Physics and Reality

LECTURES OF ARISTOTLE ON MODERN PHYSICS
AT AN INTERNATIONAL CONGRESS OF SCIENCE
679 OLYMP. CAMBRIDGE 1940 A.D.

KURT RIEZLER

Published for the New School for Social Research

CATHOLIC UNIVERSITY OF AMERICA
LIBRARY
WASHINGTON, D. C.

NEW HAVEN
YALE UNIVERSITY PRESS
LONDON · HUMPHREY MILFORD · OXFORD UNIVERSITY PRESS
1940

COPYRIGHT, 1940, BY YALE UNIVERSITY PRESS

Printed in the United States of America

All rights reserved. This book may not be reproduced, in whole or in part, in any form (except by reviewers for the public press), without written permission from the publishers.

PREFACE

THIS little book is a humble experiment in thought dedicated to those who, conscious of a widening cleavage between Nature and Man, are willing to inquire into its causes. It neither will nor can do any harm to others who feel safe only in the shelter of inherited habits.

I present Aristotle with both thanks and excuses. The first for the use of fundamental concepts, the second for the misuse of his fame. Hugh Jedell helped me in adjusting the language of Greek philosophy to the English idiom. Martha Anderson spared no pains in shaping, forming, polishing my manuscript.

K. R.

CONTENTS

PART A THE IMPASSE

PART B THE OTHER WAY

PART A

THE IMPASSE

I

THE PROBLEM OF MOTION

Ladies and Gentlemen:

Before beginning, I invoke the gods according to my country's custom, for you as well as I need their aid if we are to understand each other. Then I give you thanks for having invited me to speak here. You have called me the founder of your science. You want to learn from me how I feel about the development, the present condition, the triumph of your science.

You are caught in a maze, snared by habits and trapped by methods from which you cannot free yourselves. From my great distance I may perchance see things you cannot see. I do not know whether my voice, an alien voice, can find access to you—not merely whether the sound of the words can carry to your ears but also whether their sense can enter your minds as scientists, your hearts as men.

First of all I beg you not to expect me to praise your achievements. For this purpose you do not need me. Certainly, from my stammering to your calculating the progress has been extraordinary. You have the most ingenious instruments, you use the most efficient methods, you know the most astounding laws. Your ships, automobiles, airplanes, and radios unite the globe and connect events. Your catapults pull down cities and upturn stones from the bottoms of your fields. You endow your rulers with superior technical means that choke all possibilities of opposition. For this and still more you have my humble admiration.

My wonder at your successes is not my greatest wonder, however. The first sentence in a book I wrote in my

youth runs: All men by nature desire to know.[a] The most intense of all your experiences is your desire for knowledge. In vain do I look for the place of this experience in your scheme of the Universe. There is no place. This, not your successes, is what astonishes me most.

This experience has not and cannot have a place in your scheme. You have shut yourselves off from Nature. The further you penetrate into what you call nature the more elusive you become to yourselves. What, by Zeus, have you been doing?

The nature you talk about as scientists is not the nature you mean when you say 'I am'. Nature is one, immutable, eternally varying—the way of Being in all beings,[b] revealed as eternal movement, formation, deformation, and transformation. You yourselves, your desire for knowledge, you are Nature. And yet you have opened between your comprehension of yourselves and your knowledge of Nature a chasm that engulfs in darkness your common being. You realize it. In all the splendor of your inventions this is your secret grief and the scandal of your science.

Why? Consider the strangeness of your ways. They may be a matter of course to you through force of habit; to me, however, they seem unaccountable, and ever new reason for ever greater wonder. You are men. Whatever you know of the outside world you know as men. Man is your closest, your most authentic experience, which yet you put aside.

Ah, I well know what tempted you! The exciting experience of Nature submitting to Number first created an ideal of Truth in your souls: the certitude of mathematical statements. This ideal determined your conception of science; and this conception of science prompted your scheme of nature as object of this science. Nature became the nature of exact science. Exact science deals with laws that connect phenomena by relations of measurable quantities. You have found those laws. Their structure is of wonderful simplicity: definite differential equations. They permit you to confirm observation by calculation, calculation by observation. Overcome by this

miracle you sketch Nature in the space of your numbers. But in this space you leave no niche for yourselves and your desire for knowledge.

No doubt there were other things that seduced you: The technician in you wanted to build machines, did not care about the essence of things in so far as they 'are'. To build machines it is sufficient to measure quantities and to know their relations.

Theology, too, led you astray. When the inheritance of my people faded, your theologians separated Man from Nature, wishing to elevate Man and make him independent as a creation of that history which to them was the history of Salvation. By raising Man above Nature they degraded Nature. This is your inheritance.

The faith of your priests, however, embraced Nature and Man in one mystery. For your scientists this unity is rent. That inheritance of which you are the slaves is frozen in long-dead words. You cannot get rid of it, surmount it, cannot find the way back to the unity of Being, to that one Nature in which you are kin to all beings, the eternally equal, which, imperturbable, conceals and reveals itself in all that *is*. Shorn of the innocence of this link you wobble between two kinds of bad conscience: as human being you squint toward theology amidst your numbers; as scientist you feel guilty in that very squinting.

All these reasons for your having lost the way hardly diminish my astonishment. You have no image of Nature. You carry no image of Man in your soul. You are homeless in your own world. Perhaps my amazement amazes you. It is plain that Nature does not mean the same to you and to me. My way of questioning is obviously not yours, my ideal of knowledge, my measure of truth, are not yours.

I do not intend, however, to set concept against concept in the empty space of possible thought and to fight you with sheer words. There is something in us and beyond, call it what you will: Nature, Being, Reality—something we can hit or miss, veil or unveil with words. And

we both defer to that something as judge. So I shall get to the core of our difference by posing a specific problem: what is Motion? This question lies in the thick of my battle with the secret of Nature. It unleashes your innermost difficulties, compelling you to reconsider your own methods.

For still another reason I choose this particular question. When a mere four hundred years ago on the rostra of your universities Galileo conjured *Aristotelem redivivum*[8] to confound my adherents, the fight turned on the spatial movement of bodies in the sky and on earth. From this problem the mathematical science of Nature was born and developed, overpowering my adherents and myself. I did not heed the call of Galileo at the time. As were Kepler and Galileo, I was overwhelmed by the wonder of the harmony between Nature and Number. My theory of the movement of heavenly bodies was reduced to a pious phantasma; yet I knew I was right in the greater problem of motion. Only now, after intrinsic difficulties have sapped the vigor of the testimony and are beginning to indicate its origin and limit, can I try to plead for my vision.

What is Motion? By Motion I mean not only motion in space, but change of any sort—variation in quality, waxing and waning, growth and decay, birth and death. I shall start with your concept of motion—with the answers given first by the classical, then by the most recent physics. Later I shall attempt to show how your own difficulties oblige you to discover another meaning in the question and the possibility of another reply.

What does such a question mean? It masks a difficulty of a peculiar kind: the sense of 'is'. Obviously this little word is not merely the copula joining motion as subject to any predicate about which we are free to agree. In our answer to such a question we do not want simply to confirm our agreement about a name. Manifestly this question disguises an assertion. We must divide the question into a statement and a question: 'Motion is.' 'What is motion?' In the first, the 'is' is predicate, not copula. In

the second, in which it seems copula, the predicative force is retained. The answer to the question 'What is Motion?' must be a statement about Being. Being is intrinsically mobile, changing. What does that mean?

The voluntary element in our agreement about the use of the term 'motion' is limited. This word must be applied so as to say something, not nothing. There is compulsion in all saying. Saying means to say something, though most of our saying is saying nothing: something that seems to be but is not.

So we shall have to agree, before we attempt an answer, upon the meaning of this 'is'. Perhaps here at the very beginning lies the source of our dissension. Your meaning of this 'is' may not be mine, mine not yours. If I am not mistaken you recognize only one possible meaning of that 'is'. There is a somehow ordered multiplicity —you call it cosmos, world. It is beyond you. You are in it. In that cosmos many things exist, others do not exist. Of one you state 'it is', of another it 'is' not. Being and not being for you means belonging and not belonging to that cosmos.

If you start with this sense of 'is', 'Motion is' means first of all: In this cosmos there is movement, movement belongs to it. What does this statement really intend? I should say: this multiplicity expands and is held together by certain principles and categories of order and determination, the whole of which makes its structure. To state what Motion is, then, means to determine on the basis of these principles the place of Motion in this order. In that way indeed you go to work. You presume that this cosmos, for instance, extends in three dimensions of space and one of time, and assign to the points of this four dimensional diversity certain figures describing its physical conditions. By this sketch you determine Motion: Motion is a continuous sequence in time in which conditions change their places or places change their conditions. Thus you determine Motion by Time. I will not yet inquire whether this determination is adequate or even whether it really determines anything at all. This

obviously depends upon Time's being something or nothing. My aim is merely to show you that the ground on which any such determination stands is the total design of the order that connects this diversity: in short, that you do your determining on the basis of what you call the world.

All your determining is of that kind. You determine colors by electromagnetic waves, plants by placing them in the hierarchy of genera and species, by descent, by position in space and time, by conditions of life, or anything else of that order—the ultimate support of your determining is always a total scheme of the diversity called 'world'. This meaning of the question establishes the conditions with which an answer has to comply. Your decision as to the meaning of the question predecides the pattern of the answer.

For the time being I accede to this pattern, but with the reservation that the meaning of the question is itself open to question. Maybe it is the character of the question that leaves all answers suspended in the air. We may later be compelled to remember that the meaning of the question is doubtful and to revise the question itself as well as the answers. Now I consider the question as you pose it.

I see, however, discontent and resistance in your faces. I can guess what annoys you—that dangerous word 'is'. You fear to get entangled with its secret. You have worked out a thesis intended to elude it. You do not want to ask what Motion 'is', or even hear that this 'is' is doubtful. You pretend that no answer whatever to this question could touch you and your science in any way. Reality is perception. You say: "We seek the order in which everything perceivable is connected—the relations and laws linking our observations. With this we are content. From present and past observations we calculate future ones and rejoice when the later observations confirm our reckoning. The order of all possible observations —that is our reality and the only sense of Being, reality, actual existence that we acknowledge. Everything else we

deem vain—shams. Things for philosophers to quarrel about to the end of the world."

You agree? Nearly all of you approve of this thesis. Here your kind of arrogance wears the guise of modesty. Relating, as you say, your observations to your mathematical model you determine a single thing, i.e., the perceived by its place in an order. Thus you follow up that sense of 'is'. You see a color now and here. This now and here you determine as a spot of a four dimensional diversity you call space-time. The color, an oscillation of the 'ether', now and here, you relate to numbers measuring physical qualities of this spot. This is determination on the basis of the order of the manifold. This color is an oscillation of the frequency A, at a spot defined by the coefficients of x, y, z relative to the framework applied. Wishing to coördinate, not to determine, you dispense with 'is'.

I doubt that it is caution and modesty that recommend to you this manner of speaking. Certainly, when challenged, you hide behind your modesty, saying: "We pretend nothing about the nature of things—let alone about 'Being'. We do not care about interpretations of our statements. We coördinate. The agreement of calculation and perception is justification enough." Am I wrong in presuming that this modesty is only a way of defense? That you are all convinced or were convinced until a short time ago that your scheme of order is the basis of all knowledge about Nature since it is the scheme of Nature herself and the model of 'Being'?

No matter how pride and modesty may mingle in this manner of speaking of yours, it shrouds that very sense of 'is' I have just defined and, temporarily, accepted. By that manner of speaking you cover up some other preconceptions. The perceptible? What do you mean by it? Obviously not the really perceived. You do not want to be sensationalists. For you and for me it is plain that a star not yet perceived by anyone can be real. Perceptible by whom? By anyone, man or animal? Nor do you wish to be subjectivists. Perception necessarily refers something

perceived to someone perceiving. Your order is order relative to a subject. What is the subject of your perceptibility?

Not the individual subject. You admit perceptions only if they can be confirmed by any possible perceiver. You eliminate the particular individuality of the perceiving subject. You have taken great pains to cast out the individual. You assume one ever present anonymous observer, the possible observer. Statements relative to him are for you 'objective' statements about reality. By such statements you establish your order of nature. You have then no right to pretend that you coördinate a totality of *all* possible or real perceptions with your model of nature, that your design of this model is confirmed by the totality of your perceptions. You have made a selection, and a very narrow one at that. You have limited the perceptible to the measurable. The order on the strength of which you do your determining is not built upon the totality of your perceptions. It is no stronger than the selection on which you built it.

Your perceptions confirm your model—so you say. Certainly, but the method orders you to drop the not measurable part of your perceptions; thus the method, and by the method the fundamental structure of your preconceived scheme, selects your perceptions. Your scheme is in your instruments. This objection does not trouble you. You are quite sure that by this selection you eliminate merely the subjective quality of your perceptions, retaining the objective.

Eskimos and Negroes disagree about heat and cold, but both read the same number on your thermometer. In your mind the intersubjective is the objective. By limiting yourself to the measurable you think you feature objectivity. That is why you believe that you really stand upon the totality of experience.

You are mistaken. You have not eliminated the subject; you have eliminated merely the individual differences in favor of an anonymous subject, the potential observer. Then you have emasculated this anonymous sub-

ject; now he is an odd creature, a robot without blood and heart, whose only being consists in reading numbers from the pointers of your instruments.

Your 'objective' reality is merely an intersubjective order relative to this robot observer. All that is not measurement is closed to him. Your most intimate and impressive experiences mean nothing to him. He has no part in the colorful fullness of Being. Since he is not a number he cannot perceive himself. He does not belong to his own world. His objectivity is intersubjectivity of numbers.

There may be another reality not less intersubjective that is not measurement. The anonymous observer cannot perceive it. The subject also 'is'. Intersubjectivity is in his being too. In subject there is something not only related to this or that subject but existing in itself and therefore binding for all.

So your objective world has become a strange world relative to a strange observer. All your answers to the question: 'what is this or that?' are based on the design of nature of this your anonymous observer. On this basis you determine what motion, color, force, matter is. On this basis you are at a loss for an answer. This design you try to model as far as you can to find harmony. But your modeling does not affect your way of determining, your meaning of 'is'.

This your objective world, a pointer-reading world of numbers, is no more the world of your eyes, hands, and hearts. With the growing distance between these two worlds uneasiness grows in you. In this feeling you realize half consciously that perhaps you have excluded from your world several things of which you remain firmly convinced that they 'are'.

Thus most of your notions change color in a twilight. You use the word force and, when queried, you define it by law, field, and vector; but what you really have in mind is the force you feel in commanding your muscles. Do not imagine, however, that you are uniting these two: you mix up unconnected notions, surreptitiously exchanging

one for the other. All your thinking goes on in such ambiguity. You are aware of it; hence your discomfort.

Let this be enough for the day. My aim was to ascertain the sense you give to the little word 'is', whether you use it or go around it. To affirm that motion *is* means to you that Motion belongs to a multiplicity, the totality of which you call world. The determining is done on the strength of that totality. You determine the What of the thing inquired for by its place in the world.

II

CLASSICAL PHYSICS

TODAY I intend to walk along paths familiar to you but untrodden and arduous to me. I shall examine the answer of your classical physics to the question of Motion. I shall unfold the inherent difficulties with which your own principles have encumbered you. Maybe these difficulties will force you to ponder on these principles. What to you seems most natural is most dubious.

Your idea of motion springs from phoronomy. From the variety of changes you select one: the apparently simplest,[1] movement in space. Its mathematical pattern is your model of all change. A three dimensional continuum, Space, is extended in a one dimensional continuum, Time. First you relate a continuous sequence of points of space to a continuous sequence of points of time. This four dimensional curve is your model of movement. Then you ascribe to the points of your four dimensional space-time continuum various other quantities, representing the physical conditions, energy, potential, field values. Each of these values is a further way of determination, i.e., a dimension. Finally you represent their continuous changes by curves in the space of figures.

Thus you ascribe to a point of space-time a set of x quantities—x being a finite number. This set of quantities is a complete description of this point. The totality of all these sets of quantities would be an exhaustive description of the world. These quantities you assume to be connected by laws which comprise the laws of world geometry as well as of nature. The first refers to the properties of sets of four numbers, each signifying to you the points of space-time; the second refers to the proper-

ties of the other numbers, i.e., the physical values. Both kinds of properties, however, form an indissoluble unity.

It makes no difference whether you call world geometry a law of nature or the laws of nature world geometry. What you want to do is to calculate unknown from known numbers, rather than to describe the world by sets of quantities. Nature lends herself to your doing so. To you this is a reason for pride and awe.

The knowledge of a three dimensional cross section, describing a closed system at a certain time, gives you values, called parameters, that obey certain rules. These rules, the laws of nature, can be differentiated in simple equations in the dimension of time. Thus you are able to calculate from the conditions of the system at any one time its conditions at any other time. This kind of order you call the causal structure of world occurrences. Thus your design of nature is of grand integrity, a marvel to behold. So you think. I must confess a tinge of admiration in my horror.

This world, however, is merely the world of your anonymous observer: a world of pointer readings. Its laws link possible pointer readings. It is bleak and barren and lacks sun despite its lucidity. For centuries I have been wondering how you are able to live in this world without freezing. Even you might perhaps feel slightly chilly if you drew your own conclusions. This, however, you do not do. You relate the pointer readings of your anonymous observer to the perceptions of your own senses. Your naïve view of the world steals into the world of the anonymous observer and his figures. Now the numbers seem to take on life.

A fog of thoughts, turbid but not without at least some color, floats through your glacial number world. What I said yesterday about force applies equally to time. Time, to the anonymous observer a dimension and continuum, is to you a devourer of the Nows it begets. Similarly with cause and effect and so forth. But when asked what you really mean when you speak of force, time, and so forth,

you quickly conjure up out of the naïveté of your numbers an unobjectionable definition—only to sneak back afterward into your habitual twilight.

Your naïve world is no world. It is a muddle of rudiments of past ontologies, including my own. There is no ontology, no 'logos' of Being as Being, no unity of design of an ordered totality. Therefore I must hold on to the world of the anonymous observer and hold you within it.

In this world Law reigns supreme. Law has ever been, is, and will ever be. It is immutably the same. There is no creation, neither becoming nor decaying.

I doubt that you are satisfied. This Law is arbitrary—reason for everything and itself without reason. Moreover, you cannot make this one contingency do. There is a second: the initial constellation. You cannot deduce the second from the first. In your experiments you adjust the constellation to fit your needs—in your world you find it and must accept it.

These two contingencies are unconnected in your picture of the world: one is beside the other. This does not trouble you in your daily world. You push them off to the border conditions of the physical system 'world', to the infinite edge of beginning in time with which your research is not concerned.

Transmitting this awkward lack of connection into the language of mythical cosmogony I would say: In a divine whim your God selected, by a first creative act just this world geometry and these and no other laws of nature. Then, by a second independent act of creation, unconnected with the first, He chose in a still more capricious mood an initial constellation; He then turned His back on His creation—had to turn it, having deprived Himself of all further interference—retiring to His eternal quiet. Unless you prefer to assume that despite his Omniscience He ought to be sufficiently curious to observe the immeasurable misery growing out of the second contingency under the rule of the first. It seems to me that you gave your God too much work in the beginning of the world and too little during its course.

The muddle gets still worse, if you take your second law of thermodynamics seriously. If this law governed world development, God would have created a most improbable initial constellation which, left to itself, could only deteriorate into a growing disorder of increasing probability. Truly, more miserable even than Man would such a god be. You tell me to leave God out of the play. The myth, however, only lays bare your embarrassment, which in the cold language of your science is less obvious but by no means less acute.

Your world *has been* before *becoming*. Absolute Law governs immutably from an infinite beginning to an infinite end. What, in this world, is Motion? You distinguish one of the four dimensions of your continuum by calling it 'time'. You relate a continuous sequence of numbers and number sets, representing either points in space or physical values, to the continuum of time and call it 'motion'. Thus you define Motion by Time. But what is Time?[1]

Time, to you, is one of the four dimensions in which you conceive the cosmos to be extended. In time the world is unfolded. This time, just like space, is mere extension. Being, either resting or moving, is spread out in time. You call it rest when the points of space related to the points of time are the same; movement when they are continuously different. But this rest does not rest, this movement does not move. Equalities and differences are distributed. The world, extended in Time, stands still. The semblance of rest and movement is caused by your relating your inner knowledge of your own resting and moving to the distribution of these qualities and differences. In that world Eternal Law reigns, having immutably established the distribution of equalities and differences in the dimension of Time.

Thinking of the equalities and differences as ordered in accordance with the hypothesis of causality you cannot even distinguish between past, present, and future, let alone a present Now from the Nows that have been and will be. Thus the present will never progress, the Now

never devour the preceding Now and be devoured by the succeeding.

Everything is unequivocally determined—the Real is the only Possible and the Necessary. There is only one modality of Being. In the same mode are past, present, and future. They cannot be differentiated. All discrimination depends upon the position of some observer. You can change his position, choose King Rameses instead of yourself: he *is* just as much and in the same way in this world of yours as you are. Only at another point. His Now is just such a Now as yours. The undeniable fact, however, that all observations are chained to a present Now, that this present Now and with it the observability is moving—you can only gape at in silence. There is no provision for it in your design of the objective world. Yet you cannot explain it away by the subjectivity of the observer, for if anything at all is objective, it is. There is no escape from this embarrassing situation as long as you conceive things extended in Time as a dimension and determined unequivocally in the manner of your causality. You fake a solution, smuggling your naïve perceptions of time and motion into a world in the scheme of which they have no place. The task of determining Time by differentiating past, present, and future remains the secret of the observer.

Time is a one-way street marked by an arrow. But this quality of time also you borrow from yourselves. Not in your draft of nature, in yourselves alone, in the subject is Time directed, is one Now earlier, the other Now later, are Earlier and Later never to be exchanged. In your world they are here and there. Later could be Earlier, Earlier Later.

I have read that some of you think the second law of thermodynamics could account for Time's arrow. I confess that I have tried in vain to understand how. I believe it is not from thermodynamics that you conclude Time's arrow but from your own life put into your premises. That second law is a statistical law, a statement about aggregates. For these aggregates certain conditions are

valid. The single happenings must be relatively independent one from another. If these conditions prevail, the probability of a certain distribution cannot but increase with the number of happenings. This has nothing to do with Time. If you let the number of happenings increase in Time you can say this probability increases in Time, but then you presuppose Time and its arrow. This, however, is a minor point; and you yourselves are far from feeling safe in your argument.

No, a statistical law cannot account for Time's arrow. Time does not stand still in the thermodynamic equilibrium and would not flow backward if you could observe entropy diminishing instead of increasing. The arrow of Time cannot be deduced in this way. A statistical law does not state anything about the nature of elementary events. It is from their inherent nature, preliminary to all aggregates, that the arrow of Time springs. Here must be its source. This source you cannot find. Your concept of motion does not give you any toehold. Therefore you borrow the arrow of Time from your knowledge about yourselves and transfer it to your objective world, not grounding it in the structure of this world itself.

I now turn to another impasse. I call it the 'aporia' of Substance. First you reduced substance to matter. Speaking of bodies you thought you had something lasting, as a substrate of change and subject of motion. But this subject atrophied in your hands to the grammatical subject of your sentence. To the question: 'What is it?' your only answer is: 'The subject of motion is field.' Fieldflux, however, is a continuum in space and time. There is nothing left at your disposal that, preserving its identity in the very change, might be a This against a That, one One separated from another One. You have only one One left: the world itself as the one field expanded in space-time. You can separate parts of this continuum for your purposes. When doing this you can trust that this continuum contains sections in which certain field values are extraordinarily high, declining steeply at their borders. But this procedure is merely an escape; you cannot state which sta-

bilities of which values should serve as exact criteria and which declivities should justify your separating one section from another as one One from another One. Thus, the parts would owe their Oneness to you and your purposes, be θέσει not φύσει—by thought not by nature.

Consider the purport of this: I and thou, each a One and identical with itself. This is indeed the first and most primary of all your perceptions. If you are consistent you must admit that you cannot coördinate this perception clearly and distinctly with your design of the world. Your only weapon against this dilemma is inconsistency.

It is as a continuum that you have designed space-time. To this continuum you have ascribed continuous field values. This continuum is your only One. It is undivided, though divisible in thought. If you prefer to conceive this continuum as not only divisible but also divided in infinite points, you get lost in the maze of the most ancient 'aporiai'.[2]

You are quite content imagining yourselves represented in your field continuum as continuous sequences of points in space-time—world lines you call them—extended as four dimensional worms. You believe you are identical with yourselves, each of you, by virtue of this identity being a One, if this world line does not diverge and branch off somewhere. Such a ramification would indeed signify that at one point of time you could be in separate places. The absence of such a ramification is a necessary but not a sufficient condition of your identity.

In this continuum you can draw any world lines you wish. In this hall I can draw such a world line across your space-time, starting from myself and going through some of you. That, too, would be a continuum just like each of your individual world lines. Some of these physical values at the entry and exit of each of your bodies would show a quite abnormal declivity, especially the potentials of gravitation representing mass and energy. But the world line, despite those declivities, is a continuum. Thus you really think the world lines of this identical You are distinguished only by a relative constancy of certain

physical values; e.g., mass. But this mass also is field property and fluent. Where is your criterion of the grade of constancy that permits one world line and forbids another to be the world line of one and the same being, that, like you and me, is one One and identical with itself? You have no such criteria.

You are surprised that I demonstrate the difficulties of classical physics by concepts of field physics alone. Field physics is only a program. Your practice is governed by a dualism of field and matter. I can do nothing with the name of a name. You do not determine matter. In determining matter you determine it as field. If in a dualism of matter and field you oppose matter to field, matter becomes the uncomprehended residue, proving only that your concept is inadequate. Matter, then, is merely a name for your dilemma. The uncomprehended residue devours what you think you have comprehended—the puzzle of matter swallows up your solutions. Something is missing in your conceptual frame of nature. This gap you fill with a word. Matter furnishes you with the grammatical subject of your statement, the carrier of Motion: the stone in your hand, the water that flows, the helium atom. Matter links your concepts to the work of your hands. This may be sufficient for your practice but it does not save your theory. This embarrassment is the revenge of Substance for the treatment you have given it. You have degraded it to matter; matter, a substrate of movement—the x of the grammatical subject. Thus you have concealed the mystery, which the concept of substance woos, in the void of the name of a name. Out of this void it raises its head again. One day the riddle of your matter or the origin of dynamics will compel you to rediscover that concept. By then not much will be left of the world design of classical physics. Then only will you take up my fight against Galileo.

So it happens that field physics gives a strange answer to the question what Motion really is: Motion does not move. In your world there is no motion, therefore no rest, for the moveable alone can rest.[8] Time, which must de-

termine motion, is not distinguished as time. The moving of motion is a mirage—even the unity of the moved, the subject of movement, is the observer's assumption.

I read indifference in your faces—all this cannot give you concern. It does not affect your discoveries. Your airplanes fly. Your wireless waves race through space, bringing the commonplaces of statesmen from the other side of the globe to the remotest hovel. You calculate the pressure of radiation on the surface of the sun, the temperature in its center, you destroy atoms of nitrogen. You follow the tracks of the ejaculated particles. You sort out the elements—you take hold of matter. And here somebody rises and says: "Your motion does not move." You do not trust your ears.

Permit me to justify myself. My case is with the human being in you, not with the physicist. I do not contest the knowledge of the physicist. I deny neither your laws nor your machines. The miracle of the agreement between calculation and observation stands before me as grand as before you—perhaps even more grand, because I do not claim to know what this stupendous testimony really attests.

My criticism is of the use Man makes of physical knowledge. It applies to the discrepancy between physicist and human being, its origin and its consequences. I do not dispute the numbers of the anonymous observer but only their claim to describe Nature, the really real world. I want to confine the great testimony to what it really may attest. You overcharge it. Saying that motion does not move I plead modesty.

On what grounds? You know motion from its very source, yourselves, from your acting and being acted upon. Knowing this motion you cannot help judging motion in classical physics and denying that it moves. In the same way I am free to give the name 'time' to a dimension of my n-dimensional manifold or to call a relatively constant field 'subject of motion'. But there is a knowledge about time in you. Judged by that knowledge the dimension called 'time' is not Time. In you is a knowledge

also about the One you call 'I' and the other One you call 'thou'. Judged by that knowledge your relatively constant field—carved out of the world continuum—is still not such a One.

If your movement seems to move, your time to be Time, your substrate of movement to be Subject, it is only because you furtively slip your inner perception into the sense of your words. Did you not want to get your answer from the outside world? For this purpose indeed you drew the order of phenomena in your space of numbers, divested the individual observations of their peculiarities, and transferred them to the anonymous observer. You wanted to develop from the simpler phenomena the concepts that would explain the more intricate. From spatial movement in the heavens and on earth you wanted to obtain the laws of motion, from inorganic nature the laws of organic life, thus at last understanding yourselves on the strength of just these concepts.

Consider! The answer the world gives to your way of questioning is an order of pointer readings. Into that order you introduce vague thoughts interpreting those concepts by untested knowledge of the subject about itself. This answer is an answer neither of the world nor of your own Being. You can make it pass neither as one nor the other.

You have not examined the 'Being' of the subject. Maybe from its knowledge of its own Being the subject would have given an entirely different answer. You have lost the ability to inquire in that way: you no longer even know that such a way of inquiry is possible and still less that you could obtain an objective answer to such questions.

Your answer to the question of motion is ambiguous, detached from the subject and still attached to it. Thus you have stumbled into an unhappy predicament. You know and accomplish a great deal, yet you have no picture of Nature, no total design of Being. You have the testimony of the anonymous observer, but you do not know to what it testifies. The agreement of his figures gives no

results that enable you to comprehend yourselves as a part of this world.

It seems to me that eventually the statements of biologists, historians, and physicists about Being must tally. The world of one is also the world of the others. You have cut Science into parts. I am aghast, seeing that in your hands the specialization of sciences has resulted in dissecting the world into many worlds.

I cannot make myself believe that this satisfies you. The world is one. Nature is one. One tie links all Being. That uniting logos of Being must be unearthed. My name for this task, ontology, has acquired ill fame. But what's in a name? The task remains—soluble or not—yours as it was mine.

Only when searching for this logos, embracing the testimony of your numbers and your own living Being in one question and in one answer—then only do you, striving with greater effort for a higher goal, face the secret of Nature. Never will that forlorn creature, Man, behold an image of Nature if he does not know what he is himself. Never will Man find himself if not in the image of Nature.

I come back to the anonymous observer and his scheme of nature. His motion does not move. His time does not proceed, his moved and moving x is not a this or that One. It is your scheme of law, it is the continuum of space, time, and field ruled throughout by such laws as let Time merely extend, make movement rigid, and destroy the oneness of every One.

These difficulties are the difficulties of classical physics. Meanwhile, without allowing yourselves to be deterred by them, you have proceeded with your researches, continuing to select the measurable perceptions, to relate the observed quantities to the anonymous observer and his mathematical model, to correct this model according to the needs of this relating. And then, once again, the Eternal Teacher has led you up to the great mystery. You have discovered—and that is perhaps the greatest triumph of your methods and the prize of your very re-

straint—what did you discover? You are surprised, still doubting that you know what it is.

Two things you have discovered: That the laws of nature you know are derived laws, secondary not primary, that their kind of simplicity is consequence of a macroscopic view; That on the small scale it is not possible to establish a one to one correspondence between your measurable perceptions and the classical scheme of order and to describe Nature by differentiation of continuous quantities in the continuum of space and time.

The gigantic testimony does not testify to what it seemed to prove. Thus you have fallen from your old disguised troubles into new, obvious worries. With these we shall deal tomorrow.

III

QUANTUM PHYSICS

Since the motion of classical physics does not move let us put the question to quantum physics. Here I do not hit upon a finished, self-reliant, ready answer, but find myself up against a muddle of embarrassments. These embarrassments, however, arise not only, as most of you assume, from the incompatibility of quantum theory with classical physics. The main ill would not be remedied by tackling the quantum phenomena with the concepts of classical physics. It is more deep-seated. The design of reality in classical physics contains greater enigmas than your so-called quantum mystery. When quantum physics shows up these riddles inherent in the fundamental concepts of classical physics, you should be glad to be delivered from their bondage, instead of longing to be again under their tyranny.

It is better to be confronted with a mystery than with a phantasmagoria. You have a strange predilection for probabilities of the numerical value 1. You claim without reason that 1 must be the numerical coefficient of all probabilities arising in Nature, relative to an omniscient observer. You would love to make insufficient knowledge of that observer responsible for all probabilities < 1. If you were successful you would imagine that you have relieved yourselves of all quandaries. It is as if you wished to build machines, not to comprehend Nature.

Microphysics has no answer to the problem of motion. The classical concept of motion cannot be applied to the smallest of the small, though it seems to remain valid for the large. Moreover, obliged to base movement in macrophysics upon movement in microphysics, you have to admit that the former, which you know, originates from

the latter, which you do not know. Your up-to-date knowledge of movement refers to secondary movements.

About primary movement your knowledge gives you fragments of cipher writing. You have laws—your quantum laws—which have stood up in the practice of your research permitting you to observe the calculated, to calculate the observed. You know that out of these laws the laws of classical physics emerge. They concern happenings the probabilities of which approach with increasing quantum numbers the limes 1. Of what kind are these laws? They govern a something you call wave of probability. This means a mathematical form—a psi function. This psi function describes a state by indicating the numerical probabilities of the possible reactions an observation of this state will disclose.

When the first report of these probability waves found its way to the lower world, I believed myself to be the winner in a long fight. But nobody coming from above seemed to know about this victory. All reported only that and how and with what success and pride you make your calculations with these psi functions, without caring in the least what you indeed state about the nature of Being in using such a concept as base. Down here it is different. For us, the shadows that are no more, knowledge is but knowledge about Being. Then I met in yonder dark vault my old opponent Galileo. We propounded some questions, which you are unwilling to pose, relating not only to the fundamental concepts of classical physics, the continuum of space-time and your form of causality, but also to the applicability of Number to Nature, its reason and boundaries.

I shall now try to determine the peculiar qualities of your new knowledge. There are three difficulties well known to physicists. The first is concerned with the relation between the observed process and the process of observing; the second, with the fact that all statements of quantum physics are bound to the concepts of classical physics; the third, with the problematical nature of probability.

The observer of classical physics observes the Moon. His observation means nothing to her. She is affected by neither the human eye nor the most marvelous telescope. In microphysics, on the contrary, the process of observing changes the observed process. In other words, measured object and measuring instrument are joined in an inseparable process.

Now some of you say: if we are not able to determine a single happening, on a small scale, by laws admitting only one solution, it is because we have no possibility of observing a happening without affecting it. We could not discover such laws even on a large scale were our observation disturbing. If we had instruments that could register in the realm of the small without disturbing we would find that these happenings too are completely determined.

Others, again, say: it is for the same reason that the macrocosmic occurrences are absolutely determined and that they cannot be affected by observation. This reason is the play of large numbers regulating total behavior. The effect of observation on that behavior is smaller than the range of our interest.

Hope alone supports the first assertion. The second has a reason behind it. Most of you surrender to this reason, reluctantly renouncing that hope. Thus you cannot leave any microscopic motion to itself, observing that its passage through all phases is one and the same movement. What you can observe is a discrete sequence of disturbances. You cannot call this sequence a unity of motion or ascribe to the grammatical subject of your statement—atom, electron, neutron, proton—an identity with itself between two observations. The only subjects of possible statements are aggregates and classes.

Now I come to the second difficulty, of which you are also well aware. The psi function of quantum theory speaks the language of your instruments, i.e., of classical physics. The numbers you read on the pointers of your instruments mean quantities of space and time, frequen-

cies, wave lengths, velocities, intervals, potentials, charges, energies, impulses, etc. The concepts you use to describe the microworld are those you have developed from your experience of the macroworld. You are forced to do so. Your instruments keep you in line.

The laws of the macroworld alone support these concepts. But you must base the large world on the small. The laws of the large scale grow out of the small. Yet your interpretation of the numbers in your quantum laws is always in terms of your classical concepts. Obviously the occurrences on the small scale—the primary events—would have to furnish you with the concepts for the happenings on the large scale. Instead you have to take the concepts for the primary event from the secondary. That is most awkward, an 'atopon'.

Thus your science is a mirror inadequate to the object to be reflected. There is something to which it is and must be blind. You are not able even to name this something, let alone detach it from the qualities of the mirror and separate the object from its reflection.

Up to now, in the course of the development of your classical physics from Galileo to Einstein, you have been modifying the frame of your concepts, i.e., the structure of the mirror, in the progress of your discoveries. When your experiences did not conform to one another you corrected your frame of order. Thus you have transformed the rigid space of Newton into the elastic space of Einstein. Why not do the same again? You cannot. Your instruments chain you to your concepts. Maybe you could modify your scheme yet a little more and so surmount this or that difficulty, but that would not alter the situation. There is a limit: your own shadow. You cannot jump over it.

Now we come to the third difficulty. Your statements refer to aggregates. All you know is about the behavior of aggregates. What does the psi function say? You repeat one and the same experiment as often as possible, repeating as accurately as possible the initial conditions; i.e., you make your experiment on a multitude of equal

cases—or at least considered equal by you; e.g., atoms of hydrogen. The outcome is a catalogue of various reactions. In this catalogue the numbers of the respective reactions, i.e., their numerical probabilities, are registered. This is the psi function. It is a statement about a quantity of single cases; that is, about the particular class determined by the respective conditions. When formulating your knowledge as a statement about an individual case you merely say that this individual case belongs to a class that is defined by just this distribution of probabilities.

You can differentiate such a psi function in Time by simple differential equations. That is, you can calculate from the psi function of a class in t_1 its psi function in t_2. But this statement too concerns aggregates. It refers to a change in the distribution of probabilities for classes. You will all have to admit that this kind of change cannot be considered as a primary and original motion, fit to serve as basis for the question of motion.

But how about change in the single case—with a sequence of consecutive observations of one and the same single system (e.g., of an individual atom of hydrogen, whatever it may be), without reinstating the initial conditions? You say, there the psi function makes a jump. Prior to the first observation you ascribe the still unobserved something to a class defined by a psi function you know. After the first disturbing observation the measuring value a_1, resulting from it, is valid. After a further observation, being a second disturbance, a second measuring value, a_2, is valid. These measuring values belong to a new psi function. Thus after each observation a new psi function is valid. That means, this something, by the interfering observation, has jumped from one class to another class.

But no, it is not so. You are not entitled to talk about such a something. This something is only the grammatical subject of your sentence. There is nothing to guarantee the identity of this something with itself. One state of affairs has disappeared, another has arisen, that is all.

The order known by that kind of knowledge is order of the behavior of pluralities. These pluralities may be aggregates or classes. If they are aggregates, i.e., systems of very high quantum numbers, with whose total behavior you are concerned, the order you discover has the structure of the order of classical physics. The psi function of the aggregate has only one member of the numerical probability limes 1. Therefore you drop the psi function. Since you are concerned solely with the large scale you can treat the radiation of radium as a spherical wave. But the spherical wave does not describe what really happened.

If you are interested in the behavior of an element instead of an aggregate, your knowledge turns out to be restricted to probabilities. It is knowledge about the class to which this element belongs. The class is defined by the distribution of probabilities. Your knowledge today is a knowledge of aggregates and classes; so it will be tomorrow.

Because the object is affected by the observation your knowledge is bound to the collective and you are prevented from grasping the elements, of which such an aggregate consists even for you. Your statement about the collective certainly tells much about the elements it consists of; much that is marvelous beyond belief, but obviously not everything. To draw conclusions from class to element is difficult. If you want to draw conclusions, e.g., from the distribution of probability for the class to the possibilities for the element, you must presume that the elements are equal—in themselves and not solely relative to your knowledge. But that would be a mere assumption. Furthermore, you can formulate such a conclusion only in the language of classical preconceptions. These preconceptions, however, are developed on the strength of the total behavior of aggregates and are verified by them alone.

These three difficulties combine to increase your troubles. I hope I have described them and their source correctly.

The declination of your psi functions in quantum theory refers to secondary not to primary, to compound not to simple movements. The psi functions report the chances of an observation to find a place A for a charge B, or for a charge X a place Y. They distribute the chances of a charge to places, the chances of a place to charges. The change of chance cannot be primary motion. Chance is chance for an event. Instead of the 'ether' the probability wave does the vibrating. But what vibrates? The chance for an event.

Again, what is an event? Here you have no answer, except the answer of classical physics. But you cannot apply this unless you decide to lift yourselves up by your own bootstraps. The situation is curious. You proceed from discovery to discovery; that I do not deny. These discoveries are firmly rooted in shifting ground. They are rules for the coincidences of numbers signifying chances for events.

In this situation you turn to philosophy to provide you with a theory of knowledge enabling you to get around any troublesome question.[1] It is the old dodge: the real is the observable—at least for the physicist. You first define the physicist, setting his task. Then you limit the observable: the pointer readings of possible instruments. This is the 'reality' relative to your anonymous observer. I do not know whether this can be called theory of knowledge. Anyway it is not philosophy. It seems to me merely a definition of physics.

But that we have already discussed. Applying this so-called theory to your new situation you argue: The only knowledge I shall and can have is knowledge of psi functions. I know all that 'is' when I know all I can. It may be and usually is the case that I do not know the psi function or know it insufficiently. Then the probability this psi function reports is but relative to my insufficient knowledge. However, if I have a 'maximum knowledge' of the psi function, this psi function is the condition of physics, the maximum knowledge is the thing itself.

I understand why you assert this. You want to prevent

naïve perceptions from interfering with the numbers of the anonymous observer. If an accurate location of an electron is not observable, then an accurate location should not be postulated. An 'accurate location' of an electron is for the physicist a senseless term, to which nothing real corresponds. I approve your intention. The anonymous observer should not mix into his numbers concepts he cannot legitimate. Nevertheless, you cannot stop here. Probabilities are probabilities of something. A probability of nothing is still more senseless than an accurate location of an electron.

The physicists of past times have developed your preconceptions of the measured and measurable quantities on the strength of occurrences on a large scale—without any insight into the microworld. Now you find that these quantities are measurable with but limited accuracy. Perhaps they are not really the right concepts. If they are not, then the task would be to discover the right concepts, the true building stones of Being. But this you do not attempt. Numbers, psi functions, are observable and therefore real, even though they are probabilities of nothing. No! my friends.

Nature has erected a certain Number as a clear warning sign in front of you. This Number and its origin are the greatest of your mysteries. Your instruments speak the language of your model; they can speak no other. This model gives you the variables you must know for a complete description of the state of a system. Now it turns out that you cannot know all these variables accurately. You can measure accurately a single one, even half a set together, but not more. If you measure one accurately your knowledge of a certain other becomes inaccurate. The more accurately you measure the position in space the less accurate will your knowledge of velocity be. To this you have to submit.

You can measure both with the same degree of inaccuracy. There are couples the members of which limit each other in the degree of accuracy to which they can be known.[3] You can indicate a number below which the

product of tolerance they must allow each other cannot sink. A very queer number: you call it 'h', a product of energy and time.[4] It means an absolute limit of observability and is a universal constant of Nature. It is an enchanted number. Neither you nor I can disenchant it. Now it seems to betray something about the observer, now about the observed, now about both without your being able to disentangle one from the other. It springs from the disturbance of the observed by the observation, from the inadequateness of the classical concepts of wave and particle. Even as evidence about the observer it tells something concerning a quality of nature, but what it tells remains a riddle. You may speculate in various ways about the mysterious fact that just here a product of time and energy should appear as an indivisible number in integers and multiples of integers. But all such speculations have a short span of life in the world of your concepts. For me who do not accept your concepts, still searching for the logos of Being you think you possess, neither your energy, nor your time is a basic concept of this logos. I but not you might muse over the mystery, whether perhaps the union of time and energy in an indivisible quantum of action points to something in this logos that is more fundamental than your concepts of energy and time and their separation. Maybe this something is a product of energy and time only relative to your observer. I, however, prefer not to indulge in such speculations. I see in that enchanted number nothing but the limit of observability, germinating in the disturbance of the observed by the observation and the inadequateness of your classical concepts.

You cannot elude the difficulties of your situation by taking refuge in theory of knowledge. Statements like 'the perceivable is the real' or the 'psi function is the physical condition' or 'maximum knowledge is the thing itself' are not philosophical statements, nor are they theory of knowledge. They are simply definitions of physics, nothing more. By them you limit your task. Such a limitation may be useful to ward off strains of thought

that are useless for your purposes. But Nature does not bother about definitions of physics. After such a definition Nature is the same as she was before.

What would you think of an insurance actuary who insisted upon perceiving only the figures of his ledgers and their relations, pretending that they are the order of reality? The right and left sides of his ledger agree in a remarkable way. He may revere this conformity as a law of Nature, without dreaming that the board of directors brings it about by calculating premiums according to risk and overhead expense, and reaches the adjustment of the two sides by adding an amount they decide to call profit or loss. The actuary does not and need not know what death, fire, and burglary are. He has to do with three sorts of events, and within each sort he deals with different classes distinguished by coefficients of probabilities.

By means of these coefficients the premiums are calculated according to certain rules. The larger the number of individual cases in one class, the longer the period, and the smaller the range of the amounts insured, the greater the assurance that the balance between the losses paid and premiums will be maintained.

The actuary declares: my knowledge is the objective reality. The psi function—in his case the distribution of probability of fire, theft, death—is the state of facts. States of facts with the same psi function are equal by principle. You reply: you are mistaken; these probabilities are relative to your knowledge. But he demonstrates on the strength of his ledger that his knowledge is a maximum knowledge. His possible observer can perceive only numbers. To end the argument he finally declares: "Whatever the case may be, my knowledge is sufficient for me; at any rate it is the knowledge I need. Observation and calculation do conform. Your concepts—fire, burglary, death—are confused. They may be interesting to philosophers. I am an actuary." And you are physicists.

You cannot escape this way. Your theory of knowledge is only an attempt to cover up a very serious dilemma.

which you will have to face. You have a mirror: your basic concepts determining the measurables, the n dimensional number-space of the anonymous observer. In this mirror neither everything that is can appear nor can everything appear as it is. The mirror both fails to reflect and distorts. This is its nature. In the image you cannot separate the qualities of the thing reflected from those of the mirror. You cannot know what is omitted and what distorted. Your mirror has begotten the image with the thing. You cannot distinguish the qualities of the parent in the child. This inadequacy of the mirror to reflect the thing has led you up to now to conclude that the mirror must be transformed. From Newton to Einstein you have done this successfully. Now there seems to be a limit beyond which you cannot go. It is not only that in building your instruments you fettered yourselves to the basic concepts of classical physics. The continuum of numbers, the very basis of all your descriptions, is this limit.

The difficulty goes much deeper than you dared to fear. The problem lies not in the incompatibility of naïve concept and mathematical model, of classical physics and quantum theory, but in the inadequacy of present mathematics to Being. This limit is the limit of Number, of the applicability of Number to Nature. In order to pass that barrier you would have to think up new mathematics with possibilities not even dreamt of.

You relate your colored observations to measurable quantities; you transform the numbers of your individual observations as numbers relative to yourselves to numbers relative to the anonymous observer. Thus you jump the shadow of the individual subject. This is a stupendous performance. However, your world is merely the intersubjective, not the objective world. It is relative to your anonymous observer. This anonymous observer cannot and does not know what the event is whose probabilities his numbers report. To find out what an event is you must take a longer running start. You will have to clear the shadow of the anonymous observer as well.

This anonymous observer knows a lot. Do not think for a moment that I underrate his knowledge or doubt his figures. I bow before the miracle of the agreement between calculation and observation. This agreement is a statement of Nature about herself, about an order reigning throughout her. You did not invent these numbers. But to what do they testify? Of what kind is the minimum of order that must in any case reign in Nature, if the anonymous observer is to discover laws like the quantum laws?

An answer to such a question may not contain any unnecessary assumptions. That is important. The assumption that this order is the order of classical physics would exceed this minimum. The a priori suppositions of your probability-calculus are the minimum required. They refer to qualities of aggregates. They are the minimum conditions for letting great numbers play their play. That minimum may be little, but not nothing. Manifestly these conditions are fulfilled in inorganic nature, just as in the multiplicities with which the insurance actuary has to deal. So far as these conditions are fulfilled Number must be applicable to Nature. Here the miracle originates; here also it is limited.

But you have no right to assume these conditions are fulfilled throughout Nature. That would be an entirely arbitrary anticipation. You imply this anticipation by defining Nature relative to the measurements of your anonymous observer. Imagine for a moment that these conditions cease for some reason to be fulfilled. Of this possibility the physicist need not think. The insurance company must. Its laws rest on a relative independence of individual cases of death, burglary, and fire. Wars, riots, conflagrations, epidemics upset their rules. If the world of the insurance actuary, like that of the physicist, rests on such rules, it collapses.

Let me take advantage of my thousands of years. For you, in the toils of the quantum theory and shackled by your definition of physics, it is difficult to view the situation as a whole, for it is concerned not with physics

alone but with science in general. Nature includes Man. Man 'is' not only relative to the anonymous observer. Man—by nature desiring knowledge—wrestles with Nature the elusive one. In this tussle Man tries to get to himself.

If Herr Heisenberg talks with Herr Schroedinger or M. Dirac they disagree about naught except the structure of happenings relative to the anonymous observer. But the inherent force of the problem brings to the fore the question of the anonymous observer, of his rights and the limits of his knowledge. This is a more ancient and greater struggle—the struggle of Kepler and Galileo with my adherents. Even that struggle has not yet been decided. Both sides referred to experience, each against the concepts of the other. Each did so with right and wrong on his side. Leaning upon a different experience each judged the concepts of the other.

My theory of motion has developed from the living Man who knows about himself, acting and being acted on, striving and failing. By means of my concepts I was unable to lay hold on the laws of true and apparent movements of bodies in the heavens and on earth. For Galileo and Kepler my adherents' statements concerning this kind of motion were no match. Fighting me they developed your mechanics. Admiring its laws they took it as the model of moving nature. For my adherents the measurable quantities of this model were empty concepts. Their own experience was in the growth and decay of organic forms. Eventually they were silenced by the wonder of your laws. You thought you had won. The heavenly bodies had revealed their secret—life had left your image of Man.

But the fight is not finished. Your nature turned out to be the nature of the anonymous observer. The anonymous observer observes probability waves. Of what? Of events? But what is Event? You are mute.

Nature loves to surprise. She reveals when concealing, conceals when revealing. Suddenly the old fight is on again. Neither you nor I could anticipate the form it now

takes. You thought it a matter of course that the question of motion be put to inorganic nature; its motion was obviously the simpler, since the motion of organic nature is a compound of movements, to be dissolved into elementary movements of the type of inorganic nature; i.e., in continuous changes of quantities in Time.

Should you not reëxamine just this 'matter of course'? The ostensibly simple movement whose laws you know is a movement of compounds of elementary movements you assume but do not know. Your pattern of motion falls down when confronted with the smallest of the small. But there is a large scale too it is not able to deal with: the moving of organic life. There is a reason for this breakdown. The same reason holds in both cases: the secret of primary movement in inorganic nature disappears into ever smaller entities; in organic nature it appears in sizes visible to us.

Laws of probability can be expressed in numbers only if many single events are relatively independent of one another. Your inorganic nature is defined by this condition. When this condition is not entirely fulfilled in Nature you speak of organic life. Thus rather than putting the question of motion to inorganic nature you should put it to organic, to the best known part of it, to yourselves. Your definition of physics prevents you. If you did you would fight for me—*inviti atque inscii*—against Galileo.

But I have gone too far. Clinging to your habits you will misunderstand me. I will not tempt you to question the plant instead of the atom, your biology instead of your physics. That would be entirely senseless. Your biology is nothing but the application of the basic concepts of your physics to plants and animals.[5] I see mechanists and vitalists quarrel about the question: 'is the living being a physical-chemical system or not?' A queer quarrel that is, neither party knowing what such a system really is. The vitalist as well as the mechanist thinks according to the concepts of classical physics.

No, gentlemen. The laws you have in biology are just

like those of your physics relative to the anonymous observer. It would not help you to exchange plants for atoms in the shadow of the anonymous observer. You will have to jump this shadow. This is what I exact from you. What that means and how it might be possible we shall discuss further.

IV

EVENT

Your quantum laws account for the distribution of numerical probabilities of something rather mysterious called 'event'. What is an event? As before, you have no answer. Some of you are sure to think that you need no answer. Your observations refer to probability waves. You are interested in calculating observations. An immense work can be and already has been done without an answer. Certainly. I neither distrust your calculations nor slight your tremendous work.

Your physics deals with probability waves of events. But I do not think you can relate the differences of all phenomena to differences of probability waves of events, which are all of one and the same, although undefined, sort. You must concede different kinds of events. For these differences you can only revert to classical physics. I tried to explain yesterday that and why you are not allowed to do this.

In classical physics you define Event by Motion. You call Motion a continuous change of a quantity in time. Classical physics provides you with different quantities quantum physics cannot get along without. But in quantum physics you cannot define Event by Motion. Here is no such preconceived scheme. Here you do not yet know what Motion is. Here evidently Event must define Motion. That is your greatest impasse.

Your anonymous observer vaporizes reality into numbers. Something unsuited to become a number remains: Event. It seems to be a mysterious x, which is counted and combined in your numbers. As physicists you pretend to be interested only in this counting and combining. You

wish to remain within the boundaries you have yourselves laid out by defining your science.

Nevertheless you would like to comprehend Nature. In order to know what you are counting and combining you must define Event. You make an experiment. You have an atom and a maximum knowledge of the psi function describing the physical state of the conditions. Now your observation interferes; i.e., you put a question to the atom. It seems to have various answers at its disposal. Of these, one is given—A not B or C. After the observation a new psi function is valid. The system, called atom, has made a jump. When the quantum physicist does not resort to the concepts of classical physics he can think of such a jump as of the element of primary motion and call it 'event'. But he cannot pretend to have defined it.

Before trying to uncover the elements of a definition that such an idea of a jump might contain I want to deal with your problem of causality. For you all these difficulties converge on it. Your discussion of causality turns on an order of a manifold in space and time. The adherents of causal determination claim that a closed system is completely determined by every three dimensional cross section having an infinitely small extension in the fourth dimension. The cross section contains certain values called parameters. These parameters obey definite differential equations: the laws of nature in classical physics. That is the assertion of physical causality. This assertion is quite clear and distinct. It avoids speaking ambiguously of 'causes' and 'effects'.

In discussing causality some of you seem to oppose a theory of indeterminism to this theory of causal determination. But there are not two theories, two schemes of order. There is only one—the causality of classical physics which the determinists affirm and the indeterminists deny. The indeterminists have no other order to propose. They have no scheme of their own. I do not even know whether they are searching for such a scheme. They merely want to deny, and to prove, that even when deny-

ing classical causality you can calculate in numbers, meaning probabilities for events. The modesty is perhaps forced upon the indeterminist. Within the frame of your basic concepts he cannot offer a theory of his own. But quite obviously the order of causal determination is a very specialized kind of order which can by no means claim to be the sole way in which a four dimensional manifold can be ordered. Nevertheless you speak about your physical causality as though any doubts impinging upon its absolute validity would deprive you of the very possibility of your science. But Science is not restricted to that kind of order.

If I am not mistaken there is some confusion about causality. Many of you, it seems to me, mix up the *principium rationis* with the law of causality. Each ought to be kept distinct. The *principium rationis* binds reason and consequence. When you draw your conclusions in the realm of your mathematics you are inclined to call reason the thesis to start from—say, a given triangle having a right angle. From this you proceed to the Pythagorean proportion of the squares, speaking of consequence. In doing so you refer merely to the process of your thinking. You may also start from the squares and conclude that the angle is a right angle. Then reason and consequence exchange places. This, your habit, is misleading. In the realm of mathematics neither the proportion of the squares nor the right angle is either reason or consequence. The reason is the axiomatic system of Euclidean geometry; the consequence is the Pythagorean theorem. This relation concerns the very beings of mathematical existence, not only your thinking.

Reason and consequence are not interchangeable. There is even not a *progressus* or *regressus in infinitum*, but a first reason and a last consequence. That question, however, does not have to be considered now.

Obviously in drawing conclusions from the right angle to the squares and vice versa you refer between each two steps to the axioms of space. Thus you do not proceed straight from one position to the next. You set a posi-

tion. You go back to the axioms, to add a second position to the first, according to the axioms.

Now as to your causality. Your causality deals with successive states and events in time. Causality pretends that in a closed system a state at a given point of time is entirely determined by the preceding state and determines the succeeding. This is an assumption concerning the order of the Many in time—to be accepted or denied.

Let us look at the relation between this kind of causality and the *principium rationis*. This causality presupposes an axiomatic order that underlies the successions in time and is built in a very particular way. From this reason follows the causal relation between events or states. Thus the law of causality presupposes a specific axiomatic system. You may deny this specific order and yet maintain the *principium rationis*. If there are other axiomatic systems able to cover the order of physical happenings the law of causality would have to give way to another kind of determination. The *principium rationis* would not be shattered.

Therefore your indeterminist cannot be accused of violating the *principium rationis*—the very life of thought. He merely states that the system of physical order may not have the particular structure of your physical causality. This statement turns out to be a pure negation. The indeterminist neither pretends to know this system nor offers any theory concerning its order. He supports this negation by proving that the laws of nature known to us and bearing witness for physical causality result under certain conditions from unknown laws, which on a small scale do not entirely determine the present state by the immediately preceding. More he does not and cannot pretend.

That is the situation. You all feel that you cannot stop questioning here. You have to pass from the pure negation to a positive assertion. You must try to so construct the frame of an order that, from the viewpoint of the anonymous observer, just those laws result that we know on both the large and the small scale.

We shall assume an indeterminist who wishes to change his negation into a positive assertion. I think he ought to look closely at those jumps of psi functions and try to bring out the logical structure implied in such a conception. The psi functions are different before and after the observation. We have to do with a happening that transformed the one into the other. The indeterminist says that the preceding state of the system, described in the first psi function, does not determine completely the succeeding state which the second psi function is assumed to describe. Although well aware that this situation requires extreme caution the indeterminist cannot avoid conceding that the psi functions describe merely possibilities of reactions that might possibly take place, whereas the happening that is directly observed is actual. Therefore he is compelled to distinguish two modalities of Being: possibility and actuality. This possibility is not merely relative to a deficient knowledge; it belongs to the reality of the thing itself.

The mere possibility cannot be the whole reality of the system at any point of time. When the indeterminist attributes the first psi function to a time t_1, the jump to a time t_2, and the second psi function to a time t_3, he cannot pretend that the system at these three points of time is described completely and in the same aspect. At points 1 and 3 he describes the mode of possibility, at point 2 the mode of actuality. He must give up applying the infinitely divisible time to the concept of an event. The event, as the element of primary motion, is indivisible. It joins possibility and actuality in one and the same unity of time. The question of event involves the problem of time.

In any case the indeterminist would have to define the element of primary motion called 'event' as a kind of act that transforms possibility into actuality. But the experience available to him gives him no lead for further steps. He is not able to develop the distinction between possibility and actuality into a conceptual frame of Nature; he remains in the vacuum of mere assumptions. Thus the indeterminist is forced to stop before he starts and to re-

sign himself to a mystery. Thought, even when proceeding without contradiction, remains empty unless it refers to Being. We must question Reality and listen patiently to what it condescends to tell us.

You say you do this. I do not think you do. Before resorting to experience you eliminated the greater, the most alive and intense part of your experience: Man's life, his joys and sorrows. In applying Number to Nature you confined the perceivable to the measurable. Galileo and Kepler reproved my adherents for putting concepts before experience in astronomy. I reprove you for doing likewise. You define experience by a preconceived scheme. Galileo and Kepler were right; I too am right and in a far broader sense indeed.

Your experiments include the observer. They contain two kinds of irreducible events: the selection of these and not those conditions by the observer; the selection of this and not that reaction by the observed. You think it quite natural to disregard the first event and to isolate the second.

In classical physics you questioned the large scale of happenings in inorganic nature where the thing observed is not disturbed in any way by the act of observation. The same thing yields one and the same answer to the same observation. You discovered a most astounding harmony, suited to be represented in numbers and number relations. In the radiance of this discovery you had no reason to recall the excluded part of your experience. You were convinced that finally you would be able to explain the far more complex happenings in the observer by the laws that govern the observed. This faith of yours lasted until the beginning of the twentieth century.

In the development of your discoveries you did away with all my concepts. Whenever you preserved a name you changed its meaning. In your mouths my words dried up. These my concepts do not thrive in your kind of experience. Their native soil and habitat is quite another kind of experience: the part excluded in your experiments —yourselves, life, your desire for knowledge, the move-

ment latent in this desire. You did not and could not uproot these concepts themselves. You merely refuted their application to the visible movement of bodies. This application was wrong.

Very well! But now the situation is different. All your laws of motion in the heavens and on earth are rightly valid. But they concern derived movements, at second hand; they can by no means support your conclusions or give you models of Motion. The discoveries in the smallest of the small compel you to renounce these models and to enthrone as primary movement this mysterious event, the atomon of movement, the x you count and combine in your probability waves. This thing, transforming possibility into actuality, has no place in your design of nature.

Now, to reopen my case against Galileo, I ask you: by what reason, right, or privilege do you exclude the first half of your experiment? If the second event, the observed reaction, fails to give an answer, why do you not put the question to the first event? Are you not obliged to view the experiment as a whole, including both the thing and yourselves, and to build up your concepts and their frame in order to cover the whole and to prevent Being from getting torn to pieces and Man from becoming homeless in Nature?

You seem startled. A very old suspicion rises in your minds. But do not jump to conclusions. If the indeterminist in his present difficulties dared to recall the excluded part of the available experience he would be doing only what he is obliged to do; he would not yet offend any code of Science; his offense would be against your own definition of physics.

I do not advise you, as you are sure to expect, to put your biology in the place of your physics. It would not help to exchange the thing that is to be questioned: plants for spectra of atoms. You would only encounter the same difficulties. You must change your manner of questioning. You must spring over the shadow of the anonymous observer.

Although I scold you for asking the atoms about the

being you are yourselves I do not want you to ask yourselves about the atom. It was my mistake to interpret the movements in the heavens by assumptions developed from living experience. You have inverted this mistake, interpreting yourselves, Life, and living Nature by fragmentary knowledge of inorganic nature. Do not suppose I want you to exchange your mistake for mine. My aim is of another kind, far broader and intended to keep clear of the one mistake as well as of the other.

Your scheme of nature must embrace reality as a whole. You must articulate its unity. You may christen this task as you please—science or philosophy, physics or metaphysics. The name does not matter. The logos of Being revealed in you and in the world surrounding you—that is the kind of knowledge Man by his very nature longs for.

In one and the same breath you must put one and the same question to both parts of your experiments. In putting this question you must step back—far, perhaps so far as to revise the meaning of the 'is' in your questions.

That tomorrow, if you are willing to follow me along so unfamiliar a path.

PART B

THE OTHER WAY

V

CONCRETENESS

TODAY, dismissing the difficulties inherent in your physics, I shall appeal to you as human beings, not as physicists. You will need even more patience; both you and I will need the gracious gods more than ever. I entreat you to forget your physics as well as the Aristotle of your schoolbooks. If any of you should know my writings you need not worry lest the Aristotle speaking to you today here at Cambridge be not the very same who two thousand years ago, at Athens and Stagira, wrote a variety of works, some of which, curiously enough, have been handed down to you. I feel as free as every one of you to revise or to change or even to forget some of my written words. I am faced not only with your tremendous discoveries but also with the labyrinth of misinterpretation into which my philosophy has been drawn by the changing interests of the many centuries and because of my own shortcomings and obscurities. I cannot be blind to your discoveries, nor cling to my errors, nor agree with my interpreters. Moreover, I am more interested in Nature than in the historical identity with myself. But I hope you will credit me with having the same desire and the same reverence for knowledge you concede old Aristotle; and someone among you who happens to be interested in the historical Aristotle might perhaps be induced by my words to reconsider the meaning of my writings.[1]

What is Motion? Hitherto I put the question to inorganic nature, to meet you on your own ground. Now I shall change not merely the thing questioned but the meaning of the question itself. I must go behind your very first assumptions. I return to the meaning of the tiny word 'is'.[2]

What does this 'is' mean? That is the greatest problem. To begin with, I determined this 'is' in accordance with your hardened habits. To you 'is' means that a thing belongs to a certain order, to a totality you call reality or world. This totality you take to be spread out in time and space. A being is determined by its place, role, function in this order. All your answers are of this kind. I started by acceding to this kind of determining.

But by Zeus! Pinch yourselves. You *are*. Give yourselves, I beg you, to the first and greatest wonder. Ask what it means 'to be'! Surely not merely to belong to an order of facts in space and time." It means something in and by which you and this world of yours as a whole and every single being in it happens to be really real, ὄντως ὄν, 'being in a being way'. It means concreteness, inward density, intensity, fullness which you know without knowing. That is the heart of the wonder.

This sense is buried in your souls. It must reawake in you. How can I make a dent in and force my way through the set shell of your habits? You determine your facts by numbers. These numbers, so you demand, must be capable of being connected with potential or actual observations, i.e., perceptions, sense data. If connected with possible sense data you trust your numbers to represent a reality. But your sense data are real not only by virtue of being connected with your numbers. They are the trustees of reality. Thus they must be real in themselves. As physicists you do not inquire into this kind of realness. But your philosophers do. Having a very sound hunger for concreteness they do not want to be trapped in the web of metaphysical concepts, either my own or other. Therefore they start from the undoubtedly 'given', which they call the flux of sensations, the stream of consciousness. Here they believe themselves to be on firm and secure ground.

In these short lectures I cannot lead you from step to step, from conclusion to conclusion, as I ought, cautiously and with all the humility due the greatness of the question. I can only describe what, in my opinion, happens to

philosophers who start from this flux of sensations. They are bound to make strange discoveries. They cannot isolate perceptions. The isolated perception is no longer the perception that was given originally. Something intervenes: the philosopher's own activity. The knower is not the known. The one is as originally given as the other. Either is given only in relation to the other. My sense data are mine, yours are yours. My flux of sensations is not yours. Each belongs to a different unity. The sense data presuppose this unity. They 'are' only as yours. You can hardly build up the self and its unity out of the flux of your sensations. You may say, it is itself a sensation accompanying all sensations and making them yours. But this accompanying would be a very poor description. It disregards the relation between the peculiar perception called Self and the other sense data or perceptions that, though being your perceptions, point to something else that is not you—whatever it may be. This pointing at something cannot be disregarded either. Your flux of sensations is full of a dynamism of intentions, impulses, repulsions, and attractions. It is in these relations, I would say, that the sense data have the realness of their reality. These relations are so diverse that no language can claim to take their richness prisoner. In every moment of your stream of consciousness you resist and demand, retain and repulse, shut and open yourselves, remember and forget, expect and are surprised. You act and are acted on in wish and desire and volition, in emotion, feeling, and thought. It is in a colorful and indescribable tissue of relations between yourselves and your sensations and something referred to by your sensations that you and your sensations and this something are real, concrete.

You may pretend that all these relations belong to the stream of consciousness, within which you wish to remain. This stream then must be articulated within itself. Or you may follow the lead of your perceptions, which, being perceptions of something, seem to invite you to transcend the stream of your consciousness into a second

experience of perceived things. These relations and their interplay, be they interpreted as relations between parts of your consciousness or between subject and object of such a second experience, make up a strange kind of reality. This reality has an inward denseness. You isolate a sense datum—this reality disappears. It is in the dynamic relations, in the tensions of your acting, resisting, suffering that this reality dwells. Your heart is quite aware of this reality. I want your brain to consider it. It is in yourselves, not in an outside world, detached from yourselves. When your pragmatists speak of truth they seem to demand that truth be related to the concrete existence of subjects who act and suffer. Though not agreeing with their doctrine I agree with their desire for concreteness. The concreteness of truth they are looking for is concerned with the reality I have in mind.

This reality seems to have degrees. It can be more or less dense. You have flat and thin moments; others are rich—an inward infinity seems to appear. Consider poetry. All poets lie; nevertheless there is a measure for truth in their very lies. What kind of truth do you concede to Shakespeare? Not concordance with the supposed facts of a past reality, nor truth concerning the world as the order of beings in space and time. And yet truth? Certainly, and even a truer truth.[4] There is more reality in his inventions than in many so-called facts of science.

You know it, day by day through your acting and being acted on, by your loving and hating, your suffering and enjoying, hoping and fearing. You know even as scientists that your own selves are more real, more concrete, more fully 'being' in the triumphs and failures of your discoveries than all the reality in the figures of your number-space. Measured by this your knowledge of your own reality all your statements about the world of physics, all your concepts are pale. You define Motion. But this motion when measured by your own acting and being acted on does not move. To define Motion you use Time. But Time as a dimension of your space of numbers is extended and stands still. This time is not the living time

you are familiar with, marching without rest and respite, turning future into past and ever generating and devouring your selves and your present.

There is in you and in living time an inner density, a concrete concreteness that makes your meaning of 'is' thin and wan. You disagree; I divine your objections. You think I am speaking only of Man, of his subjectivity. No. I am speaking of Nature as revealed in Man. You are Nature; Man is for you her closest and most incisive revelation. There is in your subjectivity an objective reality by virtue of which you 'are'. That is what I am speaking of. It is the soil all beings are rooted in.

In my view of motion I court Being in this sense. On this quest you must not start from an order of the Many in space and time. Being is movement. In movement reality is really real, concreteness concrete, a being essentially 'being'.

Perhaps my point is beginning to show. The question I pose is not put to the world as the order of the Many in time and space, is not concerned with the 'omnitudo rerum'. The inward denseness, not the outward breadth, has to be grasped. What I am searching for I call 'Being', concreteness, Being of beings so far as they 'are'—τὸ ὄν ᾗ ὄν. Substantiality of all beings: that is the question. This Being itself is the supreme judge of all answers to all questions, even to the question concerning the cosmos. Empty is this cosmos and all within it futile unless it is founded in this Being of Being.

I do not invite you to indulge in questions put and answered in a bloodless world of concepts. I speak to you not of arbitrary metaphysics. I speak in the name of experience, but not the experience of your anonymous observer. There is an experience from which the anonymous observer is excluded, something that will confirm or refute our answers, guide our inquiries, restrain us when we tend to comfort ourselves with mere assumptions.

Yesterday I tried a few cautious steps toward the determination of 'event'; to uncover the assumptions con-

cealed in this remainder left by the anonymous observer. I soon had to stop. There was no experience to direct those steps. The new question unlocks the experience we need. Perhaps I can break the ice of your habits and compel its floes to move by addressing the question to your knowledge of yourselves.

Being moves. As moved beings you are concrete. You find in yourselves two kinds of movement, two modes of motion: acting and being acted on. The two are together, the one is in the other. In between them, in between their concord and discord your life lives.[5] Acting you are acted on, being acted on you act. Nature has forged the two together with iron bands. Even in your freest acting, in your researches you are acted on. Your acting is acting only by the strength of the resistance you meet and overcome, or are wrecked by. Enduring between patience and impatience is acting. Every day you go through that experience.

By what kind of a logos are acting and being acted on conjoined? What does acting and being acted on mean? We must persevere in consistently following the course of the unfamiliar question and not slip into any preconceived scheme by saying, for instance, that acting and being acted on are subjective phenomena in the consciousness of a rare kind of beings called Men, existing between other beings in the order of the Many.

You have your being in yourselves and in 'something other' that is not you.[6] These are two modes of your being, equally fundamental. They too are together, of one fabric, and cannot be torn apart. You begin to 'be' by entering into something other than yourselves, the world. Every Ego is born from the womb of a mother as a Tu for her Ego. You exist in both modes. By being something for the world you are in and for yourselves. Concord and discord between these two modes make up your very life.

Yourselves and this other, in which you are, move differently. You yourselves move yourselves. You are moved by something else. In moving yourselves you move some-

thing else; in being moved by something else you yourselves move. All these modes of motion are preunited. When you do not move or are not being moved, you are capable of moving and being moved. In every moment the possibility of motion, even if not actualized, is present, inherent in your reality, as something lacking.[1]

You act in so far as you move yourselves. You are acted on in so far as you are moved by something else. Between moving and being moved, between the possibility and actuality of either, life is suspended. The absent mode is silently present as danger or as need. In the interplay of all these modes of motion you have your life—in their concordance, tension, disunity. All these motions are knotted together. By their being so knotted they and you are concrete.

What knowledge you have of motion is gained by your own moving, by your acting and being acted on. This Motion 'is': here Motion moves, and that relative not merely to an individual or anonymous observer, but to the thing itself, to the pragma in question, which is not a 'thing'.

You know rest, what it is, when the night is still and calm is in your heart; you know that there are different kinds of rest, the rest of weariness, the rest of awaiting, and yet other kinds, each kind of rest being in a different way in between your moving and being moved. And only here is resting Rest. As beings who are restless you are able to rest, as beings able to talk you can keep silent. Rest is absence of Motion.[2] But absence of Motion is yet a presence and in a very real way indeed, be it as danger or want, as fear or as hope. There are as many sorts of Rest as of Motion. Like acting and being acted on Motion and Rest are bound by iron bands—in our very existence.

All this must seem rather unfamiliar to you, alien. Yet we must attempt still a step further, as the time allotted me is short. You move yourselves and are moved by others away from your own moving. Yourselves? What does this mean? Motion is articulated within itself into

a 'Whence' and a 'Whither'.[9] It embraces both; it ties the two together. Motion is Motion by their togetherness.

In your scheme of nature you define Motion by Time. 'Whence' means an earlier, 'Whither' a later point of time. Since Time is mere extension, this definition does not define Motion. Instead of consulting your scheme of nature, ask yourselves, question your own reality in your acting: your own selves as possibility are the 'Whence', yourselves as actuality, the 'Whither' of your acting. The Whence and the Whither are different modalities of Being. The two modes are interconnected in a unity that is not to be divided. In between the two you are at every moment of your life. You are both. You are what you are able to do. Your potentialities, even if not actualized now or ever, are nonetheless part of you. From your potentiality you reach out toward your actuality; from your actuality you are bent back to your potentiality. That is the to and fro motion and tension ever present, at every moment. When we pose the one without the other we disrupt the living reality. Here we face the basic concepts on which my theory of motion stands. From your textbooks you know them by name: potentia and actus.[10]

All that, however, is only the steps to the threshold. We must push on much farther, resolutely keeping to the path pretraced by the question, which is not your kind of question, searching, asking for concreteness, for that in which and by which a being really 'is'.

You are what you are able to perform. Your actuality at any given time is real in its relation to your potential Being, all your possibilities being mutely present. But this potential Being too is diversely articulated: the possibilities of your own selves concerning your faculties, and the possibilities of the external world concerning your environment. One might say: internal and external possibility. They too are interrelated. They move between harmony and discord. They must be embraced in one glance. Their concord and discord are the joy and the pain of your lives. In between the two you are concrete.

Each has its own movement, its own changes. This is merely the prelude to an answer. I only wanted to bring out the drive of such questioning. The concreteness must be grasped; the hunger for reality, for Being spurs on this questioning.

Perhaps the concepts I have used are not yet clear. Behind them may be other concepts. We have to consider the logos that conjoins them. You cannot comprehend one of its members by tearing it from the others. The detached part would cease to be. The parts exist only as a whole articulated within itself, only together. Each is silently present in the others. Only the whole *'is'*. In this whole the inner density of Being resides.

In you are want, hope, joy, fear, and sorrow. Both your having and not having are present one in the other. Just as Night owes it to Day that it is Night, so you owe it to your being acted on that your acting acts, to your moving that your resting rests. You use the word 'concrete'. To be concrete means to be grown together. By being grown together the concrete is concrete. 'Abstraction' means a separation. An element so separated from the whole 'is' only in a non-being way. Thus your time—that infinite sequence of Nows that are not Nows—*is* only in such a non-being manner. You have dissolved the unity of Being.

I am sorry but I am not sure that I have made my argument clear. The subject is difficult. We must hold to the question proper. We are concerned with inward denseness. These forms and concepts cannot yet be applied to the order of the Many, to the structure of the world.

My master and friend, Plato, said: all Nature is 'born together'.[24] This statement, interpreted as a statement about the order of the cosmos, would mean: all the different beings that exist—stones, animals, plants, stars—were born together. That is not the primary sense of Plato's words. Not the Many, distributed in time and space, were born together, but that logos by virtue of which every one of these Many has its being is a unity of 'momenta' that are born together. The body of this unity

cannot be disjointed. Physis means the nature of Being qua Being. This nature is the same in all beings that 'are'. It is the very nature of Nature: this nature is a community of notions interpenetrating one another.[12] It is not the Many of the world ordered in space and time, but the oneness of Being folded within itself.[13] It is this One that needs to be inquired into and comprehended before the Many can be brought into an order. If you fail to comprehend it your cosmos of the Many will be void and vain; its vacuity will suck up all the measurements into which alone the anonymous observer could transform your perceptions.

I am conscious of your unspoken objections. You still think that I am talking about Man, not about Nature—about an inner and extremely subjective experience and not about the experience of the outside world, on which you want to base the so-called objective reality science has to deal with. But you are wrong. I am struggling with something much more objective than your objectivity, which is merely the objectivity of your anonymous observer. I am striving for a kind of objectivity on which that objectivity of yours too ought to be founded. Yes, I am speaking about Man, about your acting and being acted on, your moving and resting, your having and lacking, but for the sole reason that you yourselves are the only reality you are able to inquire into, the only experience that can be viewed from inside, being something in and for itself and not merely for others; therefore the only trustworthy testimony to concreteness. Here, only here the inner density of Being becomes salient appearance, palpable phenomenon.

You must seek in a quite unaccustomed way. Nature is one. The little word 'is' has a double meaning. Corresponding to this double meaning are two senses of the word 'nature'. First yours: the order of the Many in time and space, nature as world. Then mine: nature as 'Physis'; the structure of concreteness so far as the concrete is concrete; nature as Being; Physis, born together, as Plato says.

Nature as world is 'given' as a compound of phenomena in the breadth of space and in the length of time. Nature as Physis is revealed to you in yourselves as inner density of your existing, as substantiality of your Being. Either is experience. To each kind of experience corresponds a way of putting questions: To the first, the question concerning the order of the Many, the frame of this order, the relations connecting the Many, the laws governing the relations. To the second corresponds another way of questioning: inquiry into 'Being as far as it is', into that logos and that community of momenta in which reality is really real. To me the second question is the one to be put first. You lost sight of this question when you separated subject and object. Thus the double meaning of 'is' cleaves in two the meaning of the word 'nature', of experience, the framing of the question, the logos of an answer, and knowledge.

And yet Nature is one. In both senses of 'is', in both kinds of revelation, in both ways of putting questions. This unity is Nature's own secret. To distinguish the two senses is not a whimsy of human thought and speech; the realness of reality imposes it. A mystery divides and unites the two.

It will not do to put the one question without also putting the other. The first, in isolation, leads you to a merely 'Being-to-something else', i.e., the anonymous observer, to an outside without inside, to a world without Being, and finally, to the conception of Man as a physical system. It lands you before the stumbling block of your science, Man being nothing but a compound of events and probability waves.[14] Here the hollowness of your answer gulps up your lives. If on the other hand one were to pose only the second question without also putting the first it would be like one trying to see having no eyes and to hear having no ears.

Being is nothing without a world in which it is actualized, vain is a world that does not reveal Being. Either reading of Nature remains devoid of meaning without the other. Only in each other 'are' they both. Nature

guards the mystery of this unity. She loves to conceal—φύσις κρύπτεσθαι φιλεῖ.[25] Even in revealing she conceals. In ciphers speaks the God.

Thus Nature fools the mortal race of men. I was fooled myself when prematurely I mingled half answers to the two questions, trying to explain human life by the stars, the movements in the heavens by human life. But you who smile at my errors have been fooled even worse. By the wonder of the harmony between calculation and observation Nature has led you astray from the reality you are yourselves into a net of concepts, in which you yourselves are futile, your weal and woes dumb, your experience a paper of ciphers you are neither able nor willing to read: World and Being are disconnected. You have no way of understanding the nature of yourselves in the light of Nature outside yourselves, no way of comprehending Nature as one and the same in ruling yourselves and in ruling the myriads of beings. Thus you feel homeless and isolated wherever you are. Amid your vast knowledge you miss the very knowledge you were born to desire. Never was the secret of Nature concealed more thoroughly than in the revelation of your science. And you sense it.

I invite you to travel an unfamiliar road with me, to inquire into the inward density of Being. From this the concepts by which you order the manifold in space and time must spring. Here they must prove their efficiency. It must be by the same concepts that you order the Many and articulate Being. This is the task Nature lays before you: to draw up a scheme of Being, a system of concepts, axioms, principles, which, embracing your inward and outward experience, will be capable of covering the breadth as well as the density of Nature.

The old name for such a system is ontology. This word implies the unity underlying a double meaning: the logos of Being (ὁ τοῦ ὄντος λόγος) articulating the One, and the logos of beings (ὁ τῶν ὄντων λόγος) swaying the order of the Many. But that double meaning is one. The same concepts must articulate concreteness within itself and order

the manifold, cover the wide, colorful world and your own inner reality. Such concepts must be searched for.

It is in obedience to this task that I stress Motion. Your questions concern motion only in the order of the Many, but motion so conceived does not move. Ask the other question, and Motion will move.

VI

SUBSTANCE

YESTERDAY I asked you to distinguish between two questions. I wonder whether I made myself plain. A trend of thought as foreign as mine may not, I fear, pass beyond your ears. I warned you, however, that we must go back a goodly distance if we are to clear the shadow of the anonymous observer.

Physics, obviously, does not and cannot inquire into the inner density of Being. A quantum of light meets an electron. The anonymous observer cannot look for the concreteness of such a happening. The clash of a quantum with an electron does not reveal a reality allowing inquiry into inner density. It only shows what it is for others, i.e., for the anonymous observer: a half reality. The sole being whose concreteness the physicist can judge is he himself. Kallias strikes Nikias. You may picture to yourselves what the physicist makes of such a happening when he endeavors to describe it in his way.

In objecting that this is not merely a physical happening you would be admitting that there is something before which physics must stop. Or you object that this is too complex an occurrence for our present knowledge of physics? The insufficiency is in the quale, not in the quantum of knowledge. Even if the physicist were to know all the physical data, down to the last point-event, his description would be a failure. It would miss reality.

He can describe such a happening only relative to his instruments and their pointer readings: in its 'Being-to-something else'. But Kallias and Nikias exist not only relatively to something else. They are self-subsistent substantial beings. They are beings in and for themselves.[1] The blow is something for Kallias and for Nikias; it

means acting and being acted on and a mixture of both. This clash can answer the question of inward density which it would be foolish to put to the clash of quanta and electrons. Facing the inner density you will judge and reject the anonymous observer's description.

Kallias and Nikias, I say, are self-constituent beings, beings in and for themselves, not merely for others. They are substances, 'ousiai'. This concept is at the center of my reasoning. You did indeed take it over from me, then took the meaning out of it, and at length banished it altogether from your design of the Universe. I shall not retell the chronicle of its misadventures. By banishing it you exchanged your grip on reality for a world of numbers.

Before I can try to answer the question of motion I must restore the true sense of 'substance'. You read in your philosophical textbooks that Aristotle says substance is not predicated of something else; something else is predicated of substance. Hence it is the grammatical subject in our statements. But this definition of mine is not intended to set grammar right. Because substance has a reality in itself, not merely by reference to others, it is the right and true subject of our sentences. Substance is in itself not only by virtue of our way of speaking. Not everything that happens to be a grammatical subject is Substance. But every substance is subject; i.e., something that has being in itself, something for which and in relation to which other things can be something. To be a substance and to be a subject means the same. That is not the sense of 'subject' familiar to you. As human beings you believe that you are the sole subjects in the world. For this presumption may the gods forgive you.

Substance, I say, is not the persisting substrate of movement. Such a substrate is simply an x about which you predicate. Something, this or that, moves. This x determined in your process of predicating is still related to you yourselves. Its unity, the identity of the x, to which you relate your observations, is still based upon you yourselves. It is not yet a something that has its being in it-

self. When you began to build up the objective world on the measurements of the anonymous observer, substance quite naturally became a mere substrate. Substrate is substance emasculated.[2] But Substance, I repeat, is something in itself. The blow Kallias gives Nikias is what it is relative to Kallias and Nikias, not to the anonymous observer.

I appeal to Kallias and Nikias only to aid me in making you acknowledge beings that have their being in themselves. Of course it would not suffice to say, such a being in itself means something like Kallias and Nikias. You have to determine through what it is a One, a unity, since in your usage it is merely the x, your grammatical subject. Herein lies the real difficulty.

To make sure that the terms I use will be understood I pause a moment. 'One' has two meanings. It means either a logical unity or a numerical unit. In my terminology Being is one. That means, Being is a logical unity, the unity of a structure. But beings are units that can be counted; they are Ones, not one. Keep the two meanings distinct, if you please. I confess that the greater part of all the misinterpretation my writings have encountered is due to the fact that I myself failed to lay stress upon this clear-cut distinction. 'Ousia', the Greek word for substance, means both substantiality and substance. Substantiality refers to Being whose structure is a logical unity. Although there is only one substantiality there are many substances. Substance refers to units, which can be counted.

So I return to Kallias and Nikias. They are substances and have substantiality. They are Ones and can be counted as two Ones. Each is a One, however, not only by virtue of being countable as one but by that very unity of modes united in a logos whose wholeness is antecedent to its articulations. Yesterday I tried to sketch the structure of this logos. In this logos substantiality is logically one—λόγῳ ἕν. By this logical unity of substantiality substances severally are numerically one—ἀριθμῷ ἕν. Substantiality is actualized in substances only; only substances

have substantiality. Therefore the two meanings of One, of Being, of Ousia, which I tried to separate, remain related one to the other. The relation must be grasped as firmly as the distinction.

Not only can Kallias and Nikias be counted as Ones; they must be. They are true and real Ones, substances, Ones in themselves. A substance means a this or that, here or there. In such a substantial One all momenta that articulate the whole of that logos are correlated: acting and being acted upon, moving and being moved, potentiality and actuality. All that and far more is grown together in it: concrete. Such a One is, as I say, a 'Synholon'.[3]

Kallias and Nikias are such 'Ones'. But not only Kallias and Nikias, not only human beings, as you tend to assume. Men you know to be such Ones. You imagine the only ones. From this limitation of your knowledge you deduced Man's eminence. But besides Man there is a manifold of self-constituent beings in and for themselves, standing on that logos of Physis. You cannot evade admitting this; Truth herself compels you.

Disemboweling substance means depriving reality of independence and enthroning the anonymous observer. Restoring substance means jumping over his shadow. Without substance your whole world has nothing to stand on. All the Being you talk about is merely relation or relation of relations, πρὸς ἄλλο τι, Being-to-others. In your world there is only one self-constituent something, for which, related to which the world is: you yourselves, the sole substance in your world.

You would have this world *objective* reality. Therefore you have eliminated yourselves, retaining a πρὸς τί without τί, a kind of Being-to-others without any others. In this mutilated Being all concreteness refers to you yourselves: to your ability to coördinate your numbers with your perceptions. Therefore, when attacked, you retire into a sort of sensationalism, regarding your sensations as primary facts and tying their measurable aspects to your numbers. But only physicists can stop here. Philos-

ophers cannot. They are bound to inquire into these primary facts; here they will and must meet that entire tissue of relations, the objective structure of subjectivity, by virtue of which you yourselves are real.

To put it in another way: Nature cannot be merely an object related to some subject, either individual or anonymous, outside herself. To be simply an object means to be something incomplete, secondary or derived. A pure and simple object cannot stand by itself. Therefore you tacitly pose behind the object something independently real, which is not derivative. But that means substance, subject. Nature antecedes your separating subject and object. She embraces both. Their correlation is what is 'given' first. If you separate the two and break their unity she will elude you.

Look at yourselves! You are beings among other beings, each as something in itself. You exist diversely for others, for the world, for men, for friends and enemies. This 'Being-to-others' is also part and parcel of yourselves.[4] Obviously in a certain way you are and are not what you are to others. You even want to be something to others. To be nothing to others hurts you. Hence even the deficiency belongs to your Being. But this 'Being-to-others' is only one mode of your Being, not the whole. You are to others, others are to you. You receive reality from others as well as give it to others. In give and take, in to and fro, in the concord and discord of both, has your Being the wholeness of Being. Then only are you 'in a being manner'.

As beings who are something to others you face others who are something to you. In the whole of this syngenetic Physis you are concrete, living. You feel it every day in your acting and suffering, though you are not accustomed to express it in this way and to regard it as a genuine feature of Nature herself as well as of human life.

Thus Substance, being in itself, is the first and genuine One—τὸ ὄν is ἕν and τὸ ἕν ὄν. In Substance Being ever holds fast to the One, One to Being.[5]

All the beings you see in the heavens and on the earth

and perceive as phenomena relative to yourselves are each a something in itself, if there is Substance, a genuine One, in or behind it. As substance each of you is a being and a One. Acting and being acted on, resistant in yourselves, you meet the world as the otherness in which you are.

All that 'is' is related to Substance. Thus reality is real, concreteness concrete. Now Rest rests. It is rest of something capable of moving. Now Motion moves. It is movement of something capable of resting, it is the action of a being undergoing action, the suffering of a being that acts, that is moved by others as well as moving by itself, that when resting can move and be moved.[6] In between all these momenta, in their unity, tension, conflict, Substance 'is' and confers Being on things through relating them to itself.

Look at Nature as a whole. Nature is inside and outside you. You are, others are. There is an order of beings to which you belong. In yourselves there is an inner density of concreteness.

To each of the two questions I sought to differentiate yesterday corresponds a meaning of the little word 'is'. Together these questions are a twofold unity, the one being nothing without the other. Substance is integral to both and makes their union manifest. In either question Substance puts the other. The order of the Many, called 'world', is a plurality of Ones. These Ones are Ones, by nature not by human thought. They are autonomous Ones, substances. In Substance the substantiality of the One and of the Many is tethered. Substance unites World and Being. Through Substance World becomes Being, Being becomes World. All other categories are related to Substance. Like Substance they must have their place in both questions and play a double role: they must order the Many and articulate the logos of Being.

Charged with erecting the frame of the order of the Many, these categories should have a meaning in that logos of Being qua Being that is able to cover the inner concreteness. If they cannot perform that service they are futile. On the other hand, all concepts articulating this

Being must be capable of ordering the Many in which this Being is actualized. If they fail therein they are useless. Of one mold are all beings, great and small, yourselves and the world, the inside and the outside, hiding and revealing what is eternally the same.

I have the feeling that I speak to you in enigmas. I cannot help it. The gap severing your way of thinking from mine is too wide. I am in danger of going beyond the limit of what can be explained in a lecture. Philosophy is not won through lectures. It is something to be discussed by friends united by a common desire spreading from a little flame kindled by the God.' Reverence imposes restraint. Conscious of the formidable difficulties I would be content were I successful in opening your eyes to the urgency of the question, if not in convincing you of the sufficiency of my answer, whose shortcomings none knows better than I.

The day is cold to a Negro and hot to an Eskimo. You settle the dispute by reading 50° on your thermometer. You are proud of having found the objective truth, by eliminating both the Negro and the Eskimo. I grant the importance of what you have achieved. Granted, also, that you could not build your wonderful machines without eliminating the Negro and Eskimo. What about reality and truth? You identify truth with certitude. But obviously, truth is concerned with Being or, if you prefer, with something called 'reality'. Truth can have a high degree of certitude, as truth in mathematics surely has, and nevertheless a low degree of 'reality'. What about your 50°? Since it is true for both the Negro and Eskimo you call it objective reality. This reality of yours seems to me to be extremely poor and thin. It is a relation connecting a property called temperature with the expansion of your mercury. This reality does not depend on the Negro or the Eskimo. It is related to neither but to the anonymous observer. You assume that there is a reality and that something in it is represented in the measurements of this anonymous observer. What is it? Obviously not a number. You cannot be content with

knowing that there is something you do not know. Of course you go on inquiring. You find that temperature is connected with the movement of something you call molecules. But in defining movement and molecules you remain within the numbers of the anonymous observer. If you said that temperature or movement is something for the molecules you would be guilty in your own eyes of an egregious anthropomorphism. There is nothing for which a relation could be something—no being that is something in itself, no substance.

Of course, you are quite aware that heat and cold relate 50° to the Negro or Eskimo. You say that the system under observation needs to be enlarged to include the physical happenings within the Negro or Eskimo. That confronts you with two systems in which the gradient of temperature is reversed—cold in the one and warm in the other system. This cold and warm, however, is not yet cold and warm. The Negro and the Eskimo are represented in your systems by a compound of physical or chemical happenings; they are no longer beings in themselves, they are what they are relative to the anonymous observer, a compound of happenings described by relations between measurable quantities. I feel that the Negro and Eskimo are represented in your description rather meagerly. You place the responsibility upon the enormous complications involved in such a system. No, gentlemen, you coördinate symbols but you never describe cold as cold and warm as warm. The compound of physical events, representing the Negro in your description, is not a self-constituent being for whom something could be something. It is relation to the anonymous observer. Physicists can stick to these measurable quantities. For their purposes, that is the right thing to do. But it is sheer nonsense to claim that this is the way to lay open reality. Rather you destroy it. You dissolve your most incisive experience: the unity you yourselves cannot help being. This unity underlies all your proceedings. The anonymous observer, that poor abstraction, refers his pointer readings to your sensations, which have to answer

for the reality of all your numbers. These sensations are not numbers—and they are yours. You are prior to them. No efforts of yours could construct the unity of the self from the continuous flux of sensations. The sensations are what they are on the strength of this unity. They presuppose it. Whatever you do you cannot get rid of yourselves.

All reality is the reality of substances. Substances are here and now, they move and are moved; they are not everywhere and nowhere, as is your possible observer. You may deny that you are inquiring into reality; you may say that physics is concerned only with the correlations of possible sensations. All right; then we agree. But if you pretend to deal with reality, then I must make perfectly clear how I feel about your blundering. I apologize.

Let me return to my point. Reality is the reality of substances. You do not know the substances behind the happenings your thermometer represents in indicating 50°. But you know what the Negro and Eskimo are like —ask them, ask yourselves, ask your pain and your joy, your acting and being acted on. There you know what reality means. There things are concrete. There you know that they *are*. Is it not a matter of course that the picture one draws of the Universe ought to order the Many in such a manner as to let things be what they concretely are; i.e., to unite the breadth of the world and the density of Being? The concepts intended to order the Many must have the power to articulate the One, the logos of Being. The first step is to come to grips with the concept of substance. Substance alone can link the order of the Many, called World, with the structure of the One, called Being. Man is not the only substance, though it is the only one you are sure of. Without the knowledge of yourselves you could indeed never apprehend the idea of substance, wherein the pattern of reality is articulated. Lacking the notion of substance your world has no reality.

I suppose some of you imagine that I am trying to lead you around to an anthropomorphic view, which you de-

test. Far from it. Indeed, I want to liberate you from the sort of anthropomorphism you unwittingly indulge in day by day. All your concepts dwell in the twilight of naïve perceptions and mathematical models. You smuggle into the unreal world of the anonymous observer fragments of your naïve view of Man. Manifestly you feel the need of investing your numerical measurements with a dash of living reality. Half consciously when speaking of force in science you remember the force you feel in your muscles. Illicitly you mix into your time-dimension the directive arrow everyone as a living being is aware of; into your matter the assumed unity of objects which in your behavior you treat as Ones.

This mixture conceals an anthropomorphism, a shift into another genus, which will not do. You start from an order of the Many, dividing the variety of phenomena into classes to be dealt with by the several sciences. You must not transfer your concepts from one class to the other without proof of clear title. Your concepts of force and time falter between different meanings. You have no general scheme on which these concepts are based. You lack the bridge that connects the classes.

Such transitions I neither make nor recommend. I do not separate classes. I inquire into Being. The concepts I am looking for are above and beyond all species and classes of beings. In this way alone can you get rid of the ambiguity inherent in your concepts.

I am making an inversion that may be stranger to some of you than was the Copernican inversion to his contemporaries. My inversion is concerned with the terms subject and object. 'Objective' Being is the Being of subjects as substances, not of objects that are not related to subjects. This Being includes the correlation between Subject and Object that is antecedent to your separating.

About this Being, it is true, I question Man, thus running the risk of being accused of anthropomorphism. To Man alone can I put this question; only his answer can I compel you to accept. But I do not start my inquiry with Man's place in the Universe. That is not the sense of

'is' in my question. I inquire into 'Being', into the structure of the logos by virtue of which a being essentially 'is'. I must keep my answer free from all concepts suspect of belonging to the particularity of Man as a species. I do not use the words spirit or body or soul.

Before closing for today, I want you to consider another point about which some of you have begun to worry. Look at your basic concepts, at your finite numbers of primary measurables. These quantities are connected by rules. These rules are constant. You have a certain number of universal constants. But there is not the slightest hint of any inner necessity by which either these concepts or these constants are connected with or related to one another. Their quantity as well as their quality is casual. They are accidental to one another, side by side. That is a rather awkward situation, though it by no means interferes with your calculations.

If you expect your concepts to reach the realness of reality, they ought to be conjoined as a whole in a logical structure that shows each concept as one-to-others. Such a logos builds up concreteness; wherever you meet concreteness you have to do with such a structure. I might say: your concepts have to grow together—*concrescere*. If they did, your world would no longer lack reality. But they cannot. A link is missing—Substance. It is no use shuffling your concepts or the dimensions of your number-space or your constants. You must build your frame anew and unearth the logos in which your concepts are united.

But it is late. Tomorrow I shall try to hazard an answer to the question of motion. Motion is Substance, moving and being moved.

VII

MOTION

Today I shall have to answer the question of motion. But my answer can be merely an outline of an answer, the pointing out of a possible way which you perhaps might pursue a little farther by yourselves.

Among the founders of your physical sciences Leibniz was certainly one of the greatest, and he is closer to you both in time and thought than I. He differentiated primary and secondary motion. His primary motion is acting and being acted on. To him the motion of your physics would be secondary motion. Primary motion is movement of monades, as he calls the Ones that are in themselves.

What we have to deal with is primary motion. Acting and being acted on are modes of Being inherent in substance. The essence of Being is movement. Therefore Motion and Substance imply each other. Relating Motion to Substance means differentiating acting and being acted on.

Motion links an ἐκ τινός to an εἰς τί, a Whence to a Whither. This Whence and this Whither are as yet not linked to different points of time. They are what they are not yet in an order of the Many spread out in space and time. They are what they are within the structure of substance. The Whence and the Whither may be interchangeable in your order of the Many. In the structure of substance the Whence and the Whither are of a different nature, they are not interchangeable. We shall see how and why.

We can say that living beings are always 'on the way' from a Whence to a Whither—and that not because Time goes on. Forget Time for a while. In acting and being acted on this 'being on the way' has a different meaning.

In pure acting the self-constituent being is 'on the way' from itself to itself, from its innermost potentiality to the actualization of this potentiality: moving itself, by itself, as a being directed in itself. In pure acting the Whence of Motion is somewhat like your inner nature, the Whither somewhat like its fulfilment. In my terminology the Whence is dynamis, the Whither the 'energeia' of this dynamis. This motion is self-movement. It is the joy of all your joy. So your greatest poet says: Joy's soul lies in the doing.

Measured and judged by that self-movement, undergoing action means to be moved. But we are finite beings. Pure acting is not our lot. In undergoing action we move not from ourselves to ourselves, but from one something to another something, neither of which is entirely 'we'. We are acted on in so far as we are moved aside from the way we are on in our acting, we are deprived of our possibilities, our actualities are stunted and shattered.

Thus I say: in acting and being acted on the Whence and the Whither are not the same Whence and Whither. In acting they are yours, in being acted on they are not. But keep in mind that both acting and being acted on are only modes of one and the same Being—that we are always on both ways. We are able to act only because we are beings who are acted on. And we are acted on only as beings able to act. Therefore I cannot take an example of pure acting from your everyday experience. All you call your actions imply undergoing action. Suffering may even be the larger part of your acting. All your suffering, patient or impatient, contains in your resisting a kind of acting. Reaction too contains action.

Kallias strikes Nikias. Kallias seems to act, Nikias to be acted on. Yet Kallias may give way to anger, he may strike in spite of himself—thus he is acted on. Nikias may keep his self-control and suppress his anger—thus he acts. Kallias striking acts and is acted on. Nikias struck is acted on and acts. Suppose you had to grasp the concreteness of that happening. Obviously you would have to relate to the self-constituent entities Kallias and Nikias

all the data you could discover. You would have to know how moving and being moved, acting and being acted on are interlaced both in Kallias hitting and in Nikias being hit. You would have to know something that you call the character or the nature of both Kallias and Nikias, the motives of their action and reaction, their passions, the manner in which each is 'on his way', the Whence and Whither of both their acting and suffering.

When you knew all that and then only would this happening acquire living concreteness, would the blow reveal something about concrete life. I will be cautious and merely say that the tense unity of our acting and being acted on has to do with what I call the concreteness, the inner density of Being, that truth good poets can tell even when inventing their facts.

Perhaps, if the desire seized you to find out what your passions really are—patience, impatience, pride, wrath, hate, love—you might discover that all are kinds of movement, intermingling acting and being acted on each in a different manner. Despite all differences each of these passions implies an interplay of the two manners of your 'being on the way'.

Taking up pure acting I call Kallias' blow 'acting' as far as Kallias therein is on his way from himself to himself. When our acting is pure acting, which it never is, we move from a potential self to an actual self. This is one of the two modes of our 'being on the way'. We are all at every moment 'in between' our potentiality and our actuality. Do not, please, think of these two termini of our acting as cause and effect, or apply Time to them. Time has not entered as yet. Divest yourselves of all your concepts of an order of the Many. Put your mind on the logical structure linking the two terms together in yourselves so that each is the one of the other. If the first term, the Whence, appears to be prior to the Whither, it is certainly not prior in Time, as is cause to effect. Its priority, if there is priority, is by nature not by time.[1] In this reading the two terms would be related as 'reason' to 'consequence'.

These words too are misleading. Here reason does not mean the impulse prompting Kallias to strike. Kallias himself, the potential Kallias, is the 'reason', just as the actual Kallias is the consequence of this reason. As far as Kallias' blow is pure acting the consequence flows from its reason. This 'reason' is, as it were, the soil, the ground, out of which the action grows. It is *ratio essendi.* Disregard your *ratio cognoscendi.*

Look at this queer kind of reason. Kallias hitting Nikias is not the best example. What it may contain of pure action is surely wrapped in a greater bulk of being acted on. Let us choose a better example, say Sappho the tenth muse, singing one of her little songs. From Sappho come forth sweet sounds. Only in singing is Sappho what she is: her own actuality. Sappho silent, the potential singer, is not yet quite what she is: the fullness of her Being. Or better still, consider her language. This language, as pure potentiality of singing, certainly is and is not something real. Only in singing does it become wholly itself, its very own reality become sure of itself and enjoy being real. Potentiality thirsts for actuality. Language wants to be spoken, to sound, Sappho wants to sing.

Sappho's singing will make clearer what I mean when I speak of pure action: the actualizing of Sappho's inner nature, passing from potentiality to actuality. In her singing Sappho moves herself, from herself to herself. In this kind of motion singing, not the song, is the Whither, the end. Our activity is our actuality. Doing is work.[3] My teleology has nothing to do with your means and purposes. Only because our acting is never pure acting and has to be done in a world that is not 'we' must we use means and follow purposes. If we assume a creator this creator in creating the world used no means and had no purposes; he did it out of pure joy, actualizing himself. Pure acting, however, is only the creative momentum in concrete activity.

Acting is merely a momentum of Motion. None of our divers actions is pure acting. Yet acting exists as a momentum, as something by which it may be judged what

in all actions is acting and what is not. We are always 'on the way' from ourselves to ourselves, even when we suffer, when we stand still on this way, when we are kept from it. We are 'directed', even when we err and lose our way. As beings who essentially move themselves we are moved, deviated, restrained. Suffering is what it is in relation to acting. In isolating pure acting I submit to necessity. Speech cannot help isolating. In pure acting the Whence and the Whither are not interchangeable: there is only one way. Here Time is born with an arrow.

Before going farther let us examine the first of these two terms, bearing in mind that it too must not be isolated. A Whence without a Whither means nothing. I would call this 'Whence' a field of possibilities. If that sounds odd to you let me try to justify it. Take the seemingly remote case of a language. Consider the kind of Being you must attribute to your language when you are not actually speaking it. It exists in that mode of Being I call possibility. The essence of language is that it can be spoken. But language is not a mere sum of possible utterances, of vocabulary, and grammar. It is an organized whole, a system, embracing an immensity of possible phrases, styles, manners of good and bad speaking. This mode of Being, I confess, is not altogether easy to grasp. In its innermost life language seems to be animated and governed by something you call its spirit: a thing to be neither denied nor understood clearly.

As beings capable of speech you can conceive of yourselves as being 'in' your language as in a field of possibilities. You yourselves are this field. Its inner life, its hidden spirit is part of you. When you speak you pass from possibility to actuality. You actualize the language and yourselves. Speaking you enjoy your acting: your actuality as a speaker and the actuality of your language. So did Sappho. She sang and her little island and its language sang with her. Thus the whole of a world was generated, emerging from possibility into actuality. An immensity of worlds thus awaits birth.

The basis of what you call your inner nature, your

Whence, is such a field of possibilities. A field of possibilities is a kind of axiomatic system, like one of your spaces, the three dimensional space of Euclid, for instance. The axioms govern the figures that can be actualized in such a space. In the same way the immanent axioms which, taken together, are what you call the spirit of your language rule your speech. Of course you do not know these axioms of your inner nature; they remain secluded. They limit your possibilities; they also guide your actualizing. You may again note for later, that a moment ago I used the term 'space', not yet your space of the order of the Many, but a momentum in the whole of momenta which articulate substance.

Space contains the figures in space as the axiomatic basis contains the consequences. The reason for $a^2 + b^2 = c^2$ in the theorem of Pythagoras is not that the triangle is rectangular. The reason is the axiomatic system of the Euclidean space which links the right-angled triangle to the properties of the squares. This field of possibilities has nothing to do with your electrodynamic and gravitational fields. We are dealing with something far more fundamental. In your view of reality there is no such thing as a field of possibilities or even possibility at all. You deal with actualities after having deprived reality of its reach into the realm of the possible. But the possible too is real in its way.

When you regard your inner nature you will recognize that something like a field of possibilities is part of your reality and that this field is endowed with a dynamic force. You yourselves as such a field are a 'dynamic agens'. There is something urging you from possibility into actuality. This very urge is the lifeblood of your existence. It is directed. There is an actuality of your very own that demands to be actualized: Sappho at her best sings her sweetest song.

Here I touch the edge of an ever greater mystery—the problem of the 'good' as the Ultimate Whither. It is not one for lecturing about. It abides in the Whence and I hope silently attends on all I say. So far as your acting

is acting, you move toward this Whither, though even your best possibilities are always limited and no individual Whither is the Ultimate Whither. Before leaving the Whence I should mention that it has to do with what I called matter. Matter is potentiality. It is not your matter.

Now let me proceed to being acted on. You are in yourselves each one a something in and for itself, but you are also one among others, in something else, surrounded by otherness. You 'are' for others and others are for you. These features of your concreteness are just as aboriginal as any others. They are as old as Being itself. None of you can even conceive of yourself as existing absolutely alone; surrounding you, the Nothing would benothing you in its nothingness. Selfness and otherness are 'concretum', grown together. Together they are one of the immanent articulations of Being itself. Forgive my insistence. The subject is difficult. Man tends to think in terms of the order of the Many, not in terms of Being. Our activities in space and time suggest this way as the natural way, into which we easily slip back despite all efforts.

Applying the concept of the Whence as a field of possibilities to our being among others in a common world we may say that your inner nature as a field of possibilities governed by an unseen system of laws or norms or axioms or codes, and endowed with that dynamic urge for actuality, is merely a field in a field or space in space. This conception of space in space ought to be less strange to you than you might suppose from the sheer sound of the words. Your various kinds of Euclidean and non-Euclidean spaces are spaces in the general space of projective geometry, raising metrical structures on its topological base, forming further a preformed space. In the same way you may think and speak of the different styles of a language as of spaces in space, fields in a field. I am trying, as you see, to keep in line with the concepts of your highly mathematicized science, which I regret not to have known during my life. I had need for such terms.

There are others besides you. Being expands in a plurality of beings. Space is full of spaces. Your individual field of possibilities stands in a more general space, common to you and to others. You may think of this general space too as governed by laws, ordered by axioms valid for you as well as for others. There may even be, as in your geometry, a hierarchy of spaces of increasing generality leading to the odd conception of the still undetermined space of unlimited possibility, which awaits fashioning: a receptable of axioms. That I call ultimate matter, but I do not mean your matter. It is this space Plato speaks of in the Timaeus, calling it an idea, accessible only by a sick way of thinking, assisted by anaesthesia.[5]

In this general space, which is neither your space nor your matter, you and the others-to-you are begotten. The different individual fields are not side by side, unconnected. They are in a more general field. It is in this field that you actualize yourselves as individual fields, and so do the others. Thus your moving changes the fields of the others, their moving changes yours. Referring to your possibilities you must distinguish between an inner and an outer possibility, the first expressing your inner nature, the other representing the situation that permits you to do A and restrains you from doing B. This distinction between your outer and your inner possibilities is but common sense. If your fancy led you to apply the tool of your psi function to the actual situation of Kallias, so translating the field of possibilities into a catalogue of the possible reactions and their degrees of probabilities, such a catalogue would have to be interpreted as the product of two catalogues, therefore of two different psi functions, one giving the probabilities of your reactions founded in your inner nature and in the tendencies of your 'character'; the other giving the probabilities dependent upon the situation to whose stimuli you respond. Members of those psi functions that, impossible either because of your nature or the situation, have in one of the two psi functions the numerical probability zero will disappear

in the product. But psi functions, though excellent tools for your purposes, are rather clumsy implements when applied to Kallias.

The environment in which you are changes. Changes that take place without any acts of yours alter your relevant psi function, your field of possibilities. Even when at rest you undergo change. Every day you have this experience. Time marches on—you cannot hold it back. You may rest, others move. You rest and move in something that moves. So you are moved without moving. You are even moved against your self-movement. The possibilities open to you today may be barred to you tomorrow. You cannot escape being acted on.

But pure possibility is an abstraction. Possibility is nothing in itself. It is what it is through its relation to actuality. Your possibility is a momentum of your reality. You cannot be a mere possibility, you never are.

We shall now approach this difficult matter from the side of actuality. I start from your present individual actuality. This may be your possibility actualized at the moment. It is by no means all your possibilities or the best. It is never quite your own. In this present actuality you 'are' all you are capable of, you 'are' somehow your not yet actualized possibilities. At any moment you may be said to be acting in so far as you move from yourselves to yourselves, actualizing and continuing to actualize your innermost possibility. Acting you enjoy your own selves —and the world. You do your acting as a field in a field that is common to you and to others. In actualizing yourselves you actualize not only yourselves as isolated beings but the field in which you are. In moving yourselves from your potential to your actual selves you move others. Your and their actualization interfere. You and they are something to each other.

Permit me to illustrate the matter by your attending my lectures. I may indulge in the hope that my words may disclose some possibility of self-movement within yourselves, actualizing in you a new kind of knowing. As far as that happens I should say that you are acting and

enjoying acting. I should like to think so but I fear that you simply either feel disturbed in your habitual ways of thinking or remain undisturbed and chafe at the sense of politeness that ties you to your chairs listening to such useless argument. Then it would be correct for me to say that you are acted on. But my speaking and your listening are interconnected. My speaking may actualize a certain possibility of my own. This, however, is done in changing your present actualities. You, in listening, change or resist being changed. You and I, in our present actualities, are what we are in relation to each other.

I return to Sappho, my example closest to pure acting. She sings her sweetest song. Her innermost possibility is actualized in this her singing. She seems, for that short time, the whole of herself: the actuality of her innermost possibility. She sings this song, not that one, she decides on such words and airs, not on others. Unconsciously selecting among different possibilities, she draws a figure in the space of possible figures. Your potential being holds more than one actuality. Choosing means a movement from more than one to one. But this far from characterizes the passing from possibility to actuality. Sappho in singing moves; in moving she moves others. Her actual song enters the world of others. The potential song may be naught to others; others may not be moved by your potentiality, they need not even resist.

You are something for yourselves in being something for others. This being for others is part of your selves, of your full reality. Sappho may sing; there may be no one to listen to her. Nevertheless her singing is certainly actual. Even when singing in solitude she moves the air; her tune soars over the meadows and the bushes and birds and flowers may listen. Sappho might feel unhappy if nobody heard her. She might want her chorus of maidens. Even when singing only for herself she sings for the otherness in herself, for another Sappho to be moved by her song. There is no escape: to and fro, giving and taking, you are for yourselves in being for others; you are

for others in being for yourselves. So your acting and undergoing action are yoked together—by necessity.

In beating so narrow a path through so dark a region I doubt that you can see the way. Do please remember the particular train of my question. My task is to articulate concreteness, not to order the Many in space and time. What I am looking for I might call the abstract skeleton of concreteness—a question that may never have been put to you or even dreamt of by you—though it lies at the core of your everyday experience. These poor concepts of mine are meant to be preliminary. I do not flatter myself that they are the ultimately right ones. They may, however, give you a few hints for your own inquiries, if somehow your own difficulties, which entoil you more and more, should arouse in you the need for my way of questioning.

Let me recur to the reality of Kallias striking Nikias. They are both substances, true and real Ones, units not to be divided. They are both moving and moved, 'on the way', in a double sense. By the unity of these modes of Being they are 'subjects', substances in themselves. Each moves and is moved in relation to himself. Reality here does not depend upon an outside observer.

To you possibilities are not real. An observer who happened to be of your cast of mind would insist that the actuality expanded in actual space-time is the whole of reality. He would try desperately to connect the actualities located at different points of this space-time by means of your straight-line causality. Therein he is bound to fail. But his failure is glossed over by a lot of ambiguous concepts such as faculty, will, wish, spirit, mind, which do not fit into his scheme and which he therefore shuns defining. He would be like a physicist who tried to describe a three dimensional datum in two dimensions. These ambiguous terms, and there are more—'matter' for instance—fall short of representing on the plane of actuality something belonging to the dimensions of possibility.

Maybe Kallias has been provoked; he reacts by strik-

ing Nikias. Nevertheless, the reaction contains a bit of acting. He may be moved by anger, yet he moves from possibility to actuality. So does Nikias responding to the blow, even if he merely offers Kallias his left cheek.

Kallias and Nikias, though being moved, move from the possible to the actual within the range of their possibilities, actualizing one of them, be it germane or more remote. In their action the two modes of being on the way are intermeshed. Their moving and being moved is acting and being acted on and is living and concretely concrete in the tense unity of those and other momenta of Being. Your observer, by his own method, is certain to miss this 'realness' of reality. He may mutter something about the irrationality of such a happening. But the irrationality is irrational only in reference to the flatness of his ratio.

I realize, of course, that what I have said traces only a few contours of the conceptual scheme I seek. I dare say they will seem to you rather dim. But it would gladden me were I permitted to push on into the concreteness of Being that you are yourselves and to inquire into the logic of your hearts, your passions, filling in this meager scheme of Motion with the living colors of your life. You would be astonished to learn to what these concepts, when properly developed, are meant to lead. I must, however, keep within the scope of these lectures which are restricted to your physics.

Motion is related to Substance. Substance eliminated, you define Motion by Time, Time by Motion. But your time, being mere extension with neither the arrow nor the marching Now, neither comes nor goes. This time is not able to make Motion move. Tomorrow we shall discuss Time.

VIII

TIME

Your motion connects an actuality at a time t_1 with an actuality at t_2, later than t_1. The Moon moves from A to B. The assumed identity of the Moon as a substrate and the continuity of the change permits connecting A with B in the unity of one movement. You pretend to be satisfied with this scheme. Nevertheless it is a mere abstraction. What we are after is the concreteness of both Motion and Time.

Kallias or Nikias is not only his momentary actuality, here and now. Behind and beneath his present actuality, related to it, is his potentiality, as piece of his reality. Kallias and Nikias are what they will and can. A Whence directed to a Whither. Let Kallias move from one actuality to another. Both actualities are present at different points in your time dimension. They seem to be connected by a straight-line causality. But are they really connected? Causality in science means merely succession according to a rule—if A precedes B follows. We demand more. But then we must transcend the plane of actualities. We do it, we all do it. You ascribe to the actuality A such things as faculties, tendencies, impulses, vectors, forces. All these undefined words serve only to cloak the mode of reality I call potentiality. They presuppose a kind of possibility that is real. Kallias is the potential Kallias, the Kallias who can strike. The potential Kallias moves from one actuality to another. He is neither the first nor the second. He is more than the one and more than the other. You never are merely your momentary actuality.

The two actualities—each single actuality between them and even all together, taken as a whole—must be related to the potential Kallias. The movement from actuality

to actuality includes another movement—from the potential to the actual. The beginning of this movement is the potential Kallias, not the actuality present at time t_1; the end is the actual Kallias, not the actuality present at time t_2. This beginning and this end, the Whence and the Whither of acting, are not separated by a stretch of time. They must be thought of as synchronous. This movement does not consume any time at all. One might say that it happens suddenly in a moment without duration[1], if it ever could happen separately. But it cannot. Acting cannot be isolated.

Once more I recur to Sappho singing. Sappho sings. Words and melody grow out of her. In this creative act there are two movements. One leads from the first sound to the last; the other leads from the potential to the actual song. What is the end of the second movement? Not the concluding sound but the whole of the first movement extended in the straight-line time of actualities. Allow me to apply the term 'event' to any movement of the second sort. The pure event set apart has no extension in straight-line time. Being directed it has an arrow. It cannot, of course, be isolated. This timeless time is the time of creativity, one feature of concrete time.

The actual song is extended in time. If, however, you isolate the second movement, the actual song as its end would be extended in a present without past or future. If Sappho's singing were pure acting, she would be not only godlike but God; alone with herself. In singing her song she would create an eternally present world.

In isolating pure action we are confronted not only with a timeless motion, called 'event', but also with a spacelike time in which the Whither of the creative event expands. That is another feature of concrete time: time as extension. There are forms stretched out in time like a patterned rug. In such a One you see the whole at once, the end in the beginning, the beginning in the end—each part containing the whole. Listening to a perfect piece of your divine music, say a Bach choral, you feel the succession in time as a simultaneous whole. Were your own

life pure creation it would be but one work, extended in a time that is space.

You are, however, not allowed to live such a life. Even the flowers are not. There is no acting without suffering. Concrete time has more than these two features. Even Sappho, the born singer, when in a mood nearest to God, suffers. She is in a world that is not herself. In this world she sings. In actualizing her song she must move others and be moved by others. The world resists and interferes. Sappho must overcome the otherness surrounding her; she must force the world to become her world: her song is her victory. Therein Time reveals a new feature. The time of being acted on is the order of Earlier or Later of interfering events: the time of the world surrounding Sappho. This time and its merciless pace carries Sappho with it; in this time the pure creation has its place at t_x, the pure creatum has to expand from t_1 to t_2. The Now passes along this path. The singing Sappho must proceed from sound to sound. As the song pours forth the things in the world keep changing and she must conquer again and again. A past forever determined is gone; a future impends to be determined. The time of being acted on enters into the time of acting and the two intertwine. Here we encounter a third feature of concrete time, the striding Now. All these momenta of time, however, are born together; none can be isolated.

Thus in articulating Substance we articulate Motion; in articulating Motion we articulate Time; but in all this articulating we meet one and the same logos of momenta, interconnected by an eternal necessity: the logos of Being. Nature's very nature.

Let me interpolate here a few remarks in defense of my greatest error. I mean my theory of the movements of the heavenly bodies. Astounded at the firmament I took the stars to be substances actualizing their innermost nature in shining circles, urged thereto by the Ultimate Whither: by the unmoved mover who moves all things, as the beloved, through inspiring love, moves the lover.[2] My error is patent. To you it seems even ridiculous. The stars are

not substantial units. They are compounds of units unknown to us. Their paths are not primary movements. But though wrong about the stars, it may be that I am right about Motion. The Moon, as I thought, not only moves from a place A at a time t_1 to a place B at a time t_2 in the plane of actuality. She actualizes her very own actuality in drawing her shining circle, moving from her potential to her actual self. So does Sappho in singing. As the movement from the first to the last sound of her song contains the motion of acting, so the Moon's movement around the earth contains the movement from her potential to her actual self.

Surely I was mistaken about the Moon. But even my error is nearer the truth of motion than your scheme is. Your scheme, stretched on the fiat space-time of your actuality, cannot explain Motion. My scheme includes at least the creative momentum. Without it Motion cannot move; Being cannot 'be'. My mistake lay not, as I am sure you think, in introducing acting into the Moon's movement, but in my failure to include suffering.

The Moon is not a One. She is not one substance. Therefore she neither acts nor is she acted on. The moon of mechanics is an abstraction. The concrete moon is a compound of an enormous number of events. The really real movement is concealed in these events which we cannot decipher. What presents itself to our gross view may be the result of the vast struggle of unknown entities acting and being acted on. A blind necessity issues from the large numbers playing their game. Where I imagined I beheld a divine order there is only a cruel fatality immuring all acting and being acted on in the smallest of the small.

Thus you cannot find, as I tried, in the miracle of the shining heavens the mirror of your hopes and desires, revealing the pure actuality of beings enjoying eternal happiness in joining the ends of their circles with their beginnings. Indeed, behind the Moon's luminous circle you might rather imagine the fatality of a general trend, corresponding to the fateful drift which under certain conditions in the history of Man sweeps with it all human

endeavors, frustrating men's actions and drowning their ephemeral worlds.

Motion is Life. All that 'is' lives. The life we are acquainted with is only a small part of the living world. But every part that is a real and true One, Substance, encloses the whole secret. The logos of Being articulating concreteness governs Man as well as star and stone though you can neither know the true Ones in star or stone nor read their apparent motion as acting and being acted on.

The world of your physics is finished before it begins —an accomplished work extended in time, a realm of established laws, *natura naturata*. This world does not move except relative to an observer whose time is provided with both the arrow and the striding Now.

Nature includes law giving. Nature is both *natura naturata* and *natura naturans*, each only in relation to the other. Neither can be isolated. The absence of law giving is the crux of your cosmogony. You feel that yourselves. I need not insist.

Your world is the plane of actuality. Your laws relate actualities to one another. They are verified by experience in a stratum detached by the anonymous observer from the totality of phenomena. Its content is the behavior of classes and aggregates. So far as certain conditions prevail—and they do prevail in your large scale inorganic world—the plane of actuality is governed by your sort of physical laws. Hence your straight-line causality.

But the plane of actuality is not the entire body of reality. Reality embraces both actuality and potentiality, the surface and the depth, in which the real Ones are engendered, from which they strive to emerge. These real Ones, called substances, relate actuality to potentiality. At every moment they are in between their concord and discord. They move and are moved, act and are acted on. All are both *natura naturans* and *natura naturata*, law giving and law given, creator and creature.

We are now ready to survey the problem of time. What

is Time, if you start by assuming that 'is' means more than to connect one name with another name. In concrete time, past and future are present in each other. An inexorable Now strides ahead, begetting and devouring itself. In this time the instant of your creativity is linked to the duration of your patience. Past and future are separate, yet remain connected in you yourselves. The one is forever decided, the other is yet to be decided. Your past grows, your future diminishes. In memory and expectation you are in a manner what you are no longer, and you are already what you are not yet. Thus you are always leaning backward to a past whence you come and forward to a future whither you go. Both are one-and-together. Time links your becoming and passing. In your growing you wane, waning you grow. You begin to die in the hour of your birth. You cease to be born in the hour of your death. At the same time you are young and old; you are even, as Plato says, younger and older than yourself, at every moment of your life.[3] In you yourselves Time is articulated; in you the fullness of its momenta are grown together.

This is concrete time.[4] I call it the time-structure of Being. The time of physics is an abstraction, a mere dimension of a number-space. In this time you are confronted with the same problems as in your space: the continuous line of points—the order of Earlier and Later—shorter and longer stretches defined by words like 'between', 'include', 'overlap'—the problem of measurement—Time measuring Motion, Motion measuring Time. This time has no arrow. Earlier and Later are mere names which may be interchanged by different observers. There is no absolute direction that can be preconceived.

Obviously if the time-dimension is to be distinguished from the space-dimensions, we have to discover, first, where the arrow, then, where the marching Now originates. You screen the difficulty of the problem by introducing the arrow of the observer. You ascribe physical values to points of time and refer them to observations made by an observer who is familiar with an absolute

order, where Earlier and Later are not interchangeable. You draw Time's arrow from Life. You are quite right except that you do it unwittingly. Earlier and Later must be differentiated relatively not to an observer but to the thing itself which, expanding in time, forbids their being interchanged.

They cannot be differentiated by means of the notion of a mere substrate. You assume something that remains identical, one and the same something during continuous change. But this something proves to be nothing: a grammatical subject in your arbitrary speech, an x about which you choose to predicate. The substrate could bear Time's arrow only if an absolute determination of Earlier and Later were implied in its very nature. But the substrate as such has no nature at all.

You are talking about systems, whereby you mean entities of a continuous part of space-time which you may assume to be closed. You discover the second law of thermodynamics. A certain quantity called entropy happens without exception to increase in time, i.e., in the same of the two directions of a dimension called time. Here you imagine that you get hold of an absolute Earlier and Later relative not merely to an observer but to the 'system' itself. Such foundation of Time's arrow is rather fragile, for diverse reasons. When a system is in thermodynamic equilibrium, entropy neither increases nor decreases. Your systems are compounds of events. The second law of thermodynamics, being a statistical law, deals with the behavior of aggregates. Therefore it does not say anything at all about the single event and its structure. There is yet a third reason. You seem to count the amounts of energy in a rather dubious way. By discriminating between free and bound energy you are in position to borrow the amount of free energy required from the store of bound energy: and so to save the second law in any contingency. You will certainly proceed in this way if confronted with a system of decreasing entropy. But I let that pass since you feel that on this point you can do without old Aristotle.

For these and other reasons I cannot agree that such a system can sustain Time's arrow. The second law makes assertions about systems, which are somehow derivative. Although that is not saying they do not reveal something of the utmost interest.

You must look for another sort of system. When you refer the Earlier and Later of the observed conditions to the acts of observation and thus put the observer himself into the system to be observed you are obliged to concede that at least this part of the system called the observer is himself a system, relative to which Earlier and Later are differentiated in an absolute manner and are non-interchangeable. Here Time has an arrow. The Earlier and Later of the observer's birth and death are absolute. No observer can place death before birth, birth behind death, unless he refers to the birth and death of different individuals.

Thus we pass from the time of physics to the chronological time of history, taking the first step toward concrete time: the chronological time of history may be called the order of couples of birth and death, one birth conjoined with one death, the different couples overlapping. Caesar's birth is earlier than Caesar's death, later than Cicero's birth, and so forth. This chronological time has all the features of the mathematical time-dimension, plus the arrow. This time is directed, is a one-way passage from birth to death. There is no returning.

In chronological time, however, we have not yet reached concrete time. When you look only for the arrow you may content yourselves with ascribing birth and death to points in time and ordering them in couples. Such order of couples ignores all other relations implicit in the peculiar system of relations called 'substance'. Do not forget that the observer is himself such a system, and therefore has to acknowledge these other relations too.

The Now cuts Time in two parts, Past and Future. This Now goes onward unremittingly. We must perceive the absolute distinction between an ever increasing past and an ever decreasing future. For this march of time

there is only one foundation. Possibilities progress to actuality. This is the primary movement, so Now wanders apace. The past is the actualized part of possibilities, the future the part waiting to be actualized. The past ever increases, the future decreases. It is beyond your power to change the past, an absolute impotence; you *may* be unable to change the future, a relative weakness.

You might consider Time's arrow to be based upon the second law of thermodynamics, but never the marching Now. Therefore I prefer to base the arrow of chronological time upon the absolute difference between birth and death. Although birth and death are by no means the Whence and the Whither of that primary movement that actualizes possibilities, they find their definitions in their respective relations to our possibilities and actualities. Here the arrow and the marching Now have their common source.

You can eliminate substance, if you like. But if you do, you deprive both Time's arrow and the marching Now of all supporting argument. And you cannot rid yourselves of them, nor can you enjoy letting both waver specterlike through your number-world. You *need* substance. Slowly we draw nearer the concreteness of Time. So far we have provided the dimension of time only with an arrow and a marching Now. This time is still an abstraction.

The marching Now does not simply cut straight-line time into two parts. The parts remain connected. Future is the future of a past; Past the past of a future. You cannot speak of one without implying the other; ignoring that means renouncing reality.

In your own living Now three presences are spliced together:[5] the Present of the past, memory, and the Present of the future, expectation, beheld in the present Present. You still are your past, being already your future. Thus Now severs and unites.

I doubt that the concrete fullness of memory or expectancy can be described in terms of the straight-line time of past, present, and future actualities. Memory does not

merely retain and recall past actualities of former Nows. Expectation does not merely anticipate future actualities of later Nows. In both a certain movement is concealed that connects not only present with past and future actualities but also your potentiality with your actuality. In remembering you do not merely go back to past actualities. You remember what you were from the beginning, your potentiality, your inner nature with its secret rules and tendencies. The learning child remembers what he never knew. That is Plato's Anamnesis. You go back to the 'Whence' of your acting in every moment you are fully alive; when not, you lose yourselves.

You remember past actualities. In recalling them you select, modify, distort. A struggle goes on—unconscious, conscious, or subconscious: past actualities grip you; you endeavor to master, to retain, to fuse them in yourselves; you strive to remember and you are compelled to forget, you try to forget and you are forced to remember. You can and must; you ought and you ought not to remember and forget. Without respite you are building up, pulling down, rebuilding, transforming your past in line with your changing actualities. In this continuous activity memory and expectation are interconnected—expectation makes you remember, memory makes you expect. Just as the task of memory is not merely to recall actualities but also to hold you fast to your inner nature, the 'Whence' of your acting, so expectation is by no means merely directed toward the actualities that will really come to pass. In expecting you relate the anticipated actualities to the whole of your actuality, waiting to be actualized; i.e., to the Whither of that primary movement, just as your remembering relates past actualities to the Anamnesis that retains your Whence. You fear and hope. Expectation is suspended between fear and hope. In fear and hope you relate future actualities to the motion carrying you from your Whence to your Whither. By virtue of this relation you define and differentiate fear and hope and their joy and pain.

You will never be able to comprehend the concrete in-

terplay of past and future by merely connecting past and future as parts of your straight-line time of actualities. You must draw in possibility. Then you transcend your concept of time as a line of Now-points, to each of which belongs a given actuality. I leave it to you to clothe this sketch of memory and expectation in the colors of concrete life. Day by day you face all sorts of tension arising from these interlocking movements.

The endeavor to grasp the concreteness of time leads us to the whole of momenta cemented in the notion of substance. We must go beyond the time-dimension of the order of the Many. But the time we so transcend is an abstraction. Concrete time is the time of substance. The skeleton of concreteness must be taken as a whole; it allows no separation. Marching time stubbornly going its way is what it is only in union with your being directed toward a Whither that is 'telos' but not future, or so to say, with a timeless time in which 'suddenly' your soul begets the creative Now. They are consanguineous. The logos of substance uniting the creator and the creature, *natura naturans* and *natura naturata,* is the logos of Being—to be enjoyed and to be endured. The moment you borrow the arrow of your physical time from the observer you introduce substance and must accept it as a whole with all its momenta.

There you have concrete time. Together and inseparable are the arrow and the marching Now, the divide between future and past, the unrelenting pace, rest, the timeless 'suddenly' of the creator in you, the constraint of the created. In their tension concreteness is concrete. The reality of time is the reality of motion.

From here you can go back again on the path of your abstractions to your time and to your motion: time standing still as mere extension, a motion that does not move. On this way back you get rid first of the whole realm of possibilities, and so of the interrelation of future and past, then of the marching Now, and finally of Time's arrow. At every step of your abstraction you desiccate Substance, and with it Time. By so doing you dissolved the

logos of Being. Now you stand holding dead limbs in lifeless hands.

A mere shade may be allowed to tell the living a bit about death. Death means the end of life in time. But there are two ends: the end of your life in the straight-line time of actualities, your last Now—Death. Mark the other end: the 'telos' of that primary movement from your potentiality to your actuality: your pure 'energeia', the acme of your existence. Both ends belong to you throughout your life, though you often miss the one and forget the other. They belong to you as momenta of your very nature. They are conjoined, now in concord, now in discord. You enjoy your acme and your fullest actuality as beings doomed to die. You die as beings striving toward a telos, reaching or missing it. What death is, it is concretely by virtue of this very urge: it is determined by this relation. Each of you must die your own death. Some die too late, having outlived themselves as shadows of what they once were; some die too soon, leaving their futures behind, cut off at the start of what they might have become and never will. Death ends you before or after your end. Ending your acting and being acted on, death is at once cruel and tender. You must curse and praise it; and whether it is curses or praises you bestow depends on how the two ends are interwoven in your death.

Life and death are born together, as are your growing and decaying, acting and suffering, having and not-having. One and the same logos has welded all nature in every breathing moment of every being.

For me who am dead there is no death, and therefore no time. There is only the empty time of your physics, which is not time at all. There is no arrow, no marching Now, no past and future. Time is the time of the living, striving and failing, resting and moving. For me there is neither rest nor restlessness; only a mere extension without anything to be extended, stretched out in "death's dateless night".

IX

THE ONE AND THE MANY

Although I have been speaking of Man and have endeavored to capture the concreteness of life I have refrained from using any of the handy terms mind, soul, body, emotion, sensation, volition. Such terms would, of course, have made it much easier for me to describe Man's acting and being acted on. But I am not concerned with Man as a specific being among other beings. My aim is not a doctrine of Man. All those familiar terms are undefined. You may know vaguely what you mean by, say, emotion: something like feeling angry. If I were to carry over concepts so loosely defined to the entities of your physics and talk about the sensations, emotions, thoughts of atoms or electrons, you would be right to prosecute me for anthropomorphism.

In my search for concrete motion I have sought to use words and concepts that should be applicable both to the reality behind physics and to human life. You may reproach me for proposing concepts that lack definiteness, that flit about in a hazy dusk. I do not deny my shortcomings. I admit the deficiencies in my terms. But I am not sure you are entitled to such an objection. Your concepts are applicable only to the physical world of the anonymous observer. They are not clear and distinct unless you remain within a mere number-space. They are accurate only in an empty world.

Take Matter. Try to lay hands on it. It will vanish and pretend to be something you call Field. Track down Field. It turns out to be a kind of space to the points of which you ascribe vectors standing for forces. Try to seize Space. It is vacant, waiting for fields to be engendered by Matter. Take Force. You find Law, as a geometri-

cal quality of space. I need not dwell on these difficulties. You acknowledge them yourselves when you speak of the mystery of matter.[1]

Let us see how these concepts respond to my way of looking at Nature. Space in general is a mere receptacle —a field of possibilities waiting to be ordered by axioms, a mere nothing waiting to become something. The *nihil privativum* not *negativum*. In this space other spaces are generated; for instance, the general space of projective geometry. It too is a field of possibilities.

This space of possibilities is not the actual space of your physics, nor is it even something like an actually empty space—if there be anything like that. In the space of possibilities certain values are not yet determined. An actually empty space would be something different. It would be a possible space queerly actualized; it would be a sort of actualized zero. Such a space I do not believe exists; whereas the potentially empty space 'exists'—as a mode of reality.

Now as to your fields. Your fields of force are actual fields. Your flux of fields is a continuum of actual fields extended in time. But these actual fields are possible fields that have become actualized. They are related to an underlying real possibility from which they arise. Your biologists have just started to commit themselves to speaking of biologic fields. I do not know whether they conceive of these biologic fields as having a particular structure or as being like the physical fields.

If the top of a living fir tree is cut off, one of the nearest branches will turn upward, changing the bilateral order of its ramification into a radial one. Or observe a growing cabbage building up its head. I do not see how such a happening can be understood if the plant is conceived of as obeying an actual physical field of force. I would rather conceive of the plant as a field of possibilities, endowed with something like an urge to actualize a certain form and capable of doing so in different ways. Maybe I am wrong. But I hope some day or other you will think it over. The conception of a biologic field may

possibly induce you to differentiate actual fields and fields of possibility, which are related to each other. Perhaps that would help physics too and make it easier for you to deal with 'matter'.

Did you not recently, at your international symposium on cosmic rays in Chicago, speak of the mysterious jungle of atomic nuclei and of the "darkest Africa of Matter"? Be sure, this Africa will be darker the further your anonymous observer is able to penetrate it, the more facts the distorting mirror in his hand registers. It must. All your difficulties converge on this impasse.

And now, Matter. When you take hold of Matter—a bit of Matter here and now—it becomes to you nothing but a physical field of force. Thinking about the physical field of force and its changes you feel you need something that produces and agitates such a field: Matter reappears as a 'dynamic agens'. So you endow Matter with a kind of double nature. In that you are right. But note: this double nature is not contradictory, nor is it something to get free from. The doubleness is unity, articulated within itself. The field of force is the present actuality of a field of possibilities which strive to actualize themselves. That is 'matter'.

Enough, on this point. All I wanted you to concede is this: your own concepts contain and conceal the distinction between actuality and possibility. You boast of the exactness of your science. But this exactness attaches only to the numbers of your measurements, not to your ideas of what you measure. The latter are far from accurate.

You may wonder whether I really think that physics could gain something from this distinction between possibility and actuality. Physics as the science dealing with Nature certainly could; physics as you define it by your methods could not. Even your mathematics cannot as yet treat fields of possibilities as wholes which, as such, have vectors. Perhaps your mathematicians, when facing such a task, might develop means to deal with such wholes;

but to that end they would probably have to go a little farther beyond your straight-line number-space.

The main thing, however, is the correlation of possibility and actuality in substance, not merely their distinction. Substance relates possibility and actuality as modes of Being. Only by means of substance will you be able to comprehend possibility and actuality, space and time, matter and field, as constituents of a Whole articulated in momenta. In your present view they are side by side. Nevertheless you define one by the other and some of you feel uneasy about your definitions which look so much like truisms. They are tautologies but not in a way that ought to worry you. They say the same thing, certainly. Matter talks about space, space about field, field about force, and force about matter. But all their talk refers, though you are not aware of it, to substance. They are interconnected in substance as momenta of one and the same logos.

In what way and sense should the concepts of your physics be related to one another so that you might be happy about your conceptual scheme? You are not worried about circular definitions when you define father by child, child by father. Why not? Because in this case you are sure of the tie that relates the one to the other and makes father the father of a child, and child the child of a father. Obviously this relation is prior to the relata. You actually do not define one by means of the other but each by means of a whole that is articulated within itself.

In your physical concepts such a whole is lacking. There is reason for some uneasiness on your part. Such a feeling is rather helpful. It gives us a lead, it calls to knowledge. You think, however, you can get along without such a tie. You measure velocity by your watch, weight by your scales, you refer the pointer readings of each instrument to different perceptions, and that makes you certain that these definitions are mutually independent. But now another difficulty arises. You have the choice between two possibilities, neither of which is satisfactory. Either you mix your sense perceptions into the definitions of your

concepts or you content yourselves with taking them as mere measurable quantities; i.e., dimensions of your number-space. Dimensions are independent directions. But there is no difference between them. You have only a set of characterless quantities. If you undertake to determine their differences in quality you must refer to your sensations or to the instruments by which you measure the quantities. I understand quite well that this situation bothers you occasionally, at least in moments of pausing between your merry calculations.

Why? Because your concepts or your dimensions are accidental. How are they, how should they be related to one another? As father and child. And so they would be related, were they the right concepts. Your space is not space-to-time; your time is not time-to-space. Your space-time is not an authentic whole, articulated in four dimensions. The physical contents you ascribe to the points of your space-time are an aggregate. They too are accidental. No one is implied in the others as father is in child.

I shall do whatever is in my power to make perfectly clear what I mean. Take the three dimensional space of your Euclidean geometry. We can start with a multiplicity of elements and order the relations between these elements in a set of axioms. Thus we build your space from elements which precede the whole. A point is a point, be it the point of a line or of a plane or of a solid. But obviously a point is nothing. We may also start from the whole. We may demand that the whole be prior to its parts, unfolding itself in three dimensions. In the geometry of such a space there would be nothing but figures of three dimensions. A line would have the length x, the breadth o, and the height o. A point would be a sphere of the radius o.

You say, that makes no difference in geometry. Certainly not, because geometry takes no interest in the reality of its figures. There is no geometrical reason for treating just the three dimensional, not the two or one dimensional space as the unity to start from. But what,

if you want your scheme to fit real things, or even the realness of these real things?

I suppose that for a complete description of a real point you need 16 numbers, 4 standing for space and time, and twice 6 for gravitational and electrodynamic quantities. You are not entitled to leave out any of these numbers; you must retain even those with the value o. This o, too, belongs to reality, just as in my example of space. There a plane is a three dimensional thing which lacks the third dimension. That is *privatio*, not *negatio*. If you omit one or more of these zero quantities you deal with abstractions, no longer with physical things. And this is the case not only when you speak of geometrical lines, planes, solids, without including time, or of a time-span without space, but also if you deal with electrodynamics without including gravitation. Even there you would have to carry with you symbols for the properties whose value is zero, if what you talk about is supposed to represent something that could be real.

You may think that easy to concede but a silly demand. You do not comprehend the reason for the demand and sense no need of complying with it. Why not? Why do you miss nothing when you leave out some of your numbers? Because there is nothing to clinch your concepts. Concreteness is syngenetic. Your concepts also should be connate. Each must be the one of the others-to-it, just as the father is father to a child. But your space is not space-to-time, your space-time not space-time to your fields, let alone the contingency of gravitation to electrodynamics.

It is perhaps just on this point that your own difficulties may direct you to the general problem. You are working hard to unite your physical world in one world geometry. You hope Einstein will solve the problem. But suppose he succeeds. All depends on whether his solution would merely mean that all your quantities and vectors had gathered in a common geometry, or that they are knit together in the unity of a whole, in which each member is the one of the others-to-it. It is only such a logos that can concrete the concrete and make reality real. You can

verify that in your moving and being moved, in your joy and your pain.

I doubt that you will ever encounter this logos on your way, no matter how much farther and farther you travel, how many more and other astonishing things you discover. Again and again just that in which the realness of reality resides will elude you. It must. For a simple reason: you have surrendered to the anonymous observer. He does not and cannot know anything about this logos. The anonymous observer registers pointer readings. He discovers differential quotients which represent the relations between the changes of his numbers. But he has no concept of the unity in which all distinctions originate. He knows no substances, therefore no substantiality. He cannot. He was even right in eliminating substance. Substance would be an alien within his methods.

Here you are blocked, fenced in by your own procedure. You have enthroned your anonymous observer. You are his slaves. He stands between your physics and your knowledge about yourselves. Nevertheless by no means would it be of any use to introduce into the conceptual scheme of the anonymous observer the distinctions and concepts I have ventured to propose. I am far from making such a suggestion. These distinctions, transplanted from their native soil to your scheme of nature, would lose their interconnection and correlation in the notion of substance. Separated from substance they become separated from one another and can no longer say what they want to say—like single letters which have lost their word.

Thus an abyss gapes between the world of your physics and your own living reality. You may be worried by it; you may desperately try to connect the two kinds of experience or to look for a common system of basic concepts adequate to cover both. In vain. In passing from one kind of experience to the other you change the point of view. In passing from your physical world to the experience of yourselves you abandon the anonymous observer. In passing from your life to physics you subject

yourselves to the anonymous observer. As you change your point of view all your concepts change their meaning. There is no such abyss in Nature herself. You are responsible, not Nature.

The ultimate goal of science is, so I say again, a frame of concepts that will cover both the physical experience of your anonymous observer and your inner concreteness. The Many are ordered in time and space. The One is folded within itself. If any concept claims to concern reality it must mean something in the order of the Many as well as in the structure of the One. There must be a principle of correspondence between the basis of that order and the momenta of this structure. You must look for this correspondence. The place to look is the problem of motion. Once you understand Motion you will discover that the outward and inward infinity of Nature reveal the same secret. It is but the anonymous observer's view which, in eliminating substance, disjoins the categories ordering the Many. If referred to substance these categories are forced to join; conjoined they must correspond to momenta which articulate substance.

If you ever happen to succeed in working out a 'construct' in which your physical concepts are a whole, one implying all the others as father implies child, I feel confident that these concepts would lead you to corresponding ones that articulate the inward denseness, the Being of substances. Then your physical and mental experiences would meet.

May I dare an even bolder statement? The dualism of Matter and Mind is what most troubles your philosophers. Indeed, their matter and their mind belong to different worlds. They start with a dualism of mental and physical experience and carry it over into their scheme of reality itself and separate a world of matter from a world of mind.

But what is Mind and what does Matter mean? I have intentionally avoided all such terms as body, soul, mind. They are misleading and have been abused for hundreds of years. Maybe I myself am responsible in part. Let me

try to ferret out the common root of matter and mind. Motion unites a Whence and a Whither. You must begin with their unity. Turning to dynamics you utter the word 'vector'. But consider what this term implies. A directed quantity. It enables you to deal with something you call 'force'. A directed quantity combines numbers in a unity. In this unity a Whence is referred to a Whither, a Whither to a Whence. Let us disregard the mathematical form and reconsider this unity. There is no Whence without a Whither, no Whither without a Whence. One is the one-to-the-other. One contains the other. It makes no difference whether you start from the one or from the other. Think of yourselves! In you a Whence and a Whither are united. By their unity you are Substance. When in acting you move from your Whence to your Whither it is equally correct to say that your Whence is pushing or that your Whither is pulling you. Neither has priority.

Let us turn again to matter and mind. It is from Motion that you have to start. Matter and mind tell the same tale. If you glance at the Whence you may say 'matter'; if at the Whither, you may say 'mind'. You have two aspects of Motion to deal with, not two different things. In saying one you imply the other. There is no such thing as matter without mind, mind without matter.

You stumble over this unity even on your own path. Mind has never been introduced into your conceptual scheme, matter has nearly faded out. But something has remained: a mysterious 'dynamic agens' producing and inducing fields. Does not such a definition of matter, if it is one, look very much like a definition of mind or of 'spirit'? Is not that just what spirit does? Induce and engender fields, systems of norms and forces? So did Dante and Homer and Plato, and the founder of your religion. Matter and mind tell different aspects of the same story provided they happen to be defined instead of only being vaguely connected with perceptions in which their separateness is preconceived.

If in reading my books you never lose sight of the con-

cept of the unity of motion you will discover that in referring to substance I speak of matter and form; in referring to motion, of potentiality and actuality. But the unity of substance is the unity of motion. The one implies the other.

Now I hazard a further step. You infuse the dichotomy of body and soul into your dichotomy of matter and mind. Thereby you cover up the unity in which both yet remain united, despite their difference. But whereas the distinction between matter and mind resides in that twofold unity of Whence and Whither, in distinguishing body and soul you would have to start from the unity of your acting and being acted on, saying soul when you speak of your moving yourselves, and saying body when you refer to your being moved. Thus bodies would have the ability to move themselves so far as they are and have souls; souls would be capable of being moved so far as they are and have bodies. But in any case do not isolate either the one or the other. No self-constituent being moves without being moved, or is moved without moving; no such being is a body without soul or a soul without body. Neither would be substance. Your belief in dead matter is just as mistaken as your belief in a life of souls in heaven and hell. Both are abstractions.

You object? You bury the body of your friend who has died—this body is real. Surely, but not as a One in himself, no long as a being who is himself to himself. The dead body is no longer your friend. It is only a One—πρὸς ἄλλο τι—for something or somebody else; for instance, for the men who carry it away. Death dissolves the unity and extinguishes this substance. Life does not end. This man dies. Being is immortal; all beings die.

I shall attempt another step in the fog of inherited distinctions. As human beings you want to be credited with having not only souls but something called spirit. You may even remind me that I myself differentiated soul and spirit. I did. But again you must go back to the starting point, that unity of motion that unites Whence and Whither. All beings are directed toward a 'Whither'.

Soul means the potentiality of moving one's self. Man, a being ἔμψυχον μετὰ λόγου—animate and endowed with 'logos'—is capable of knowledge. Other beings may be blind; he can behold the end toward which he is directed. Thus Spirit is Soul's eye.

But ignore this chance digression in which I dealt ambiguously with ambiguous terms. You would do better not to use these terms at all. It is late. Thank you for your patience.

X

NATURE AND MAN

As this is my last lecture it will be well to summarize my argument. I started by unfolding the manifest and the hidden difficulties of modern physics about which some physicists, fascinated by their discoveries, are not troubled, while others begin to worry. Next I tried to justify my demand for another way of questioning the unknown. I made a distinction between Being and World. I put the utmost stress upon Being, upon the inward density of concreteness. I wanted you to doubt the meaning of the littlest and the greatest word, 'is'. If I have not succeeded in this point at least in some degree you may forget these lectures altogether. They will have profited you nothing.

I venture to say that Reality has both an outward breadth and an inward density. Countless phenomena are spread out in time and space. They seem to be ordered by different kinds of relations. Let us call this aspect 'world', the order of the Many. You transform these phenomena into measuring numbers and refer them to the anonymous observer. The other aspect is less familiar to you and foreign to your science. Reality has an inward density: not the numbers but the beings like yourselves that are self-constituent. Your anonymous observer eliminates such beings. They 'are', however. This aspect of reality I call Being.

The two are correlated. They must be seen together. The one must help you to decipher the other. Their relation precedes the relata. This secret is far beyond the power of my words. Sometime, perhaps, in a timeless

moment, the gods will reveal it to you. Then be quick to seize it. They will surely cover it up again.

You divide Science into different sciences, either by dividing the Many into groups, referring animals to zoology, plants to botany, or by detaching layers from reality and making arithmetic, geometry, kinematics deal with things so far as they are countable, spacial, or moving in space. The difference between the two procedures is obvious, although often disregarded. In your definition of physics you jumble the two.

Zoology permits animals to be animals. It professes to be interested in the entire reality of substances, called animals. So does physics with its part of reality. But I doubt that physics deals with the entire concreteness of its entities. Its interest is restricted to a detached stratum corresponding to an axiomatic system wedded to instruments which transmute the phenomena into numbers.

The two classes of science differ in their relation to Reality. The first class divides the world into parts. The world as the order of the Many can be divided. One can speak concretely about animals without speaking about the stars. The second class cuts Being into layers. But Being cannot be cut. One cannot speak of space without speaking of time, of numbers without entities to be counted; one cannot speak about waves of probability without something that is probable, unless one renounces concreteness. That means: the Many can be ordered in groups, each of which retains the entire substantiality of its substances. Substantiality itself is a whole of interconnected momenta which cannot be separated.

I am convinced that this unity of Being is found in every one of the many substances, provided they are true and real Ones. Wherever we dig down to the bottom of reality we shall meet the same Physis, Nature's nature. All beings are kin. Being itself is analogous in all beings. Things differ widely in their, may I say, knowability. But your scale for this quality is the inverse of mine. You start from the order of the Many and believe that the phenomena of the physical world lend themselves most

the mirror that might possibly distort the image. He may find not much more in the way of conclusions than the minimum conditions of an abstract order.

The physicist can go no farther. An immensity of diverse realities may respond to these conditions. But the anonymous observer is not allowed either to picture such realities or to prefer one to another. He cannot take the hurdle of the anonymous observer's shadow. The anonymous observer deals with probability waves of undefined events. That is your cosmos. I think you are not much pleased with this cosmos, though on the large scale the play of great numbers flattens the waves of probability to the straight line of the probability-value limes 1. Your cosmos is a void. Reality has evaporated into numbers.

If I applied my way of thinking to your discoveries this cosmos would differ widely from the cosmos of my books, of course. It would no longer be modeled on the stars as eternal substances actualizing themselves in shining circles. It would, however, remain a cosmos of substances. It would refer the phenomena to substances. In Substance the building blocks of reality are mitered. But our knowledge of the inorganic world is not knowledge of Substance. We could at best assume that behind and beneath the spectacle of the inorganic world there move and are moved an immensity of substances of unknown nature, which produce in the anonymous observer's mirror both your classical laws governing the behavior of compounds in the way of your causality and the quantum laws dealing with classes of events and probability waves. In atoms and electrons, in stones and stars we may revere one and the same Nature which makes us kin to all created beings. But here once more we must resign.

Another experience, however, enables you to refer events to substances. Consider human history. History is a part of Nature. It is, to Man, the image of the cosmos. Consider the play of births and deaths enacted before your eyes. Here Motion moves. Here you know what an Event is. From the boundless sea of possibilities actualities emerge, change, and sink. Generations of mortal

easily to arrangement in a lawful and transparent order. You overlook the fact, however, that you succeed only by transforming them into numbers. I start with the inward density of Being. There Man is obviously the one of all beings best known to Man, the one knowable in relation to himself. In him the realness of Reality discloses itself. There is only one window through which we can look into the interior of Nature. This window is Man himself, though Man's eyes be weak, the window commonly dirty, cobwebbed with errors, including mine.

Now allow me to turn from ontology to cosmology and to glance at your cosmos and mine. Your cosmos is relative to the anonymous observer. In it there are no autochthonous beings which are either something in themselves or something in relation to which other things are what they are. You insist on referring your pointer readings to an observer whom you place outside the physical world. You supplant the individual by the anonymous subject and so attain an intersubjectivity, not an objectivity, unless you use this ambiguous word in a much limited sense. This intersubjectivity is still not Reality, as the word objectivity would suggest. Your physical world is an intersubjective phenomenon, connecting and ordering in a marvelous way certain subjective phenomena of every possible observer.

This number-world of yours is still not the cosmos. It is the message of a cosmos. It will reveal something if deciphered, but it needs deciphering. Your physics is not and cannot be concerned with deciphering. Physics resigns itself to calculating undecipherable numbers.

Classical physics believed in absolute laws. In these laws at least the structure of a cosmos seemed to show. The modern physicist, however, if interested in a picture of the universe, must establish the minimum conditions an unknown order must fulfil to yield the kind of laws an anonymous observer observes. He would have to find them by a highly mathematicized reasoning. He must try to draw an inference from the image in the mirror to the thing mirrored, taking into account all the qualities of

men thrive and wane—societies, races, tribes, cities, realms, empires, religions, and civilizations battling one against the other. Worlds in the world grow and decay. The gentle breath of graciousness and the moans of sorrow, the shining deed and the dark misery, love's smile and the rattle of death—they rise together to the seats of the unmovable gods. The past curbs the future and releases it, begets it and strangles it; the bodies of uncompleted worlds half rise above the surface and disappear. Others are choked before they can emerge; others again dry up and ossify. The debris cover the bones; a few only remain visible in the pale light of memory and yet are but bones.

Laws, habits, conventions, virtues, vices, and their ranks and values, the names and images of gods varying in space change in time. And yet Man, the ever new being, is what he always was and ever will be. An unendingly changing world weaves the same threads into ever new tissues.

Man is the substance of history. To him all is related. He acts and is acted upon, he moves and is moved. The space of history moves and is moved. Thus Man moves in a moving space. Man is the maker of history. History makes Man. Either aspect is true, either alone is false. Man is both the worker and the work. As creator he is creature, as creature creator. Past is scar and treasure; it constrains and nourishes him. Future is hope and fear; success and failure. Out of a timeless past he moves into a timeless future; and so acting is his own creator. But acting he is acted on; leashed to the relentless pace of the ever marching Nows, wedged between the movements of the others and their order, compelled to accept his past and future from other hands, as the creatum he is—the powerful powerless man.

So you know Being—the realness of reality. Try to grasp the iron logos welding together the inseparable joints of this Being; you will find it at the bottom of whatever you choose to look into: in Babylon and in Manhattan, in the life of the individual man and in the fate of

the greatest empire; in primitive life as well as in your latest civilization; in the remotest past and in the farthest future, not of your utopias, but of the concrete actualities that your dreams when actualized would turn out to be. A firm hold on this Being will save you from sliding off into the void of bodiless abstractions.

But Being is by far broader than Man. There are plants, animals, stones, and stars. To them all you are kin by the same Being. The realness of their reality is also yours. They are Man's brothers and sisters. But they are not what they seem to you. You do not know the 'Ones', the substances to which their appearances have to be referred. You do not know the true entities. You know their appearances. Thus, looking at the heavens you may dream of an immense struggle of the unknown entities of smallest worlds, emerging and sinking away in a time-span none of your clocks can measure, but which, nevertheless, could be as long as your life, if measured by their own scale. You muse over the movements of the stars or their incandescence and cooling, the speeding waves of all sorts of rays; in short, over all the mysterious laws of physics, and envisage the ineluctable fatality, as which such struggle must present itself when viewed on so large a scale. If you could view these appearances as you view human history you would, perhaps, discover that their spectacle is not ruled by your kind of physical laws nor is it the pure actuality of the blessed beings I dreamt of; but that it is, like your history, a vast web of acting and being acted on where threads of joy are interwoven with strands of pain.

Whereas the anonymous observer of your physics is restricted to admiring in his laws the play of a sheer fatality governing the unknown existence of unknown entities, precluding any analogy to human life, you are free to assume that the so-called organic part of nature is just where living entities grow into visible volumes. There is no real cleavage dividing Nature into an inorganic and an organic part. In both Nature is one and the same. Your eye only and its peculiar qualities and limita-

tions make the division. Organic nature only carries forward the life of inorganic nature. There the substances, the real Ones, unrecognizable in inorganic nature, become manifest; there you cannot eliminate the notion of substance. You kill the plant when you dissever its unity. Thus your biology, guided by your physics, flutters in its answers between the accuracy of chemical and electrical laws that never touch life and the vagueness of analogies to human acting and suffering that never touch accuracy. You can analyze a flower, but not being a flower yourself you will never be able to relate what you observe to what it may be in the flower's life. Nevertheless, you are neither compelled nor entitled to draw the conclusion that there is no such relation. Look at the uncountable varieties of plants and animals on the earth and in the seas and revere their secret. It is your own secret, the secret of Nature, revealed to Man in Man, and spread out in the immeasurable profusion of human history.

Give yourselves to this mystery and stop separating Man from Nature. If you wish to elevate him above all living beings, do so without degrading Nature. I myself endowed Man with a particular distinction. All is animate, but Man's soul alone has speech and thought. Man alone can know.

This distinction harbors a danger. Maybe Man can rise above all other beings if he lives up to his distinction. When he fails to do so he sinks below the lowest animal. Concerning some of Man's achievements you might say that in him Nature seems to culminate, but you will admit that in no plant or animal can Nature so completely run amuck as in Man. Man can be the best and the worst of all beings.

Man alone, so I said, is capable of knowing. Knowing what? You know infinitely more than I. I must humbly confess that it is not your kind of knowledge I had in mind. Your knowledge is concerned with means. The knowledge I had in mind is concerned with ends, not with means. In all your knowledge of means you seem unsure of your ends. Idolizing your means, you take them for

ends and rush along in a senseless race for ends that are merely means. Stones, perhaps, live in darkness, with neither error nor truth. We may assume that plants and animals live in the dusk of dumb impulses and pressures.[2]

You boast of the high degree of your consciousness? But of what are you conscious? If there is distinction, if this distinction is knowledge, this knowledge is of another sort. It is knowledge of Being itself. It is in itself the end. Its perfection is Being's pure actuality, the Ultimate Whither through which all ends are ends. Though perfection is beyond Man, Man, in his highest moments may graze the edge of this knowledge—and there he recognizes his end.

The souls of men, when they draw near to the logos of Being, are like charcoal which glows and becomes transparent when brought near the fire and darkens again when withdrawn.[3]

Before rejoining the shadows below I thank you again for having invited me. If my reasoning seems odd to you, do realize please how queer your concept of nature seems to me. Maybe it is too soon to reopen my case against Galileo. My breath, however, is longer than yours. You may smile at my argument today and forget it tomorrow. When rulers of another breed run the enormous machines of your states and use your discoveries as means for their ends, and everywhere thought is banished into secret societies, you may one day be disposed to ask my question and ponder my answer.

NOTES

LECTURE I

1 Aristotle, Metaph. A 1.
2 That is the meaning of the term φύσις at the beginning of Greek philosophy.
3 Cf. Kepler, *De Stella Nova in Pede Serpentarii*, Op. II, 693 ff; Galileo, *Lettere intorno alle Macchie Solari:* "Nec sum ignarus, quam haec opinio sit inimica philosophiae Aristotelicae: sectae magis quam principi est diversa. Da mihi redivivum Aristotelem...."

LECTURE II

1 If mathematicians object that mathematics does not resort to time to define motion, this Aristotle would turn this objection in his favor. He would argue: Phythagoreans are right: τὸ ἓν ἀεὶ περιπατεῖ—the One always walks on. The transfer of one number to another number involves an operation, a creative step, the acting mathematician. If numbers proceed, thoughts, not numbers, move. If a modern school of mathematics bases the series of integers on creative steps, not only motion and time's arrow but number itself presupposes action.
2 Discussed by Aristotle, Phys. 239 b, ff.
3 Aristotle, Phys. 226 b, 229 b.

LECTURE III

1 Cf. Schrödinger in *Die Naturwissenschaften* (1935, No. 48-59).
2 Heisenberg's 'principle of indeterminacy'.
3 6.55×10^{-27} erg-seconds.
4 A. S. Eddington, *The Nature of the Physical World* (Macmillan, 1930), p. 237, uses a similar example for another purpose.
5 Biologists will disagree, pointing to biological concepts that do not depend on physics. Aristotle, however, could easily defend himself by analyzing these concepts which either lack accuracy or presuppose the Aristotelean 'potentiality'.

LECTURE V

1 This book aims by no means at a complete interpretation of Aristotle's views of Nature. It emphasizes one current of thought implied in the Aristotelean ontology. The notes refer to Aristotle's writings mainly in order to support, by Aristotle's own words, this emphasis which is unfamiliar to most interpreters. Where there is no reference Aristotle is not held responsible for the views advanced.

2 Socrates asks: What is this or that? This question implies the question: What is the 'is'? τί ἔστι τὸ ἐστίν. The problem of determining this or that presupposes the task of determining determination. This is the problem of Plato's 'dialectics'. All his dialogues converge on this question.

3 This Aristotle resorts not to his physics but to their very fundament in his 'first philosophy'. The scholastic scholars differentiate 'metaphysica generalis' from 'metaphysica specialis'. The latter deals with theology, cosmology, anthropology; the former treats ontology. Neither Plato nor Aristotle can be understood unless the inner life of the ontological problem is reanimated. What is Being qua Being?

4 Aristotle tries to suggest a meaning of 'Being' that permits speaking of 'more or less being'. He emphasizes the differentiation of two questions which he occasionally mixes up in his writings. But in his time philosophers were aware of both; now the one is forgotten and needs to be stressed.

5 'In between' is Plato's μεταξύ. Plato uses the term when speaking of Soul's Life. Eros being in between wealth and poverty is both wealthy and poor. Soul's wings are both light and heavy in between an upward and downward drive. 'In between' relates two terms to each other.

6 Plato, Parmenides (XII ff): the 'One' that participates in 'Being', τὸ ἓν μετέχον οὐσίας, is both in itself and in something else. Plato, in such statements, does not play with contradictions, as most interpreters assume, but tries to unfold the structure of Being. The genuine sense of his 'dialectics' has been neglected by the philosophical tradition and rather spoilt than revived in Hegel's transformation.

7 The scholastic scholars call this presence 'modus deficiens'. The term of Aristotle is στέρησις. When something that belongs to a system is lacking it is present as absent.

8 In Aristotelean terms: ἐρημία στέρησις κινήσεως.

9 ἐκ τινός—εἴς τί.

10 δύναμις—ἐνέργεια.

11 τῆς φύσεως ἁπάσης ξυγγενοῦς οὔσης. Plato, Menon 81 D. Aristotle speaks of Plato as of his master and friend. Despite two thousand years of battle between Platonism and Aristotelism, Idealism and Realism, Plato and Aristotle might fairly be supposed to join in opposing the modern concept of nature.

12 Plato: κοινωνία, συμπλοκὴ τῶν ἰδεῶν, emphasized in Parmenides, Sophistes.

13 Aristotle stresses a point that most interpreters miss. Metaphysics, III 2, differentiates πρός τι from κατά τι. The latter preposition subsumes similar things under classes; the former relates one thing to another thing. The notions belonging to 'Being' are πρὸς μίαν φύσιν; they refer to one and the same nature, to a unity, which they articulate. Potentiality and actuality, matter and form do not divide the Many into classes—κατὰ γένη καὶ εἴδη. There are no things that are matter without form, form without matter. All beings as far as they 'are' contain the one and the other and relate them to a unity. Therefore these notions accompany one another ἀκολουθοῦσιν ἀλλήλοις. In this unity of a logos all beings are analogous, ἀνὰ τὸν αὐτὸν λόγον.

14 The 'nothing but' attitude in modern thought; cf. Wolfgang Koehler, *The Place of Values in a World of Facts* (Liveright, 1939), Ch. I.

15 Herakleitos, fragm. B 123 (Diels).

LECTURE VI

1 Only such beings have 'Physis'. Cf. concerning the link between physis, motion, and substance, Aristotle, Phys. B I, 192 b 13.
2 Aristotle, Metaphys., Z 3.
3 Aristotle, Metaphys., Z 11, 1037 a 29, Z 3, 1029 a.
4 Aristotle seems to give three of his ten categories a higher dignity: οὐσία, πάθος, πρός τι. The first actualizes itself in the second and third, in acting and being acted on and in relation to other beings. Substance is essentially related to others as a being among other beings. The Aristotelean system of categories, however, is far from clear (cf. Metaphys., 1089 b 20; Prantl, Logik, I, 190).
5 Plato, Parmenides, 142 E; cf. Aristotle, Metaphys., 1003 b 23 ff.
6 Aristotle, Phys. III, presupposes this correlation.
7 Plato, Epist. VII, 341 D

LECTURE VII

1 Cf. Aristotle, Metaphys., Z 1029 ff., dealing with the question of the priority of ὕλη and εἶδος.
2 Cf. *ibid.*, ϑ 8 1050 a.
3 Plato Timaeus, 52 B: μετ' ἀναισθησίας ἅπτὸν λογισμῷ τινι νόθῳ.

LECTURE VIII

1 Plato, Parmenides, 156.
2 Aristotle, Metaphys., ε 1072 b 3.
3 Plato, Parmenides, 152 ff; cf. note 6 to Lecture V.
4 "Scrivi la qualità del tenpo, separata dalla geometrica", *The Literary Works of Leonardo da Vinci*, ed. by Jean Paul Richter (Oxford University Press, 1939, II, 138 (917).
5 Augustinus, Confess. XI, 17 ff.

LECTURE IX

1 Cf. Eddington, *op. cit.*, pp. 260 ff.

LECTURE X

1 This is not the *analogia entis* of Thomas Aquinas. Thomas Aquinas, though starting from Aristotle's Metaphys. Γ 2, inverts the meaning: he replaces Substance by God and changes immanence into transcendence; cf. note 13 to Lecture V.
2 "L'uomo à grande discorso, del quale la più parte è vana e falsa, li animali l'ànno piccolo, ma è utile e vero, e meglio è la piccola certezza che la grã bugia." *The Literary Works of Leonardo da Vinci*, II, 246 (1184).
3 A metaphor of unknown origin, related by Sextus, *Adversus Math.*, VII, 130, and pointing to either Herakleitos or Poseidonios.

INDEX OF NAMES