Anton Zeilinger

Encounters Between Buddhist and Quantum Epistemologies

When in 1997 my colleague and friend Arthur Zajonc invited me to visit His Holiness the Dalai Lama in his residency in Dharamsala to discuss modern physics, I was very excited. My work on the foundations of quantum mechanics had led me to asking progressively deeper epistemological questions, and I was interested in discussing some of these questions with His Holiness, whom I saw as the representative of one of the large spiritual traditions of the world.

The meeting in Dharamsala itself was organized and arranged by the Mind and Life Institute under its president, Adam Engle. The meeting itself took place from October 27–31, 1997. Every morning, on five consecutive days, one participant would present his views on a question of quantum physics or cosmology. In the afternoons there would be long discussions and debates among all of us. The participants were

- His Holiness the Dalai Lama, Tenzin Gyatso
- David Finkelstein
- astronomer George Greenstein
- Piet Hut
- Thupten Jinpa
- philosopher Tu Weiming
Alan Wallace
Arthur Zajonc

An account of this meeting will be published in due course, edited by Arthur Zajonc.

I should mention that for myself the first encounter with Buddhism was when, on the morning of October 27, 1997, I met His Holiness personally and presented an introduction into fundamental concepts of quantum mechanics. I had never investigated Buddhism in any depth before, nor did I ever have close encounters with Buddhist philosophy. My main surprise during the discussions with His Holiness was to learn that Buddhism is not just a spiritual tradition but represents a very concise and stringent logical and epistemological system. I would also like to mention that the discussions with His Holiness were very rewarding not only on a personal level. He always found the right pertinent questions, like the best student one can imagine having as a teacher. Very impressive as well is His Holiness’s openness concerning Buddhist teachings. More than once, he indicated that should we in Western science ever find anything that contradicts Buddhist teaching, then that teaching must be changed.

Since I had been told about His Holiness’s interest in technical apparatus, I had brought some experiments with me to Dharamsala. One was a setup of the famous double slit experiment and the other one was a demonstration of the polarization of light. I am sure that the double slit experiment was the first quantum experiment ever performed in Dharamsala. As the experiments both apparently succeeded in being very instructive, and as they were able to arouse His Holiness’s interest, I dared to invite him to come to Innsbruck, where I was situated at that time, in order to see our laboratory. To my great excitement, he immediately accepted this invitation.

So, in June 1998, I organized a conference entitled the International Symposium on Epistemological Questions in Quantum Physics and Eastern Contemplative Sciences in Innsbruck, again with partial financial support by Mind and Life. The meeting with His Holiness himself took place over two and a half days. Arthur Zajonc, Thupten Jinpa, Alan Wallace, Adam Engle, and I met two days earlier in order to prepare the meeting in depth through intensive prediscussions. We also felt the need for more discussions afterward for a day or two.

During the laboratory visits the discussions focused on various funda-
mental quantum experiments that I had arranged with my group in our laboratory. Again, it was interesting to see how His Holiness always addressed the deep epistemological issues directly, challenging us again and again to give the evidence for the various statements we made as physicists. If I may dare to say this, His Holiness might have become a great physicist in another world without his duties as spiritual and political leader of the Tibetan people.

It is very difficult to do full justice to the depth and breadth of the debates we had both in Dharamsala and in Innsbruck. It is also very difficult to avoid mistakes in analyzing the exchange of concepts and ideas from one's own perspective. Therefore I feel it best to just recount below some interesting parts of the discussion that focused on issues pertinent to both the Western quantum and the Eastern Buddhist epistemology. I understand that this gives only a very limited impression, but I am sure it will convey some of the spirit of the debates. A somewhat more detailed representation of the debate was published in the German monthly magazine GEO in January 1999. I am certain that some time in the future this material will be analyzed carefully and presented in a broader way.

ABOUT THE LIMITS OF ANALYSIS

Zeilinger: What kind of things might we discuss today? We were thinking of talking about some philosophical or general questions that have already come up in the discussion with Your Holiness in Dharamsala. We are interested in discussing the following: there are some instances, or were some instances, in the discussions in Dharamsala where Your Holiness said that a line of reasoning sometimes can only be carried to a point where you finally say, "That's the way it is. That is the nature of the situation." What we really would like to know is, when can we say that? When do we know that we cannot give any further reason? This is important in the discussions about the foundations of quantum mechanics, for there we also have similar situations, and we would really like to know from your tradition when you say, OK, that's it.

. . .

HHDL and AW: [Tibetan]

AW: In traditional Buddhist philosophy, if you ask why does the apple fall down, would you not say that that's simply the way things are? In other words, that's it. His Holiness said, no, that would be incorrect. You haven't found an explanation. The mere situation of not having an explanation is not a sufficient cri-
tion for saying that's just the way things are. Then I said, how about the color of
the sun? The sun is yellow. Why is it yellow? Would a Buddhist not say, why, that's
just the way things are? His Holiness said no. Once again, you don't have an ex-
planation, but that's not a sufficient criterion for saying that's just the way things
are. But then you can make another statement, which His Holiness is content
with, and that is, if you engage in a positive action, it has a positive result, karmi-
cally speaking. Well, why is that? If you engage in generosity, then affluence or
prosperity is a karmic result of that. Why is that? Then we'd say, that's the way
things are.

HHDL: [Tibetan]

AW: And likewise, in terms of the salient characteristics of consciousness.
What are they? They are that it has a luminous or clear attribute. One. And that it
has a cognitive attribute. Two. Why is it that consciousness has these two salient
characteristics? It's just the way it is. Maybe you could also say, why does a photon
have these three attributes? Why does it have direction, frequency, and polariza-
tion? Would you say, that's just the way it is? Or do you have anything further that
even conceivably could be said about it? Is there possibly an underlying explana-
tion to that, or do you have the confidence that's it? That there's no more to the
story.

Zajonc: That's a good example.

AW: And Buddhists have a lot of confidence about the nature of conscious-
ness—that that's it. There's nothing obscured here. It's not merely our ignorance.
That's just it (Tib. chos nyid, Skt. dharmatā) the way it is.

Zeilinger: And they have this confidence because of analysis or what?

HHDL, AW, and T]: [Tibetan]

AW: His Holiness is saying that it's not only that we don't know any further
explanation, there isn't any more explanation.

HHDL: [Tibetan]

AW: And likewise, you must have situations like that in quantum mechanics.
You have confidence not just that you can't find an explanation, but that there isn't
one.

HHDL: [Tibetan]

Zajonc: But for us there are sometimes some gray areas where we're not sure.
For example, one is you could say there are certain fundamental units, for exam-
ple, Planck's constant or the charge on the electron. This is a universal constant.
You could ask, Why is Planck's constant exactly the value that it is? Now there's
some discussion, and maybe there are cosmological reasons that this is actually
not just the way things are, but this is because of the distribution of energy or
something or other in the universe. So, there’s that. Or why is it, for example, that an object has inertia? Why does it resist motion? Well, you could say that’s just the way things are, but there are other people who say, no, that’s because it stands in a particular relationship to all the masses in the universe, so it has inertia. These are to me some gray areas. It’s not sure that you really have a boundary or whether it’s still open to some discussion. So, it would be nice to know if there were rigorous criteria that one could apply.

Will: Just to come back to consciousness, to analyze that in the spirit of what Arthur said, sometimes it’s not completely clear whether this is just the way it is or whether there might be an open inquiry.

AW: [Tibetan]. I just asked, How do you distinguish that? What are the criteria?

TJ: [Tibetan]

AW: There is no explanation, and I don’t have one.

Zeilinger: Right. How do you know that? When do you know that?

AW: You have to take it case by case.

HHDL, TJ, and AW: [Tibetan]

TJ: When His Holiness is speaking from the Buddhist point of view, he’s taking into account even the existence of Buddha’s omniscient mind, which is supposed to know everything. So, even from the Buddhist point of view, to the question “Why does consciousness have these two salient features?” one can respond only with “That’s the way it is.”

HHDL: [Tibetan]

TJ: Similarly, to the question, Why does positive action lead to positive results and negative action lead to negative results.

Zeilinger: Maybe the best example of something like “that’s just the way it is” exists in physics. So far the program is to base everything on certain symmetry principles. Symmetry in a very general sense, not just right/left symmetry but also the following symmetry: for example, that the laws of nature should be the same now and in ten minutes. It need not be the case, but nature seems to be that way. And they are the same here in Innsbruck and in Dharamsala. There doesn’t seem to be a difference. These are what we call symmetry principles—that the laws stay the same, even as you change something. Concerning these symmetry principles, we probably have to say, “That’s just the way it is.” There is no deeper reason.

HHDL: [Tibetan]

TJ: So, would you say that many of the natural laws are, That’s the way it is?
AW: The laws of nature and so forth? Gravity?
Zajonc: Some of these can be derived from this way of viewing things.

Zajonc: They are entailed. In one sense you can say, well, yes, that's the way things are because in order for the world to be, yes it has to be this way. But the physicist finds it more elegant to move back to very simple presuppositions, very simple statements, very general ones.

HHDL, AW, and TJ: [Tibetan]
AW: As general as possible and as few as possible.
TJ: [Tibetan]
Zajonc: Maybe in that sense, the situation would be, “That’s the way things are.” Those are the laws of nature.

TJ: So the most fundamental ones.

Zajonc: Yes, the most fundamental ones. There are a few very beautiful, very simple principles that then allow you to derive many specific results concerning gravitational theory, electromagnetic theory, quantum theory, and so forth. And then you wonder, well, what's the power of this simple principle? A number of physicists have thought of it in a kind of a metaphysical way—this is so powerful that this must represent a kind of greatest possible order in the universe. This simple law. And there you would say that's just the way things are.

AW: There's a similarity in Buddhism. In Buddhism we speak of four laws of karma. One of them is what His Holiness said: if your action is harmful, you get a negative result back. There are three other ones, and none of these can be derived from the others. So, they are all equal in status. But for each one I think you would say, that's just the way it is. And they are fundamental, and the implications are enormous. So there are very few—they have totally universal application and a massive number of derivatives.

Zajonc: In specific circumstances you may have a law, which if you look at a deeper and deeper level reduces to some combination of more basic laws. You wouldn't say, that's the way things are, necessarily, on the higher, the more incidental level. You'd try to trace it back.

ON ATOMS, PHOTONS, QUANTA

HHDL, AW, TJ: [Tibetan]
TJ: We can go up to the minutest particle and the Madhyamikas would reject the notion of some kind of fundamental, absolute, elementary building block—
some kind of atom, that is, or particle that is indivisible. For the Mādhyamikas, they would argue that that concept is incoherent.

Zeilinger: It's ontological. There is, at least within physics, a breach with a long-standing tradition. The idea of physics until the beginning of the twentieth century was that you can basically explain—at least in principle—you can basically explain why specific things happen. There was this old picture of the universe being a clockwork, which was at some time started by the Christian creator—there was the ultimate clockmaker, God, who built the clockwork—he started it—and now the universe is running deterministically. The idea was simply to explain what the laws are according to how this clockwork runs, and you have to start with—in what we call in physics—the initial conditions. You have to know what the universe looked like in beginning, and then the rest is clear.

Now, in the modern view, we know that such a picture is not possible anymore. In other words, the facts in the universe in five seconds are not determined by the facts in the universe now, at least not completely. I think that has consequences for the way we view the world. To me, such an open view of the universe is much nicer than the old view of a closed universe where everything follows its course—it's much more open. It's much more romantic in a sense. It's not so boring.

Zeilinger: My friend, Abner Shimony, is one of the few people in the world who is both professor of physics and professor of philosophy. He says that most practicing physicists are schizophrenic. They have two parts of their brain. In one part of their brain, when they are in the laboratory and play with things, when they play around and do something, they are realists. They talk about the photon. They talk about this going here and there and so on. But when you tell them, but now let's talk about the foundations of quantum mechanics, they switch to the philosophical side, and they say, oh nothing exists without the apparatus defining it and so on.

TJ: So the question His Holiness is asking is that from your point of view, from the quantum mechanical point of view, given these ambiguities, would it make sense to talk about reality in general?

Zeilinger: You know the problem is, if you investigate things in detail, the nature of the things, then you can dissolve everything.

So, the problem looking at quantum mechanics, the way out is that we say we
have to start from somewhere. We have to build our worldview on something. This something onto what we build is sometimes called the classical world, or you could also call it the world of everyday experience. We build it. We do not doubt this. And on the basis of the properties of these things that we immediately perceive, we build the rest of our description. Then we observe many things, and the quantum features of objects become, in a sense, very unreal. We should be very cautious then to talk about reality there. From a very purist point of view, you can say that all we really can talk about is these experiences of the everyday world. The rest always has to be taken with a grain of salt.

**HHDL, AW, and TJ:** [Tibetan]

**Zeilinger:** We should be open about any other statements about the world. We should be open to the possibility that this could be completely wrong or changeable, or—well, we should be flexible in that respect. The question then, which is probably one of the most important ones we can ask, is, "If we start from everyday experience, when we build models—could it be that in our way of looking at the world, in Western science, we built just one of many possible models? Maybe a completely different physics will be possible. Could that be? Should we start fresh again? Maybe the turn Galileo and Newton took is not the only possible one. This is to me one of the most fascinating questions. Could we build a science that looks completely different? I would simply like to get an idea how to attack such a question. I don't know.

. . .

**AW:** Arthur, we're trying to make a relationship with the macroworld, and that is, I was arguing that the photon as the attribute bearer is a cipher. To think of it as having something real, independent of these totally indeterminate, nonlocal probabilities of attributes, is just a cipher. It's just a nominal cipher. But then His Holiness, and also Thupten Jinpa-la, says, well, wait a minute, you get a whole bunch of these so-called ciphers and then you have to squint your eyes. So, how do you move from the discourse about light on the quantum level to the stuff that gives you sunburn? Or, you know, the stuff that makes you squint your eyes? That is, if you're going to make ontological statements that the quantum realm exists only in relation to system measurement and so forth . . .

**Zajonc:** I think this puts you in a better position, because what you've done, you've said you've taken the measurements, or let's call it generally the observations, really seriously. You don't posit the existence of this thing without attributes on the other side, so what you're squinting at is not this thing that's on the other side. What you're squinting at is brightness. Brightness is given standing, not this attributeless thing. You'd say that what causes sunburn is a particular attribute of
light. It's not the thing on the other side that causes sunburn. The materialist feels like you can't give an account of the world that's robust unless you have the thing on the other side.

AW: We're getting into very deep ontological waters here. I love what you said there: we can't posit the photon independent of the measurement system, but we can't say it's simply an artifact. You've set up a classic situation of having to find a middle way. Where somehow subject and object are inextricably, primordially related. This is right in the lap of Buddhism, on the one hand. On the other hand, it seems like the sun is blowing out things in all directions irrespective of any system of measurement. It seems like. How are you relating that which the sun is blasting out.

Zajonc: It's not anthropomorphic somehow or other. It's not...

AW: Waiting for little measurement systems all over the place to say, OK, you photon, you can exist. OK, you can have a polarization. I think we really need to avoid what most scientists have fallen into, and that is localizing all the problems into your lab. Rather, get them out into the macroworld. What implications does this have in the macroworld? And what are the ontological issues—are there ontological repercussions?

Zajonc: It's good.

AW: I think we must do that today. Otherwise this is so [local].

Zajonc: It will be so hard. But it's good.

HHDl and TJ: [Tibetan]

AW: So, we're making very interesting ontological statements. But now, as His Holiness was saying, meantime, light is very bright. The sun is giving light in all directions. So, are these photons coming from the sun, do they also not exist independent of the measurement system? Who's doing the measurement? And should all human beings vanish—with no measurements—who believes that the sun then doesn't give any photons anymore? So, how to relate quantum mechanics with the everyday world, and with the sun, the stars?

Zajonc: . . . One final example of that is every molecule that binds together by what is called covalent bonding—so, for example, a hydrogen molecule relies on this ambiguity, this quantum mechanical ambiguity, to bind those two atoms together into a single molecule. So without this kind of quantum ambiguity all our chemistry would disappear. Life itself wouldn't be possible. So, it's not only a kind of abstract property of photons in universities with lots of money.
FROM THE BIG BANG TO THE BIG CRUNCH

TJ: His Holiness was saying that if one has to posit only one Big Bang . . .

HHDL: Then why did it happen?

TJ: Why did it happen? That’s really a big question.

HHDL: That’s also part of nature. If it continues all the time, then it is much easier to accept.

Zeilinger: Yes, I understand what Your Holiness says, but I would really like to leave it open.

HHDL: Really! [Laughter]

AW: It’s a safe position. A respectable position.

Zeilinger: You know about the other end—it’s still open. It is still open whether there will be a Big Crunch or not. This is undecided.

Zeilinger: I would not say it does exist . . . it’s an empty question. It’s the same as—there is supposedly the story that in the middle ages they discussed how many angels can sit on the tip of a needle. How many angels can sit on the tip of a needle? It’s a useless question. [Laughter]

HHDL: [Tibetan]

TJ: In some Buddhist philosophical writings the claim has been made that in relation to physical objects—matter—there is no beginning in terms of the continuum of the causal chain. But there will be an end to the continuum. But from the point . . .

Zeilinger: Another question is whether there will be a Big Crunch.

HHDL: Big Crunch . . .

Zeilinger: The two go together. What you need for that is for the universe to have a certain minimum mass, so the gravity is strong enough to pull it together again. Now, it turns out that the mass which we see in the universe, the stars and the galaxies, is, at most, maximally, about 10 percent of the critical mass necessary to get the Big Crunch. So, people have been talking about the missing mass problem. Is there some other mass somewhere in the universe that would make it possible—the Big Crunch? One of the possibilities would be many, many particles that have mass, but that would be very difficult to see, nearly impossible to see.
AW: Because they have no charge?

Zeilinger: Because they have no charge and they have no other properties that make them easy to detect. They only interact very weakly. The candidate for this kind of particle, for a long time, is the neutrino. The neutrino is a very tiny particle. The question was, "Does the neutrino have zero rest mass?" If you stop it, is it like the photon, having no rest mass? Or does it have some rest mass, a little bit of rest mass? It's a long discussion. Because if the neutrino would have even a tiny rest mass and there are so many of them, it could possibly, as we say, close the universe. It could easily make the universe such that it will collapse again. Just two weeks ago, in some experiments in Japan, they claim to have found evidence that the neutrino has a rest mass by studying the neutrinos coming from the sun. And they claimed that they found evidence for a little bit of a rest mass.

HHDL: [Tibetan]

Zeilinger: If that is true, then the universe might be closed.

HHDL: We're trapped.

Zeilinger: Not in our lifetime.

HHDL, AW, and TJ: [Tibetan]

TJ: The conclusion is that this is pointing towards a Big Crunch?

Zeilinger: Yes. That's right. If that is really true, then it makes a Big Crunch possible again.

AW: So, it's not even on the cusp. It's over the cusp and you can say yes.

Zeilinger: The exact numbers are not there. The exact numbers are not out—what the mass is and so on. But certainly—the question is open again. So, it's easily possible. But it will not happen during our lifetime.

HHDL: I think, billion.

Zeilinger:Billions of years.

Zajonc: It's a good reason for reincarnation. [Laughter]

Zeilinger: So, we can watch the Big Crunch. [Laughter]

AW: Make your reservations now.

Zajonc: We'll see you there.

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Buddhism & Science
BREAKING NEW GROUND

B. Alan Wallace, editor