

Chapter 2

Preliminary Epistemological Considerations

This chapter originates from the introduction to a lecture course on “The Conceptual Structure of Theoretical Physics” that I held at Göttingen during the summer semester of 1948.^{1,2} The topic of that lecture was already basically the one of the present work. The addressees of that lecture were primarily scientists, particularly physicists. The introductory sections reprinted here essentially express, in a casual style, the same basic approach to the ‘phenomenal premises’ of *The Structure of Physics* (2006), upon which the present book also relies. Hence they can—as I hope—serve as an easily accessible introduction into this way of thinking. More precise details will appear in subsequent chapters in treating the pertinent problems.

In basic outlook the thoughts developed here otherwise also date back to a note from 1932 that I had published in excerpt in the book *Wahrnehmung der Neuzeit*.³

2.1 Similes for the Structure of Physics

This lecture is divided up into three parts.

The first part deals with “Elementary Givens”. Under these I would like to comprehend everything that is held to be valid methodologically and conceptually as a general precondition for science, particularly physics. The path that leads to general concepts, such as, thing, space, time and generality, starts out from phenomena. Phenomenology is the endeavour to reflect on the givenness of

¹ This text was first published in: Carl Friedrich von Weizsäcker: *Zeit und Wissen* [literally: ‘Time and Knowledge’] (Munich: Hanser, 1992), pp. 35–59. It was translated for this volume by Ms. Ann Hentschel with the financial support of the Udo Keller Foundation—Editor [MD].

² von Weizsäcker (2004)—Editor [MD].

³ Carl Friedrich von Weizsäcker: *Wahrnehmung der Neuzeit* [‘Perception of Modernity’] (Munich: Hanser, 1983). Cf. there the sections *Bohr und Heisenberg, eine Erinnerung aus dem Jahr 1932* [‘Bohr and Heisenberg. A Recollection from the Year 1932’], pp. 134–146, and *Begriffe: Bewußtsein als unbewußter Akt* [‘Concepts: Consciousness as an Unconscious Act’], pp. 359–362.

phenomena. The majority of my considerations will be of a phenomenological character in this sense. The problems of phenomenology are different from those of physics. Whereas physics struggles foremost with the complexity of its subjects, it is the simplicity of phenomena that poses the greatest difficulty for the conscious mind reflecting on them, as reflection on givens certainly does not follow along its natural line of thinking.

The second part is set under the heading “Regional Disciplines”. This means the individual areas of classical physics as well as neighboring sciences. This section may be considered relatively the most secure.

The third part deals with “Elementary Objects”. I have designated as such the subjects of relativity theory and atomic physics. Entirely different objects form the basis of phenomenal givens. Objects are what make a real understanding of phenomena possible but they are only found at a high level of abstraction. How both lines of inquiry relate to each other will be presented at length in the following.⁴

Our science is strongly influenced by the *deductive* disciplines of mathematics. A few statements, called axioms, are presupposed there; all other statements should follow from them. Formerly, axioms were regarded as evident; in most recent times they are often treated as preconditions without any assumptions being made about their truth, consequently turning the whole system into an ‘if-then’ logical construct.

Physics obviously is not made that way. The concept of *inductive* science comes closer to its essence. Individual statements made by experience are the immediate givens, out of which the few simple principles are gathered by systematic generalization. The finished inductive structure can then perhaps be recast in deductive form at the end.

This image comes closer to the reality of our science but it does not contain decisive features yet. The words deduction and induction both conjure up the simile of a pyramid for science that is either resting on its apex or culminating in an apex. Recall, for comparison, our disposition with the three parts: Elementary Givens, Regional Disciplines, and Elementary Objects. In this simile, science has *two* apexes. Physics does indeed permit a dual structure.

One can start out from the elementary given, from concepts such as number, time, space, thing, cause, motion. This structure finally leads to the atom, like to an outermost twig of a branching tree. This may be called the *phenomenological* structure of physics.

One discovers, though, that concepts like atom, field, or wave function yield a new substantive unity that even questions phenomenological concepts. The true link between phenomena is only revealed when penetrating behind phenomena. A different kind of *substantive* structure of physics is implied.

⁴ This text comprises only the first section of the first part of the introduction to the book, cf. footnote 2—*Editor* [MD].

Which structure is the true one? We cannot do without either of the two. The only way to the objects leads via phenomena; understanding the phenomena is only attainable by objects. A *mutual dependence* exists between both ways of construction.

In addition the two apexes are not the most certain part of the system but the most uncertain part; they are like mountain peaks piercing into the clouds. This is clear for the substantive apex. It lies beyond immediate sensory perception. It is merely a thought-up or hoped-for point; in reality, there is only a *frontier of research* on the substantive side; it has even been said that the substantive apex is not completable. The phenomenal apex is in no better a position, though. Its simplest concepts, such as space, thing or causality, impinge on the area of philosophy and, whatever its merits otherwise may be, philosophy is famous as being the science with the most persistent and unsolvable controversies. One would be pleased just to be able to find a generally acknowledged research frontier in it. Only the centre of the double pyramid is barely free of controversy, its belly of science, classical mathematics and physics: Euclidean geometry, arithmetic and analysis, mechanics, thermodynamics, electricity, optics, etc.

Any attempt at knowing the real runs up against similar difficulties. How does one address them? Theoretical philosophy of science has not yet made available any concepts by means of which we could contemplate this situation adequately. Therefore, let us initially fix them by means of *analogies*. Heisenberg says that the closed disciplines of exact science seem to float over unexplored depths on every side. One could also compare science with a ship that “is midway” between the unexplored heights of the sky and the unfathomed depths of the ocean. And if we wanted to add the progress of research into the picture, we could choose a less poetic simile: Science is similar to the task of unravelling a tangled ball of yarn, just a few threads of which are exposed at its centre, whereas we have none of the ends in hand.

The simile of the ball of yarn allows another application: Maybe the two ends are connected together. I spoke about the mutual dependence between the two ways of construction. It is most distinctly manifest at the pertinent frontier of research. The most modern physics of objects imperceptible to the senses has not only stimulated but also used considerations on the foundations of sensory experience. Think of the concepts of simultaneity in the special theory of relativity, of materiality and causality in atomic physics. No matter how the ultimate structure of physics will look, if it should ever come to that, it owes its formation to repeated runs through the *cycle* of mutual dependence between our phenomenal and substantive concepts. To speak metaphorically, the double pyramid repeatedly meets itself end-to-end like a ring.

The foregoing was said in order to raise awareness about specific problems. It itself is not yet part of the conceptual structure, as the utilization of metaphors shows. I myself would like to express again in a metaphor what these metaphors teach us about the process needed for this conceptual structure. It is an anecdote.

Niels Bohr is the man from whom all atomic physicists learned the kind of thinking that I have been trying to indicate by those similes. He comprehends

under the term ‘philosophers’, perhaps not entirely rightly, primarily people who have not grasped this floating character of knowledge and want to construct all knowledge out of one fixed point. One time, we were in a ski lodge together and were washing up the plates and glasses after a meal we had prepared for ourselves. Bohr was particularly lovingly polishing the glasses dry and proudly observed afterwards how clean they had got in his hands. Then he said thoughtfully: “If a philosopher had been told that dirty glasses can be cleaned with dirty water and a dirty towel—he wouldn’t believe it.”

We must, in fact, start with the impure concepts that practice offers us and spend time cleaning them by rubbing them against each other, so to speak, without even foreseeing the end of this polishing. I am perhaps not entirely in agreement with just one point in Bohr’s formulation, that the very awareness of this provisionality, this indicative character of every concept, does not seem to me to be genuine philosophical awareness.

I start by attempting to repeat in epistemologically precise terms the essential content of what I have just said in similes. Henceforth I shall strive for rigorous conceptuality. It lies in the nature of this subject matter that these concepts, too, will bear a character of provisionality and imprecision in order to be immediately understandable. They are introduced to lay the basis for their own mastery.

2.2 Cognition

The view that I would like to question thinks that somewhere in science there could be absolute, intrinsically fixed certainty. Absolute certainty could also be circumscribed by the words: Cognition subject to no doubt. Thus the concepts *cognition* and *doubt* become the object of examination.

Let us consider one simple piece of physical knowledge, e.g., “Lead is heavier than water.”

This statement is right. What does this mean?

The statement *asserts* something. That which it asserts is a *matter of fact*, namely, that lead is heavier than water. The statement is right if the matter of fact *holds*, i.e., if lead really is heavier than water. Lead is, in fact, heavier than water, and that is what I initially mean when I say that the statement is right.

The matter of fact would hold even if I had not asserted it. I have now asserted it, however, because I have *recognized* it. I *know* what I have recognized. This cognition or this knowledge is *expressed* by that statement.

The statement therefore refers to two things: to a process or state in my *consciousness*, which I call cognition or knowledge, and to *what I have* consciousness of, the matter of fact. Consciousness is *consciousness of something*. I call the individual process of cognition or state of knowledge an act of consciousness. The matter of fact, I call the *content* of the cognition or knowledge. I say that the statement *expresses* the act of consciousness and *asserts* the content of consciousness.

I say that to me the content of each individual act is *given*. I thereby also express at the same time that to me just the content of the act is given, not the act of cognition itself, in any case not explicitly. If I say, “lead is heavier than water”, I mean that lead is heavier than water and nothing else. I don’t mean that I am thinking and just now know that lead is heavier than water. I am certain, however, as I am posing the question whether I am just thinking it and know it right now, that I am just thinking it and know it. The consciousness is not unfamiliar with itself as a consciousness, but it does not naturally take this theme up. The consciousness knows its content *explicitly*, but knows itself *inexplicitly*. Consciousness is generally *oblivious of itself*. It “thinks of” the content, not of itself.

If I want to explicitly recognize consciousness, I must perform an act of cognition that *asserts* the existence of what was *expressed* in the original statement: the cognized knowledge. I call this new act of cognition an act of *reflection*. By it the consciousness is ‘bent back’ upon itself. I call this new act of cognition *reflective cognition*. The original act, I call a *plain cognition*. A piece of knowledge or cognition that has become a reflective cognition—in brief: on which I have reflected—I call *reflected knowledge* or *reflected cognition*. If I understood under ‘cognition’ a new process each time, every cognition would again always be plain. By my cognizing that it ‘recognizes’ an already familiar matter of fact, however, it can participate in reflected knowledge. Reflective cognition is generally plain unless it is reflected on once more.

As long as I just think of the original content, that lead is heavier than water, I can say the statement “lead is heavier than water” *is* the cognized knowledge. When I reflect, I notice that the statement actually only expresses this cognized knowledge. That is, I now distinguish between the *statement’s body* (this sound, these chalk strokes on the blackboard) and the *sense* of the statement. The word ‘sense’ is ambiguous, as it can mean either the act or the content. I shall therefore only use it where the distinction between act and content, between expression and assertion is of no import.

Distinguishing between the statement’s body and its sense is an act of reflection. Usually the statement self-obliviously *serves* as an *expression* of the act or as an *assertion* of its content, which according to our definitions is equivalent. A statement that serves in this way I call a *plain expression*, a *plain assertion* or, in short, a *plain statement*. A statement whose sense has been reflected on, I correspondingly call a *reflected statement*. One can likewise use individual *words* plainly or reflectedly. I do not discuss the details of these possibilities here; they would lead us deep into logic.

An act of cognition does not need to be expressed. I can cognize a matter of fact silently but consciously. I let a piece of lead fall into water and see it sink down; now I establish or remember that lead is heavier than water, but it is not worthwhile to speak about it. The thought can also come up or be evoked on the side, while I am doing something else. I can weigh down a sack with lead so that it sinks. Here my matter of fact is *inexplicitly carried along* within a context. I make use of it without expressly thinking of it. We do in fact constantly take into

account an inestimable amount of matters of fact in daily life that we do not give any special notice to. Cognition therefore is not attached to expression.

Where among this series of phenomena is the boundary beyond which one cannot speak of cognition? Such a boundary will not be determinable without some arbitrariness. I do not see in this a weakness in the cognition concept. This fading of cognition, of consciousness in a series of diminishing degrees of expressibility is a phenomenon that we must look directly in the eye.

Each act of expressed consciousness is surrounded by a *corona of unexpressed consciousness* that fades away into the completely unconscious. (For instance, the visual field has a focus of attention, the relevant matter of fact that is fixed upon, around which is a multifarious corona whose conscious character of perception fades away outwards toward the limits of the visual field. The limits of the visual field are blurred and with heightened sensitivity can be expanded astonishingly.) If one denotes as cognition only what is expressed, this corona is not cognition. If one denotes as cognition the *apprehension of matters of fact*, then there is *unexpressed cognition*, indeed I would even volunteer to justify speaking of *unconscious cognition*. In the following I want to choose a manner of expression, according to which any apprehension of matters of fact is cognition, and distinguish explicit cognition by this adjective.

Any explicit cognition presupposes an abundance of inexplicit cognition. If I establish: "This piece of lead sinks in water", I have inexplicitly also been thinking: "this piece of material is lead", "water is inside this pot"; I threw the lead into the water, thereby silently applying the physical facts of free fall, the physiological exertion of energy required for carrying, the conscious fact that I want to perform an experiment and what for, etc. And how do I know that this material is lead? Because it had been given to me as lead, because it is gray, heavy, soft. I know each of these facts and this knowledge has a prehistory. It could be another rarer element. But my informant is not deceiving me. I contemplate: No, he has never deceived me yet. Thus every expressed act is *embedded* within an inestimable multitude of unexpressed acts.

Any inexplicit cognition is plain. One can hence also say: Any expressed cognition presupposes an abundance of plain cognitions, without which it would be impossible.

2.3 Doubt

I don't know everything. There are matters of fact that I do not know. Just because of this, special acts of cognition are necessary. I must *seek* cognition.

This search can *fail*. Either it can fail in a way that I know I did not find the sought item. Then I at least know one matter of fact: that I don't know. Or else it can fail in a way that I don't know that it has failed. Then I am of the *opinion* that I have cognized something, but illegitimately. My act is then thought to be cognized knowledge but it is a *mistake*.

Any act that is meant to be cognition I call *cognition intention* or *intended cognition*. A cognition intention that really is cognition I call *true*. A cognition intention that is a mistake, I call *mistaken*. The statement that expresses a cognition I call *right*. The statement that expresses a mistake I call *false*.

He who errs does not know that he is erring. How should we distinguish between cognized knowledge and mistake? This question sets me before the third option: The intended act of cognition can have the outcome that I don't know whether it has succeeded or failed. It presents to me the option of *doubt*.

True and mistaken cognition intentions can be plain. A cognition intention that is doubted must therefore itself become the object of cognition. It is either eliminated or, if it continues to hold, it is henceforth attended by the cognition intention: "this cognition intention is true" and is, to that extent, reflected.

A statement that asserts a matter of fact, whose tenability is under doubt, I call *doubted*. Different acts can be directed at a doubted statement: doubt, inquiry, supposition, fiction, etc. Doubt first gives occasion to regard the matter of fact asserted by a statement separately from the cognition intention directed at it, that is, to regard a statement as something that can be right or false. Logic is based on this interpretation of a statement. Logic is the doctrine of *dubitables*. (An omniscient being has no need for logic.) Logic, as cognition about cognition, has formed its concepts as suits its nature, out of reflected cognitions. Let us not go into those problems here. Let us just remember that a plain cognition intention, especially if it is inexplicit, is not meant as something that could be true or mistaken, rather that the matter of fact in it is simply given.

At this point it can become clearer why I have defined cognition so that any apprehension of matters of fact be understood as such. One can doubt the tenability of a matter of fact irrespective of how explicitly it has previously been apprehended. If the apprehension was inexplicit, it is raised by the doubt itself to the level of explicitness. It is desirable to draft the concept of cognition broadly enough that it encompasses all dubitables; so that every act of doubting corresponds to an act of cognition intention that it is doubting.

How is doubt eliminated?

Someone may doubt that lead is heavier than water. I take a piece of lead and throw it into the water. It sinks down, therefore lead is heavier than water.

This is convincing but only to whoever accepts an abundance of plain cognition intentions as cognized knowledge. He must believe what he sees. He must be certain that this is lead, that that is water. A prestidigitator could deceive him. He could be dreaming. Hence, the elimination of doubt is, like any act of reflection, linked with plain cognition.

Doubt that reveals some obscurity of expression is a special case. A small piece of lead is lighter than a large pot of water. One has to say more exactly what 'heavier' means in the statement: i.e., 'specifically heavier'. A *definition* is given. That is, reflective manufacturing of an expression indicating the sense that a word frame should hold. This sense must be denotable by other words, however. It therefore already presupposes plain expressions, e.g., here 'volume', 'equal', etc.

All doubts discussed up to now referred to a *single* cognition intention or, if at all, to an individual range of cognition intentions. It also arises generally out of a particular individual *doubt motive*. We express this referencing to particular cognition intentions and doubt motives by calling it a *relative doubt*. Its elimination leads to a *relative certainty*. It is, on one hand, certainty about an individual matter of fact or range of matters of facts, on the other hand, certainty only about the particular individual doubt motive that has been eliminated. The reflective cognition eliminating the doubt cannot yield more certainty than inherent in the plain cognitions out of which it is composed or which it makes use of.

The point of departure of our entire consideration was that we wanted to acquire concepts suitable for judging a particular ideal of cognition: that of *absolute certainty*. The concept of science that became questionable to us in the introductory considerations wanted to see at least some cognitions secured against *any possible* doubt. Is there such a thing? Do cognition intentions exist whose truth cannot be doubted at all anymore? Do statements exist whose meanings are indubitable?

We are far from being guided to absolute certainty by this question. On the contrary, it opens for us the possibility of *absolute doubt*.

He who errs does not know that he is erring. This single statement basically lays out the impossibility of absolute certainty. Yet we have now delved too deeply into the problem of certainty to be able to be satisfied with a single statement as an answer. We ask whether absolute certainty doesn't exist somewhere nonetheless? This question is our guiding thread for learning the *art of doubting*. We must understand something about it in order not to be crushed unsuspectingly by the *fate of doubt*.

One can speak of an art of doubting because a person living normally along is not versed in doubting. His understanding of the world is based on a plain apprehension of matters of fact, plain cognized knowledge in the broad sense of the word 'cognition'. When he does doubt something, he is prompted into doing so by a doubt motive that itself is a plain cognition. Mr. Mayor is walking up the street toward me. But he's wearing a brown hat. Mr. Mayor doesn't wear such hats. Maybe it's not Mr. Mayor at all. Here plain apprehension of a matter of fact, namely, the hat's brown colour, is the doubt motive. If I doubted everything from the start, I would also have to doubt whether the hat is brown; the doubting motive itself would not be plainly given. In normal life doubt is an individual event that is only possible, the way it is played out, because of the plain givenness of the not-doubted.

One can call the manner of givenness of the not-doubted *plain evidence*. Everybody knows that plain evidence offers no absolute certainty. Appearance is misleading and the difficulty is that one does not know where semblance is involved. But in practice one mostly manages to attain the certainty needed in life, which if preceded by doubt can be called *reflected evidence*. Philosophers sometimes think that reflected evidence could be elevated up to *absolute evidence*. But how do they defend themselves against the statement that he who errs does not

know that he is erring? Classical examples prove that the evidence experience can be misleading.

It is sensorially evident that the Sun orbits around the Earth. But the opposite is true. It is evident to pure intuition that parallel lines don't intersect. But doesn't non-Euclidean geometry enter the discussion? I recently dreamed that two times two equals five. Now that I'm awake I know that two times two equals four. But then I knew the contrary. On what does the certainty that I am now right base itself? A *dream* is the big example of the dubitableness of evidence having dawned on people. What if life as a whole were a dream? What if a god were systematically deceiving us?

Is this question already absolute doubt? Descartes tried to develop absolute certainty out of it. I doubt everything. I doubt. I. One thing is certain, that I doubt. Doubting is a way of thinking. One cannot think if one doesn't exist at all. Therefore, I cannot doubt my own existence. Cogito ergo sum—I think, therefore I am.

This train of thought is extraordinarily important because it directs the view onto what has been called pure consciousness. It is a first attempt at the undertaking, pursued up to the so-called phenomenological reduction by Husserl in our century, to distinguish conceptually sharply between the consciousness and its objects. Here, though, we are just concerned with how it relates to doubt. And there the statement to be made is: It offers no absolute certainty because it does not presuppose absolute doubt. Descartes was still a beginner in the art of doubting.

Descartes doubts, for instance, the *rightness* of statements but not the *meaning* of his statements. He asks: "Does the world exist?" and dares to doubt whether the answer must be 'yes'. He doesn't ask: "What does the word 'exist' mean?" "Does it mean anything at all in connection with the word 'the world'?" Is 'to exist' perhaps a concept that only makes sense relative to a particular context? When *Romeo and Juliet* is performed, Juliet exists as certainly as does Romeo. But they exist only 'for the play'; 'in reality', Juliet is Miss Miller. To Homer, Zeus exists and works wonders; to the modern physicist, the atom exists and works wonders. Is the atom less of a myth than Zeus? Is there a different existence than 'existing to' someone? Then the purported certainty by Descartes might be nonsense, because it would be an answer to a senseless question.

Perhaps I don't mean all that I have just said so seriously? How do you know that? You must in any event make it clear to yourself once that one can question like this.

Descartes does not doubt the sense of his statements. He thereby acts, on a higher level, exactly like the person living unreflectedly along. Certain elements of cognized knowledge are plainly given for him, so it does not even occur to him to doubt them; and specifically these become the motive for him to doubt other elements of cognized knowledge. Just because he believes that the statement 'the world exists' makes sense does he believe one could doubt whether the above statement were right. When a statement makes no sense, one doesn't ask whether it is right or false. But far be it from me to positively assert that the statement 'the world exists' made no sense. That would be badly doubted. I just say that one could doubt whether it makes sense.

All that I have been saying does not express absolute doubt. One cannot express absolute doubt. Whoever utters it does not presuppose the plain sense of the words. Absolute doubt can only remain silent. It cannot be argued against, precisely for that reason. It cannot be argued in favour of, for that reason either.

One could say, though, that absolute doubt is unattainable for a living person. This is right. Apprehending matters of fact isn't just a theoretical process. It is constantly necessary in our lives; and, no matter which way we turn intellectually, animal life puts it ever at our disposal. The doubting philosopher who is startled back into reality by a wasp sting or a box on the ears is a favourite theme in a comedy. A statement that is almost the converse of the Cartesian statement states: *He who lives doesn't doubt all*. It is made to take on the Cartesian form by specifically saying: To be able to doubt, one mustn't doubt all.

You would be completely misunderstanding me if you thought I wanted to hold my ground against absolute doubt, nevertheless, by these last considerations. He who still lives doesn't doubt absolutely yet; but who says that the living are right? The art of doubting obviously ends here. One cannot propose to doubt absolutely. But one can be driven onto a path that offers no foothold against absolute doubt. There is no argument against the fate of doubting.

This doubting isn't an intellectual enterprise anymore.⁵ It is a form of despair. With Kierkegaard, in Dostoyevsky's *Ivan Karamazov*, in Hoffmannsthal's *The Lord Chandos Letter*, you will find more about that than with all the philosophers. Its utmost point will never be written down, though. Wanting to be right against it is not only impossible, it is also wrong. The despairing soul will never be reached by being right anymore, perhaps only by love.

2.4 Faith

The discussion about doubt is framed by the two statements: He who errs doesn't know that he is erring, and: He who lives doesn't doubt all. For us who are alive there is neither absolute certainty nor absolute doubt. It surely cannot be denied *that* we find ourselves in this situation. Yet we find ourselves in it even with a relatively good conscience. We have considerable trust in what we know, and don't think we are doing badly by it, despite standing alongside the abyss of possible doubt. We must try to find concepts that describe this attitude distinctly.

⁵ Note 1983: When I quoted this statement: "He who errs doesn't know that he is erring," to my uncle Viktor von Weizsäcker in 1948, he spontaneously rebutted: "That's not right. He does know it, all right, but he doesn't want to know it." Thus a discussion was opened that did not feature in this lecture; one can say: the moral aspect of epistemology. The closing passage of the section on doubt is rather commented on by it. Despair is not just despair about my knowledge and known reality but also about my will and the willed good. Ivan Karamazov did not despair about God's existence but about His kindness; Dostoyevsky saw this as the deeper atheism.

I would like to choose the word *faith* for the attitude we have toward the contents of our knowledge, in view of the two impossibilities of absolute certainty and absolute doubt. We must agree on the exact meaning in which this word should be used.

In general, faith is considered to be deeming something true that one does not know. Faith and knowledge are then regarded as opposites and even relegated into separate fields: religion and science. I consider this whole confrontation false and chose the terminology that I shall explain now primarily in order to make slippage into this interpretation through word usage impossible.

Faith is not an intellectual act but a way of living. Having faith in something means behaving in every situation the way one must behave as if what one believes really existed. Holding something to be true is merely the intellectual pinnacle of believing conduct accessible to reflection. To express it in a metaphor: A soccer player must occasionally pass the ball on, to another player of his team. This only makes sense if he can count on his partner taking over the ball and, perhaps, kicking it back to him. There is no certainty about that, since the other player could be impeded by the opponents or may miss the ball. Despite that, he must pass it on to him. This calculated passing of the ball on to his counterpart and expecting it back despite the uncertainty is faith.

Faith—just like cognizing—is conduct toward a matter of fact. If cognizing is addressing the matter of fact as a given, then faith is addressing the matter of fact independent of whether it actually is given. The fact that neither absolute certainty nor absolute doubt is possible for us can also be expressed this way: *One cannot cognize without faith*. This may become clearer if we distinguish between *inexplicit* and *explicit* faith, as we did with cognizing.

The deeper we go down into the sphere of inexplicitness the more impossible it becomes to distinguish at all between, on one hand, knowledge and cognition and, on the other hand, faith. In order to establish that lead is heavier than water, I let a piece of lead fall into water. By letting go of it, I count on it dropping. I cannot know that with certainty in advance. If it were paper, it could be drawn sideways by a gust of wind; if it were iron, by a magnet; maybe it had been lying in tar and will stay stuck to my hand. Maybe a new effect still unknown to physicists will occur. But I cannot be detained by such scruples. I let go of it and count on it dropping; and almost always what ensues will prove me right. This “counting on” is the passing of the ball and, to that extent, faith. It occurs with such a great chance of success, however, that it does not need any concentration of attention. Just because it is almost a piece of knowledge, it can remain inexplicit. The statement: “Within the sphere of inexplicitness, knowledge and faith are not clearly distinguishable,” can hence also be read conversely: “Where it does not become necessary to distinguish between knowledge and faith, conduct on a matter of fact can remain inexplicit.”

If I reflect on whether I know a matter of fact or ‘just’ believe it, I have entered into the sphere of explicitness. I encounter a mistake. That is, I see that much of what I had unexpressedly believed, I did not in truth know—that it was false. The striving after absolute certainty was an attempt to make faith superfluous.

This has proven to be impossible. By living, we believe. Because we know this, it now involves an expressed faith. *How* do we believe, or *what* do we believe in, now?

It would again be a misunderstanding stemming from reflection to want to try to formulate a 'legitimate content of faith'. If one could prove the 'legitimacy' of some content of faith, one would probably better be speaking of knowledge. We just have the matter of fact as the point of departure, which is summarized in the statement: "He who lives, believes." We do not ask what he *may* or *should* be believing, rather what or how he *in fact* believes. But this is different for different people.

The person who does not give much thought to these questions I will call the *natural person*. He encounters relative doubt from time to time and is satisfied with reducing it to relative certainty. He notices that one does not get far with fundamental doubting and lets such things be. His faith is *implicit granting* of the plainly given.

Also someone who has deeply engaged in doubting and perhaps even experienced despair finally finds himself, if he lives on, facing the same world again that was a given for him as a natural person. He will then have learned caution on many points and relative doubt; maybe the floating character of all knowledge has become clear to him, the possibility to doubt all. But by living he lets the world be. This is *explicit plain granting*. One can hardly say it more clearly than Faust at the instant he returns from despair: "The teardrop wells up, Earth has me back." The tear is the real that he plainly grants, and along with it the world, since weeping means living.

Whoever has come back out of real despair probably always has undergone an experience in the range called religious. The possibility of living on is mostly attached to this experience for the person. His continued life thus becomes a conduct that reckons with a reality shown by this experience in the manner of faith, even if this reality is not or is no longer manifest. *Religious faith*, where it is genuine, is therefore in a special way not merely a taking-as-true but a way of life. It is not a mere granting of something anyway manifest but an active, constant address or appeal to something not manifest outright.

I have attempted to *describe* some manners of faith. I did not try to argue about its value, since one can only do so by oneself believing, hence not from a place lying beyond the decision in any conscious faith. This abstention of mine cannot be more misunderstood than by being taken for an expression of relativism with regard to the truth of the relevant substance of faith. I had defined faith in such a way that cognition is not possible without faith. Faith is, consequently, the way to truth; and precisely because it is the only way to truth, one must engage in faith if one wants to evaluate truth. This is valid at the simplest levels: Whoever does not grant the verdict of the senses, with him one cannot speak about matter. It applies just as well in religion itself; Christ says: Whosoever does God's will shall know whether my doctrine be of God (John 7, 17). If in search of the whole truth, it is therefore impossible to make a philosophy independent of the religious decision.

A philosophy that purports to be independent of faith is, in truth, just not conscious of the faith proper to it.

The subject of this lecture course, physics, does not compel us in any obviously ascertainable way to reach a decision on the ultimate questions of faith. For, the faith that physics has as a precondition, faith in the applicability of rational thinking to sensory experience, is a common property of people of our times. (I only need to point to technology. It is perhaps its most conspicuous manifestation.) One might almost even say, the faith of physicists is the sole faith connecting all people of our day.⁶ Thus we do not need to produce this faith but instead can begin right away to examine the contents it gives us. It is different when we ask what the significance is that this faith has become possible and generally prevalent. As living human beings, we cannot escape this question as well. However, I do not pose it at the beginning of this lecture but at the end.

2.5 Methodological Consequences

Now we shall pin down the *principles* of our *method*. There is no absolute certainty as a point of departure. We must presuppose a faith. We want to speak of physics. Therefore we presuppose the faith of physicists: What is this faith composed of and what does ‘presuppose it’ mean?

I understand the confidence in the methods and results of physics necessary to conduct physics as physicists’ faith. I repeat that faith is not (or not just) a taking-as-true but a way of living. Presupposing the physicists’ faith hence means, put in human terms, granting validity to physicists. One might not grant them validity in what they do and think outside of physics. But presupposing their belief means granting that they are doing things about right in their own field. What they have to say must be taken seriously because otherwise one cannot converse with them at all.

I have purposefully expressed myself very vaguely now. But we want to come far enough along to formulate opinions; thus we must strive for conceptual rigor. For that it is necessary that we define the concept ‘presuppose’ more precisely. I could also describe this act as *reflected granting*. What does that mean?

By considering the methods and certainty of physics we have entered into a field that one would not call physics anymore but philosophy. By having once gone down the path of doubting, we have left the plain faith of the natural person in his surroundings, the plain faith of the physicist in object and method. By then recognizing that no knowledge is possible without faith, we coined the concept of a physicists’ faith. We *reflected* on this faith. This reflection is somewhat different from plain—even if explicit—granting of faith, upon which our life depends. This latter faith makes it possible for us to analyse something but it does not itself

⁶ I later took this notion as the point of departure of the lecture *The Relevance of Science* (London: Collins, 1964).

become the object of analysis; we have already seen that we could not come to any agreement otherwise, because, assembled together as we are, we do not have the same faith in many decisive things. Notwithstanding where each of us gets the energy to live, we want to grant the physicists' faith as something that exists in order to examine it.

Permit me to present a metaphor, albeit saying at the outset that it does exaggerate in one respect. The frogs trapped under the winter ice of a pond promised to sing like nightingales if they were freed. When spring arrived, they sat along the edge and croaked as in the old days.⁷ Croaking is the frogs' plain faith. They can just either live and croak or not live. We, however, don't want to croak as in the old days. We only want to grant that frogs exist and that they croak and want to observe how far croaking can take one.

Physicists are the frogs, and our decision to grant the physicists' faith is the granting of croaking. But this metaphor exaggerates the distance between the grantor and what he grants. The physicists' faith is part of the faith of all people of our times. Whoever switches on an electric lamp concedes in this way the inexplicit faith that he expects physics to be right about its evaluation of practical tasks in life. To that extent we analyse our own faith, which we cannot give up at all, within the physicists' faith. We all are 'frogs.' On the other hand, we aren't going to be prepared to follow this faith without reservations as an absolute truth. We reserve for ourselves the possibility of doubt in each individual case.

This doubt can only be meant as relative doubt. Otherwise, as an absolute doubt, it would be retracting the matter we want to have granted. The boundary between relative and absolute doubt itself cannot be drawn absolutely, though. No barrier can be indicated beyond which relative doubt ought not to be extended. We have no other alternative to participating in the intellectual movement in physics and experiencing along with it how each relative doubt might not ultimately overturn concepts but rather clarify it further. Nothing else was meant by Bohr's metaphor of cleaning glasses.

I occasionally call this reflected granting a *hypothesis* of physics. We presume that physics is cognized knowledge and observe what comes out of it. Now, what does the practical procedure look like that must be followed?

What we are granting is not a small, sharply outlined area of doctrines, not the apex of a pyramid but a way of *cognizing* and the *breadth* of the *pool of observations* that this way of cognizing conveys. This pool of observations is not sharply defined and not fully organized conceptually. It permits two directions of further inquiry that I would like to call *substantive* and *reflexive*. The substantive inquiry seeks to *expand* the pool of knowledge, the reflexive one seeks to analyse it, to

⁷ Goethe: "Ein großer Teich war zugefroren ..." ["A large pond was frozen over ..."]. Johann Wolfgang von Goethe: *Poetische Werke* [Berliner Ausgabe, vols. 1–16], vol. 1 (Berlin 1960 ff): 603.

clarify it. Science moves forward only by an interplay between both ways of inquiry. Here, however, we must regard them as separate methods.

Substantive inquiry can plainly, indeed, inexplicitly presuppose the physicists' faith and asks further in that sense: "This I already know about nature. What else can I find out?" Thus it requires no special methodological contemplation. The reflexive inquiry, by contrast, explicitly performs the *hypothesis*. It asks: "If one grants physics as cognized knowledge, what has thereby already been conceded? What presuppositions are contained in physics?" Hence, not the objects of physical knowledge are made the subject of new knowledge, but physical cognition itself. It is reflection.

Reflexive inquiry is almost what Kant calls the transcendental question: "How is physics possible at all?" That which one already concedes by granting physics as cognized knowledge is the *a priori* of physics, the condition for the possibility of physical experience. I avoid the Kantian expressions, however, because they are stamped in the mentality of absolute certainty which we cannot presuppose. We shall be comparing our notions against Kant's throughout this lecture.

You notice the relation between the two paths of inquiry and this lecture's organization. Regional disciplines are the core of the stock of physics that we grant in the sense of hypothesis. The plain faith of a physicist guides him further along the substantive path of inquiry up to what he regards as the most elementary objects known until then. Reflection, conversely, leads him to delve into what, according to his own knowledge, must count as the most elementary given. These two motions are the arrows that signify the two "apexes" of physics, which we spoke of at the outset; they constitute the two frontiers of research.

Another confirmation is needed that reflection also creates a research frontier. One could say: "A given simply is given. One only has to notice it and then it is known." However, the self-forgetfulness of cognition is overlooked. The eye sees things but not itself. The consciousness is explicitly consciousness about some content and only in an inexplicit way hardly known to itself, consciousness about itself. Reflection simply means establishing what is actually given for us and how it is given for us, therefore, making the 'phenomenon' in the cognized knowledge conscious. To that extent, the basis of the reflexive method should be denoted as *phenomenology*.

Phenomenology is at least as difficult and unfinishable as physics because reflection is a line of inquiry unnatural to the original consciousness. If phenomenology were an end in itself for us here, we would have to develop it by increasing reflection, setting out from the regional disciplines. But we want to establish physics here.⁸ Phenomenology is merely an auxiliary science for us. If we inquire about the given in normal physical knowledge, the aim is not to examine cognition but the given inherent in it. That is why I place the phenomenological chapter at the beginning.

⁸ i.e. in the lecture this text is a part of—*Editor* [MD].

This doesn't mean that I could start with the simplest givens independent of all that follows. It just means that I throw myself into the swirling current at one place and then let it carry me around. In order to make understandable the first givens I am going to be speaking about, I shall employ a language that relies on your already having the physicists' faith and already having reflected on it to a certain degree; otherwise this language would remain incomprehensible. This is expressed in that vocabulary is used in the description of the first phenomena to denote phenomena described only later on. Herein is expressed the *cycle* in which any cognized knowledge is acquired.

We must now try to define this cycle conceptually more precisely. Any matter of fact that is the content of a piece of knowledge that I do indeed have, I call *given*. Any matter of fact that holds, whether or not it is given for me, I call *factual*. I am aware that these labels are also liable to raise many doubts; but at the moment they should serve as a brief form of expression for initially pointing out a phenomenon. From the standpoint of strict methodological doubt, I may only assert a given. However, faith always presupposes the factual, which is not-given, for me: He who lives, believes; hence presupposing the not-given factual is a precondition for living. The substantive line of inquiry keeps within this faith and tries to understand the given in the totality of the factual as well. On the other hand, I can only really know about the factual insofar as it becomes given for me; relative doubt is always permissible, of course. Hence, methodologically, the factual should only be characterized as what *can* become given for me. With this 'can' enters the concept of *potentiality*, which will soon become a main object of reflection for us. Thus we have a cyclical connection: The given is an excerpt of the factual, the factual is what can become given. Otherwise put: The individual is only understandable from the whole, the whole is only exhaustible by way of the individual. Therefore the methodological necessity to jump into the swirling current.

I have, in fact, already done so in this methodological preliminary consideration. I relied on your having often cognized knowledge, having had doubts and faith already, and know what it means; and then I tried to maintain the degree of precision on the problem I had started out with in going around this cycle. That is also why I first went through a purposefully vague cycle with the summary overview and the metaphors. The concepts used there gained more precise meaning by the methodical contemplation we are just completing: the second round. The first round was only possible because the matters of fact exist that were drawn into closer view in the second round. The given in the second round was the not-given factual in the first round, but which was the factual condition for the given in the first round. Now we are entering a third round which will comprise all the rest of this lecture course. It will acquaint us again with the factual conditions of the given in the second round and thereby make the second round understandable, in a certain sense. We would have had difficulty understanding the process we shall be undergoing in the third round and hence would have hardly

been able to handle it correctly without having gone through the second round beforehand.

There is no need to comment that these circles do not demonstrate the path by which these insights were first made but only the shortest form that occurred to me to present the acquisition of knowledge. All knowledge is gained by struggling through by trial and error.

But enough of this methodological business. Let us turn to the subject matters.

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