SONDERDRUCK AUS: exposé donné à Heidelberg (1989)

Philosophia naturalis

Band 28 (1991) Heft 1

VITTORIO KLOSTERMANN · FRANKFURT AM MAIN

Bernard d'Espagnat

Open Realism

Usually "invited speakers" at a meeting are only allowed some 30–40 minutes to give their talk. Here I have been kindly informed that I could speak somewhat longer. I do welcome this opportunity for it will allow me to be more explicit, and therefore clearer, on some points that really need explanation. But on the other hand longish talks easily give an impression of confusion. To prevent this, I shall split this talk into three neatly separated parts:

The first part is an introduction, where I shall define and explicate my starting point, namely "open realism", and where I shall try to justify this starting point in the eyes of the philosophers that, I guess, most of you are.

The second part is essentially a discussion of realism, made in the light of modern physics. In it we shall see that, although most physicists are *would-be* realists, still: it is the very science of physics that bars out several traditional forms of realism, including of course naive realism.

The third part is a description of what, I think, should be inferred from these restrictions. In other words this third part describes my own *point of arrival.* There will be some overlap between the first and third parts but it will be kept minimal.

First Part

Introduction: My Starting Point

As mathematicians very well know, you cannot deduce something from strictly nothing. Even a theorem cannot be proved without first formulating a starting point, in the form of some axioms. But these axioms should be as few and as general as possible. The same holds true in my approach. I must have a philosophical starting point but I want to make it as uncommitting and *generality-preserving*, as I possibly can.

Well, to get at it let me first say that I reject solipsism. Of course I know quite well, as you all do, that solipsism cannot be rejected on purely logical grounds. But whatever meanings the words *to exist* and *to originate* may have, I feel quite convinced that my mind is *not* the only existent, from which everything else would originate.

Similarily – and *this* is the starting point I promised you – I reject what I call "collective solipsism" (with apologies for this strange association of words), namely I reject the hypothesis that the *human minds* have the privilege of being the only really *existing entities,* everything else originating exclusively from them, as collective hallucinations these minds have. Collective solipsism is no more falsifiable than "ordinary" solipsism, of course. I mean: it has no internal inconsistency. Still, if you ask the man-in-the-street what he thinks of it, he will say it is just rubbish; and I am partly on the side of the man-in-the-street in that affair. We shall have opportunities to discuss the question further. For the time being let me just reiterate that I take the rejection of collective solipsism as my starting point. This rejection can also be formulated in a less negative way and this is what I call "open realism". This is it:

Open Realism

There is something (the set of all the physical plus biological objects, the set of all the atoms, the set of the Platonician Ideas, God or what not: this is left unspecified at this stage) that does not derive its existence from the existence of the human minds.

Definition:
By convention this "something" will be called "independent reality".

Some comments are here in order if we want to avoid misunderstandings:

1) a question of vocabulary. A misunderstanding may take place here because what most philosophers call "reality" is not what *I* call "independent reality". It is something else, that has much to do with human representations. We shall meet quite soon with such a notion. But for the moment let me just say that as soon as we accept open realism we find it convenient to give a name to that "something", so that we can refer to it. The name "independent reality" is not awfully nice, I grant that, but it has the advantage of committing us neither to materialism,

nor to Platonic realism (the realism of the essences), nor to Deism, nor to anything else. It is just a neutral label, that I ask you to consider as such. By the way: it does not mean that we cannot *act* on that reality: just that its *existence* is independent of our own.

2) The second important point is that very neutrality. So let me insist on it. Open realism is our starting point. Later we shall argue and make things more precise. We shall eliminate some of these conceptions I mentioned. But we want to make things more precise by means of *argumentation*, not by arbitrarily picking out one particular philosophical system and forgetting about all the other possible ones. In this aspect, you see, open realism is fully suitable since it is compatible with nearly all the various philosophical systems that were put forward in the past, be they materialist or spiritualist. Indeed the only one with which it is not compatible is strict idealism, in the sense of collective solipsism. So, by postulating open realism we are really begging very little.

3) My third point is somewhat of the nature of a side remark. But it may help us understanding better each other's view point. It is this. Most of us, before we were philosophers or scientists, started with a kind of robust commonsense realism: the moon "of course" exists per se, every electron, of course exists per se, independently of our knowledge, and so on: and the purpose of science is to know those things *as they really are*. Now, in the course of their existence most philosophers and quite a number of scientists are led to water down such a naive realism. But for philosophers this watering down takes place much earlier than for scientists. It is also much more radical and it concerns many more people. Indeed, it seems to me that within the philosophers' community the realists are a minority and have the feeling of being one: they strive for the defense of an idea (namely realism) that they themselves consider as daring, and far from obvious. Within the scientists community it is, I think, just the reverse. Most scientists never heard about Berkeley (I mean the bishop, not the university!) and those who have, mostly laugh at his ideas. Instinctively – I mean – most scientists have a feeling that, in spite of well-known difficulties, there must be something right, deep down in the idea of realism. And I think they are correct. I think "open realism" marks the limit in the possible regression from naive realism, in the direction, say, of idealism, since if we do not even defend that, we fall into the most unpalatable conception that I called collective solipsism. My impression is that this point was not considered seriously enough by the philosophers of the phenomenalistic or pragmatic schools. These philosophers quite rightly insist, as I already said, on the fact that the phenomena we observe owe much to the structure of the human mind, and should therefore not be considered as necessarily being faithful descriptions of "external reality". But in their insistence at stressing this, they somewhat forget, I think, the fact that if the phenomena in question originated *quite exclusively* in our minds we would be back to collective solipsism. For these reasons I think we should not *start*, as many philosophers would, with the idea that the phenomena observed by science are basically " something in the mind". I think it is just the other way round. We should start with a kind of realist outlook and see to what extent the data of physics, chemistry and so on force us, step by step, to make this realism more subtle; in the direction, perhaps, of a phenomenalism of some sort, but this remains to be seen.

Second Part

A Discussion of Realism in the Light of Contemporary Physics

As we have seen, "open realism" is infinitely less specific than what philosophers usually call "realism", since it is compatible with several standpoints that fall quite outside the commonly accepted range of "realism". My idea is that from now on we should proceed as scientists usually do when they need to make their ideas more specific. That is, we should proceed by formulating several alternative working hypotheses, by studying the consequences of each of them, by comparing them with the well-established facts (or with the experimentally testable consequences of well-established theories) and by *rejecting* the working hypotheses that fail to pass this test (in a way, this is the method that Popper called "fallibilism", applied at a very early stage of our philosophical orientation).

So much for the *method*. Now, going back to open realism, one of the first questions that it raises is, "is independent reality fully describable?" Opinions differ on this point. I call "hypothesis of physical realism" the working hypothesis that it *is*, at least in principle, and that it is, funda-

mentally, by physics (supplemented if necessary by companion sciences, chemistry, biology etc.: the question of their reduction or non-reduction to physics I prefer to leave open). Let me state this.

Hypothesis of "physical realism":
Independent reality is, at least in principle, describable by physics (plus, conceivably other sciences).

Now, to describe we need *words*, that is *concepts*. Physical realism therefore implies that some at least of the concepts used in physics refer to elements of independent reality. What are these concepts?

The first idea that comes to mind is that they are our familiar concepts or at least concepts derived by quite straightforward generalization and abstraction from our familiar concepts. This is therefore a (restrictive) sub-hypothesis within the physical realism hypothesis. Let us call it the "near-realism sub-hypothesis". Here it is:

(Sub)hypothesis of "near realism":
The scientific description of independent reality can be couched entirely in terms of familiar concepts (or of concepts derived from the classical ones by means of short straightforward generalization as well as by combination).

Roughly speaking, near realism reduces reality to a collection of *things*, that is of localized objects, electrons, quarks and so on conceived of just as localized objects, bound up by forces to one another.

Now, modern physics has shown near realism to be false. For example, Einstein's theory of relativity has shown that it is not with the old familiar concepts of universal time and space that we can hope to describe independent reality. And high energy physics goes even further.'Through the phenomena of pair creation and annihilation it shows that *existence* and *properties* are *intermingled* instead of being *distinct* categories of thought, as we naively believe them to be. But all this is not by itself sufficient to dismiss physical realism, because there exists another variant of it, which I call "mathematical realism".

(Sub)hypothesis of "mathematical realism":
Physical realism is true but, for adequately describing independent reality, we need, along with familiar concepts, also *non-familiar* concepts, borrowed from mathematics.

Just as near realism, mathematical realism is a sub-hypothesis of physical realism (or, in other words, it is an ontology). But it asserts that to describe independent reality we must use, among others, concepts that are not familiar, such as space-time, curved space and so on. In other words it says that we must use a mathematical language.

Mathematical realism – under this or some other names – has a very glorious past. Pythagoras, Plato, Spinoza, nearer to us Einstein defended it. Indeed when, in talks such as this one, I come to speak of mathematical realism, I always feel that somehow I do not pay justice to its importance and beauty. It is a conception that amounts to giving to matter something resembling a spiritual foundation; thus bringing the essence of matter close to that of the mind that, step by step, discovers its structure. From the point of view of (if I may say so) attractiveness, its only blemish is its dryness.

But anyhow we shall see now that in the light of contemporary physics, mathematical realism does not appear as being the end of the story. The advent of quantum physics has induced a considerable regress of any "reasonable hope", I would say, of ever getting at a scientific ontology, including even that of mathematical realism.

To explain this, let me first recall that quantum mechanics is based on a set of axioms that, in a first approach at least, can be said to *replace* those of classical mechanics (I mean the three basic laws of Newtonian mechanics, that force is proportional to acceleration and so on). The necessity of this replacement was forced upon us by the fact that, when applied to the atom, the classical axioms gave false predictions: predictions that were falsified by experiment.

One first important difference between these two sets of axioms is that, contrary to the axioms of classical mechanics, those of quantum mechanics refer explicitly to the concept of *probability*. In other words, in quantum mechanics the *probability* notion is so basic that it comes in at the very level of the axioms whereas, in classical mechanics, it enters the scene at a much later stage, in some applications of classical mechanics, and merely as a specification of our ignorance.

This major role imparted to the notion of chance arose a great deal of interest during the first half of this century. But between the classical and the quantum sets of axioms there exists *another* difference which is not as known as the one just mentioned but which, concerning the subject of our discussions, I consider as even more important. It is as fol-

lows. In classical physics it is perfectly safe to speak of the value a physical quantity *has* on a physical system, irrespective of the size of this system (be it a material point or a brick) and irrespective of whether anybody intends to, or is able to, measure that quantity. Not so in quantum physics. Let me be more precise. I just said that in quantum physics probabilities enter at a very basic level. This being so, one might expect that the basic quantum laws should tell us, for example, what probability a given particle *has* (in such and such circumstances) of *being* at a certain place at a certain time. But in fact it is not possible to formulate in that manner the content of the basic laws of standard quantum mechanics. To do this would lead to false predictions, disproved by the data. In fact, instead of speaking of the probability for a particle to *be* here or there we must speak of the probability there is of it *being found* here or there. More explicitly the content of these basic laws must, in all strictness, be formulated in the form "if we try to find out by experiment whether the particle is at such and such a place or has such and such property, we have such and such a probability of getting a *yes* answer". Clearly, a statement of such a form is much more consonant with a phenomenalistic than with any conventionally realistic viewpoint.

This fact was nicely expressed by Heisenberg:

"The conception of an objective reality of the elementary particle thus strangely dissolved into (...) the transparent clearness of a mathematics that describes no more the behaviour of the particle but only describes our own knowledge concerning it." Heisenberg (Nature in Contemporary Physics)

And a very similar statement was made by Wigner:

"The laws of quantum mechanics only furnish probability connections between results of subsequent observations carried out on a system. It is true of course that the laws of classical mechanics can also be formulated in terms of such probability connections. However they can also be formulated in terms of objective reality. The important point is that the laws of quantum mechanics can be expressed *only* in terms of probability connections [between results of subsequent observations]." E. Wigner (Symmetry and Reflections)

This last quotation of Wigner sheds adequate light on the phenomenalist character of standard quantum mechanics and it also shows that mathematical realism is not the only conception in which mathematics can have the basic role in physics. Indeed it shows the pertinency of a

kind of "mathematical positivism", in which the various mathematical entities describe not *physical entities* but man-made *operations.*

In my opinion the clearest way of expressing the difference between mathematical realism and mathematical positivism is to neatly distinguish *two* types of objectivity: strong objectivity and weak objectivity (that may also be called "intersubjectivity"). The difference concerns statements: a statement will be said to be *strongly objective* if it refers (or if it can be interpreted as referring) to the objects themselves (or to reality itself); if it can be viewed as a description of the properties the objects (or reality) actually *have.* Most statements of classical physics (take for example Newton's gravitation law) are strongly objective...

But not all of the statements to which we attribute the label "objective" are of that type. There are also *weakly objective* statements. A statement is weakly objective if it contains a non-removable reference to the community of all possible observers, while having a truth value that does not depend on any individual observer (this is why it is "objective"). Predictive rules (if we do this we shall observe that) are examples of weakly objective statements. Please note that the difference between strongly and weakly objective statements is one of form, not of content. You can have wrong strongly objective statements and true weakly objective ones or vice versa.

In this language, what Wigner tells us is

a) that a strongly objective statement can always be converted into a weakly objective one but that the converse is not true,
b) that the quantum laws are weakly objective only.

Is this last point unquestionable?

Well, here I must be honest, and to be honest I must open up a parenthesis. A rather long parenthesis the substance of which can be summarized as follows. No: strictly speaking the weak objectivity of quantum physics may indeed be questioned. There *are* ways of reformulating subatomic physics so that strong objectivity is recovered. But the price to be paid for that is in my opinion quite forbidding. So, I do believe that the reasonable scientific standpoint is to keep on with standard quantum mechanics and with the weak objectivity that goes with it. Now let me explain.

A sharp distinction has to be made between: *standard (or "orthodox") quantum mechanics* on the one hand, and *non standard quantum models* on the other hand.

Standard quantum theory is the theory we have been speaking of until now. It is the theory that has allowed for decisive advances to be made in: atomic and subatomic physics, chemistry, nuclear physics, laser optics, solid state physics, astrophysics, cosmogenesis and probably other fields I forget about. In other words, its few and neatly expressible axioms constitute a framework in which it proved possible to develop rational accounts of a nearly uncredible amount of data in all the important fields of the so called "exact sciences", and to succesfully predict an enormous number of "new facts". In the course of all these developments standard quantum mechanics has put on various garments, so to speak, that we call "formalisms". But all of these formalisms are weakly objective only. And this is all the more true concerning the more "advanced" among these formalisms. In them the most basic notions do not refer to "objects out there" as in classical physics. They are the "state preparation procedure" and the "measurement of observables".

But there also exist several *non-standard models,* that were explicitly constructed in such a way that their axioms be strongly objective, just as those of classical mechanics were. These models enjoy internal consistency and within their range of applicability they agree with the experimental data, due to the fact that they recover, there, the predictions of standard quantum mechanics. But this range of applicability is distinctly smaller than that of standard quantum mechanics, and they all share a common feature of complete sterility, in the sense that no new successful prediction could ever be derived from them. Let it also be mentioned that these strongly objective non-standard models meet with difficulties concerning the phenomena of particle creation I alluded to before, and also with difficulties concerning the theory of relativity. In balance with these disadvantages (as compared to standard quantum theory) we only have the fact that the models in question fulfill a requirement that is purely of a philosophical, or some could even say ideological nature, namely strong objectivity. I do not consider that this advantage, if it is one, is sufficient to match up the disadvantages I just mentioned, especially since there are several such models among which it is very hard to make a scientific choice. To put my appreciation of them "in a nutshell", I would say that I consider them as being brilliant metaphysics. The kind of metaphysics, indeed, that would naturally spring up in the minds of some scientifically trained people, just as

quite different metaphysics sprang up in the minds of differently educated people. But I do not commit my belief to any of them.

This, then, closes the long parenthesis I opened some minutes ago. But I shall retain one aspect of it, namely the difficulties concerning relativity that all these strongly objective models meet with. Where do they come from?

Well, this is rather straight-forward. Special relativity puts in the forefront the notion of "event", which is a strictly *local* notion. Now in all of these non-standard models we have some real entities that are nonlocal: I mean entities that cannot be reduced to the notion of events; such as for example the wave function of a system of particles, or of the Universe as a whole. These entities are holistic. They cannot, not even conceptually, be decomposed into parts. And if we raise these holistic entities to the level of "real stuffs", as these models are bound to do, then we land with having influences at a distance propagating instantaneously, which violates special relativity.

But on the other hand it can be proved that such influences at a distance cannot be used to send faster than light *signals.* This may seem surprising (since: if these influences exist, why not use them?), but I repeat: it can be proved. It is a very important point. It shows that if – contrary to Einstein himself – we understand the theory of relativity as a merely weakly objective theory, then we can keep it without qualms. We just have to say that the very notions *influence* and *causality* are tightly bound to what the human collectivity is, in principle, able to do. Correlatively, we may also explain in this way that standard quantum mechanics, being itself a weakly objective theory, is not burdened with difficulties of this sort.

This is probably the right place for me to say a few words about nonseparability. Nonseparability essentially concerns those theories – or models – that aim at strong objectivity, or in other words that purport to describe independent reality as it really is. Nonseparability is then nothing else than the holistic character all such theories must have if they are to reproduce all the predictions of quantum mechanics, as I mentioned a moment ago. What the celebrated Bell theorem shows is that this character *must* be present in such theories. It shows that it is impossible to construct a correct description (that is a description not generating false predictions) of independent reality, if that description does not, in some way or other, imply nonseparability: which allows us

to say that independent reality is not separable, not even "by thought": we are *not* allowed to think of it as universally composed of distinct localized parts. This can also be said in another manner, by referring to the notion of Being, with a capital B. One can point out that among the scientists, and even more so among the authors of popular books about science, there has been for quite a long time a tendency to "scatter Being" (so to speak): To say: what really *is*, in an absolute sense, is a myriad of tiny material particles linked by forces. And one can then assert that the great philosophical discovery of contemporary physics is just that such a view is erroneous; that Being, though it is structured, is too basically *a whole* to be conceived of in this way.

But in addition, as we have just seen, the attempts at describing independent reality "as it really is", even taking into account this feature of wholeness, are all quite inconclusive. In view of their unfruitfulness they even appear as being in the margin (so to speak) of physics. Essentially we are thus left with weakly objective theories only.

Well, this is the end of my second part, which, as you may remember, was a discussion of realism. Its conclusion is that there are very serious reasons to reject the hypothesis of physical realism. So, from here on I reject it.

Third Part

Inferences

In this third part I shall (as I promised) try to describe to you what I think are the *most reasonable* inferences that can be drawn from the situation that I have depicted.

As a "starter" (or "hors d'œuvre") let me first say a few words about the notion of *object*.

For a naive realist (a supporter of "near realism" in the vocabulary I used before) objects exist *per se* and their properties also exist *per se*, more or less as we perceive them. Not completely as we see them, of course. For example, even a naive realist will grant that whereas a stone looks as if all the points inside its volume were occupied by matter, classical physics tells us that in fact it is mainly empty space in between the nuclei and electrons. But precisely that: he will maintain that with the help of experimental and theoretical science we can, and do, know how a stone really is, what tiny pieces compose it, what forces keep them together and so on.

Now, I consider that if, from early nineteenth century to now, science had evolved more or less as Laplace, for example, thought it would evolve: namely quite smoothly, within the unchanging framework of one set of general laws (those of Newtonian mechanics) and in such a manner that all its statements could always be interpreted in a strongly objective way, *then* the conception of our "naive realist" would, now, be extremely reasonable indeed. It is true, of course, that, logically speaking, a philosophical doubt (such as the one Descartes started with) would still be possible. But I mean, it would seem reasonable to overlook it. In my opinion the most reasonable attitude would then be to say: well, there is an overwhelming probability that the reason why those physical descriptions work so well is just that they are correct, in the sense that they do describe reality as it really is!

Of course, even then, this could only be an *opinion*. Against it a phenomenalist could put forward rather weighty arguments. He could point out that all scientists are human beings and that human beings are subjected to quite restrictive limitations: spatio-temporal localization, restricted and biased perception of "natural beings", impossibility to think without a language, while none of the conceivable languages can claim full faithfulness concerning expression of thought... Still, in my opinion such philosophical arguments could not outweigh the likelyhood of the naive realist being right *if physics had evolved as Laplace conjectured it would*.

But that, precisely, is the point. Physics did *not* evolve that way, as we saw, so that *a posteriori* the arguments of the phenomenalist regain weight. Indeed, in view of the weak objectivity of standard quantum physics the comparison of physical objects with rainbows becomes, in my opinion, quite pertinent. The physical objects stand, with respect to us, in somewhat the same relationship as a rainbow with respect to a community of observers who would be confined to a small island on a river. These people would tend to consider the rainbow as a material arch, existing by itself and endowed with properties, such as location, also existing by themselves, quite independently of human beings; whereas of course, we, who can take our car and travel a few kilometers, see that the rainbow moves accordingly, and infer from that that it is no such thing. The point at which the analogy breaks up is that, of course, a

classical physicist living on the island could eventually discover the strongly objective classical theory of the rainbow, thus explaining it in terms of droplets existing *per se* whereas, our basic theory being weakly objective only, we cannot hope to achieve this, concerning physical objects.

As I said, these considerations about the physical objects were intended only as an introduction to a reflection concerning reality. They have shown us that the properties of the physical objects – including the scientifically established ones – are mere phenomena in the philosophical sense, implying that they owe much to the structure of the human minds. Now, as we also saw (although quite cursorily) when I spoke of pair creation: it is very hard, in modern physics, to establish a conceptual demarcation between existence and properties. So, the very existence of this or that object must also be considered as being of the order of a mere phenomenon in the philosophical sense.

As I previously mentioned, the set of all such stable reproducible "phenomena-in-the-philosophical-sense" (from now on I shall just say "phenomena") is just what a great number of philosophers, more or less inspired by Kant, call "reality". But it is *not* what, in the first part of this lecture, I called "independent reality". In order to prevent confusion let us call it *empirical reality*. Then we have two different concepts of reality: independent reality and empirical. Isn't that strange? I am sure, many of you will, at first sight, feel skeptical about the relevance of such a distinction. So let me comment about it. Well, my first point will be that there is nothing new in this duality of meanings. On the one hand, the word "reality" has always be used to refer to "what is", to "what exists", to (say) the "Substance" of Spinoza. But on the other hand, the notion of a real attribute of an object was always associated to the congruence of two things. One is the possibility of thinking of this object independently of other objects: of *isolating* it by thought, so to speak. The other one is the possibility either of directly acting on that object or at least of conceiving of forces acting on it, the essence of which is not entirely dissimilar to that of our own bodily force. Now in the age of classical physics, that is, roughly, from Galileo and Descartes to Bohr, this distinction between the two meanings of the word reality (the Spinozian and the "operational") remained in a stage of latency, because it seemed that the things science discovered were real in *both* senses. Well I think we now have overwhelming proofs that this was just an illusion (at least we have proofs that not *all* basic real entities are local), so that such a distinction *must really* be made.

Now what remains to be seen is, of course, whether these two concepts are both relevant.

The concept of empirical reality hardly needs any justification. At least, it certainly has a referent, namely the set of all that science tells us. The only point that can be raised about it is that a die-hard realist might question the use of the word "reality" to qualify it. But this is merely a semantic point.

On the other hand the pertinency of the "independent reality" concept may be disputed. Strict phenomenalists or idealists might put forward the objection that it has *no referent*. But I must say I never understood strict phenomenalism. Does it coincide with what I called "collective solipsism" a moment ago? Most of its supporters would indignantly reject such an identification. They take a position which, in their opinion, is a more subtle one, and which consists in saying that what science describes is nothing else than mere experience, or alternatively that it is just a set of relations. Well, I tend to agree (more or less with both views). But at the same time I consider that we cannot *stop* at such statements. We must ask "experience of what?", "relations between what?" If it were merely experience of (or relations between) our own – individual or collective – feelings, impressions and so on we would be back to – individual or collective – solipsism or to something very akin to it. Having rejected that view we must grant (this is just a point of logic) that this human experience has also some other ingredients in it. The expression "independent reality" is just a name for that other stuff.

At this stage I still have to face two objections. One is "why not accept collective solipsism after all?" And the other is "independent reality may be there but it is unknowable and therefore uninteresting". I lump these two *objections together* here because I consider it as convenient to discuss them more or less on the basis of the same arguments.

Now we already granted that collective solipsism cannot be refuted on purely logical grounds. Hence, the arguments I shall put forward can only be plausibility arguments. This being acknowledged, I still consider that they have appreciable weight. Here they are.

First of all, if independent reality did not exist, or if it were totally disconnected from our experience, if we had not even a glimpse of it, then the predictive rules of physics would only be those of a man-created game. That is, they would be completely arbitrary, subject only to internal consistency. But we know this is not the case. In the course of my

life as a physicist (and any scientist could say the same thing) I have seen several cases of beautifully self consistent theories, very general, very smart and so on, being refuted by experiment. In other words something resists us: and I am at a loss to understand how this something could just be *us*, I mean our minds. To try to defend such a thesis would lead, I think, to quite unacceptable intellectual contortions. It is infinitely more reasonable to "grant the obvious", namely to grant that there is an independent reality – a reality whose existence does not depend on our existence – and that it is *that* reality that sometimes resists us. In addition I may add that in the case of such a negative experimental result we, scientists, are disappointed of course, but we nevertheless have the feeling that we did learn something. This is negative knowledge of course. But, still, it is knowledge, and sometimes important knowledge, so that independent reality does not seem to be completely opaque to us.

This was my first and most general argument. But there are also more specific ones. Let me briefly mention two.

One is the intersubjective agreement. The fact that we all, more or less, agree on the results of trivial observations. Many philosophers seem to quickly brush this argument away by attributing it to the fact that our minds are similarly constituted. But it seems to me that in saying this they overlook the very important difference there is between general laws and initial conditions. The similiarity of the minds may perhaps explain that they all generate identical general laws; but initial conditions are viewed, in modern science, as essentially contingent; and it seems therefore that some more specific arguments should at least be produced – by the "collective solipsists" – if they want to account for the intersubjective agreement concerning these initial conditions.

Another argument to counter collective solipsism (and also the idea that independent reality is totally disconnected from our experience) is that Kant's conjecture that "our basic scientific concepts are just *a priori* modes of our sensibility and nothing else" is more questionable now than it was in Kant's time. Curved space is certainly *not* an a-priori mode of our sensibility. In a sense it is *one a priori* mode of our intellect. But it is certainly not an *a priori* element of our mind-structure that we should use space-time instead of good old space and time. Here again independent reality seems to crop out.

Well, it is very much time that I should arrive at a conclusion! Let me

formulate it this way. I think that the weakly objective character of modern science is here to stay. In other words I think that practically *no* feature of independent reality is scientifically knowable with certainty. The prospect of ever being able to reduce what is, or Being, to the scientifically established phenomena is therefore to be considered as illusory. In other words, we must consider that there is "something" lying beyond the phenomena. This is my first point.

But – and this is my second point – I do not consider either that this "something" (independent reality) is totally opaque to us. On the basis of what I just said, I consider instead that even science, by means of negative knowledge, but also by means of some positive general views, gives us some *glimpses* at Being. It suggests for instance that Being transcends space, time and even space-time, and that it indeed has something of that "Umgreifende" philosophers such as Karl Jaspers have written about. But as I said, these scientific glimpses at Being are merely glimpses. Could it be that other approaches, the poetical, the artistic, the mystical, should also give us valid glimpses at Being? If it is the case we shall never know for sure that it is. But the hypothesis, which looked somewhat absurd as long as it was believed that a purely scientific knowledge of Being (a scientific ontology) was reachable, does not look absurd any more today. This, in my opinion, is important: for the greatest cultural achievements of mankind were indeed always prompted by the ambition to, so to speak, "sing the glory of the gods". When, during this century and in the West, artists and poets came to lose their confidence that *this* is what they were doing, many of them turned into charlatans, merely in quest of pleasures of vanity. If a new generation among them comes to realize that the ambition in question is not so foolish after all, we may hope that Europe and the West will recover – through this – the real creative power that, in my opinion, they have now lost.

Author's address:

Bernard d'Espagnat
Laboratoire de physique théorique et particules élémentaires
Centre d'Orsay
Bât. 211, Université de Paris XI
F-91405 Orsay Cedex