always have the feeling it gives you an additional added value, so that your acceptance is easier by whoever you talk to. So, in that sense it was of big value for me from my realizing my ideas with my activities.

HOLLANDER:

One last question about international science politics [unclear], [unclear] and, of course, warfare. Do you feel scientists have a strong enough influence on politics—world politics?

ARBER:

Yes, I do, and with increasing importance of science for the human society, I think it will still increase. I do know quite a number of famous scientists which have moved into politics themselves, which are actually ministers in some countries for education or for science, and I think they have another view of natural sciences than would have some other persons which went through other kind of careers.

HOLLANDER:

What about the issues of war and peace? The twentieth century has seen a century of warfare. Do you think scientists have done all they could do to [unclear]?

ARBER:

I do realize that there is a problem, because it is clear that modern arms would not exist without help of science and technology. So, some of my colleagues, of course, just in order to earn money, have contributed to these developments. But, I think it would be wrong to accuse all of science for these misuses, which were very heavily pushed sometimes by political leaders, and I think bringing more knowledge and science and its potentials into the leadership in politics might help. I hope so, really, to see that there are very interesting beneficial applications and misuses, which would be much reduced.

HOLLANDER:

Do you think—one last part, the last [unclear]—do you think the laureates here, [unclear], share your view here?

ARBER:

I'm convinced from personal talks with many of them, that many of them will share these views. There are little variations, but I don't think that you will find colleagues which are of the opposite side.

HOLLANDER:

Thank you very much, Professor.

[End of Interview]