Meeting of the Aristotelian Society at 21, Bedford Square, London, W.C.1, on 13th October, 1958, at 7.30 p.m.

I.—BACK TO THE PRE-SOCRATICS

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I

'BACK TO METHUSELAH' was a progressive programme, compared with 'Back to Thales': what Shaw offered us was an improved expectation of life—something that was in the air, at any rate when he wrote. I have nothing to offer you, I am afraid, that is in the air to-day; for what I want to return to is the simple straightforward *rationality* of the Pre-Socratics. The simplicity and boldness of their questions is part of it, but more important still is the critical attitude which, as I shall try to show, was first developed in the Ionian School.

The questions which the Pre-Socratics tried to answer were primarily cosmological questions, but they also dealt with questions of the theory of knowledge. It is my belief that philosophy must return to cosmology and to a simple theory of knowledge. There is at least one philosophical problem in which all thinking men are interested: the problem of understanding the world in which we live, including ourselves, who are part of that world, and our knowledge of it. All science is cosmology, I believe, and for me the interest of philosophy as well as of science lies solely in their bold attempt to add to our knowledge of the world, and to the theory of our knowledge of the world. I am interested in Wittgenstein, for example, not because of his linguistic philosophy, but because his *Tractatus* was a cosmological treatise, and because his theory of knowledge was closely linked with his cosmology.

For me, philosophy as well as science lose all attraction when they give up that pursuit—when they become specialisms and

cease to see, and to wonder at, the riddles of our world. Specialization may be a great temptation for the scientist. For the philosopher it is the mortal sin.

II

In this paper I speak as an amateur, as a lover of the beautiful story of the Pre-Socratics. I am not a specialist, nor an expert: I am completely out of my depth when an expert begins to argue what words or phrases Heraclitus might have used, and what words or phrases he could not possibly have used. But when the experts replace a beautiful story, based on the oldest texts we possess, by one which—to me at any rate—makes no sense any longer, then I feel that even an amateur may stand up and defend an old tradition. Thus I will at least look into the experts' arguments, and examine their consistency. This seems a harmless occupation to indulge in; and if an expert or anybody else should take the trouble to refute my criticism, I shall be pleased and honoured.

I shall be concerned with the cosmological theories of the Pre-Socratics only to the extent to which they bear upon the development of *the problem of change*, as I call it, and only to the extent to which they are needed for an understanding of the Pre-Socratic approach to the problem of knowledge—of their practical approach as well as of their theoretical approach. For it is of considerable interest to see how their practice as well as their theory of knowledge is connected with the cosmological and theological questions which they posed to themselves. Theirs was not a theory of knowledge that began with the question 'How do I know that this is an orange?' or 'How do I know that the object I am now perceiving is an orange?' Rather, their theory of knowledge started from problems such as 'How do we know that the world is made of water?' or 'How do we know that the world is full of gods?' or 'How can we know anything about the gods?'

There is a widespread belief, due I think to the somewhat remote influence of Francis Bacon, that it is better to study the problems of the theory of knowledge in connexion with our

knowledge of an orange rather than in connexion with our knowledge of the cosmos. I dissent from this belief, and it is one of the main purposes of my paper to convey to you some of my reasons for dissenting. At any rate, it is good to remember from time to time that our Western science—and there seems to be no other—did not start with collecting observations of oranges, but with bold theories about the world.

III

Traditional empiricist epistemology, and the traditional historiography of science, are still deeply influenced by the Baconian myth according to which science starts from observation and then slowly and cautiously proceeds to theories. That the facts are very different can be learned from studying the early Pre-Socratics. Here we find fascinating ideas, some of which are strange and even staggering anticipations of modern results while many others are, from our modern point of view, wide of the mark; but most of them, and the best of them, have nothing to do with observation. Take for example some of the theories about the shape and position of the earth. Thales said, we are told, ' that the earth is supported by water on which it rides like a ship, and when we say that there is an earthquake, then the earth is being shaken by the movement of the water '. No doubt, Thales had observed earthquakes as well as the rolling of a ship before he arrived at his theory. But the point of his theory was to *explain* the support or suspension of the earth, and also earthquakes, by the conjecture that the earth floats on water; and for this conjecture (which so strangely anticipates the modern theory of continental drift) he could have no basis in his observations.

We must not forget that the function of the Baconian myth is to explain why scientific statements are *true*, by pointing out that observation is the ' true source ' of our scientific knowledge. Once we realize that all scientific statements are hypotheses, or guesses, or conjectures, and that the vast majority of these conjectures (including Bacon's own) have turned out to be false, the Baconian myth becomes irrelevant. For it is pointless to

argue that the conjectures of science—those which have proved to be false as well as those which are still accepted—all start from observation.

However this may be, Thales' beautiful theory of the support or suspension of the earth and of earthquakes, though in no sense based upon observation, is at least inspired by an empirical or observational analogy. But even this is no longer true of the theory proposed by Thales' great pupil, Anaximander. Anaximander's theory of the suspension of the earth is still highly intuitive, but it no longer uses observational analogies. In fact, it may be described as counter-observational. According to Anaximander's theory, ' The earth . . . is held up by nothing, but remains stationary owing to the fact that it is equally distant from all other things. Its shape is . . . like that of a drum . . . We walk on one of its flat surfaces, while the other is on the opposite side '. The drum, of course, is an observational analogy. But the idea of the earth's free suspension in space, and the explanation of its stability, has no analogy whatever in the whole field of observable facts.

In my opinion, this idea of Anaximander's is one of the boldest, most revolutionary, and most portentous ideas in the whole history of human thought. It made possible the theories of Aristarchus and Copernicus. But the step taken by Anaximander was even more difficult and audacious than the one taken by Aristarchus and Copernicus. To envisage the earth as freely poised in mid-space, and to say ' that it remains motionless because of its equilibrium ' (as Aristotle paraphrases Anaximander), is to anticipate, to some extent, even Newton's idea of immaterial and invisible gravitational forces.

IV

How did Anaximander arrive at this remarkable theory? Certainly not by observation but by reasoning. And since his theory is an attempt to solve one of the problems for which his teacher and kinsman Thales, the founder of the Milesian or Ionian School, had offered a solution before him, I conjecture

that Anaximander arrived at his theory by way of criticising Thales' theory. This conjecture, I believe, can be supported by a consideration of the structure of Anaximander's theory.

For Anaximander is likely to have argued against Thales' theory (according to which the earth was floating on water) on the following lines. Thales' theory is a specimen of a type of theory which, if consistently developed, would lead to an infinite regress. If we explain the stable position of the earth by the assumption that it is supported by water—that it is floating on the ocean (*Okeanos*)—should we not have to explain the stable position of the ocean by an analogous hypothesis? But this would mean that we have to look for a support of the ocean, and then for a support of this support. This method of explanation is unsatisfactory; first, because we solve our problem by creating an exactly analogous one, and also for the less formal and more intuitive reason that, in any such system of supports or props, any failure to secure one of the lower props must lead to the collapse of the whole edifice.

From this we see intuitively that the stability of the world cannot be secured by a system of supports or props. In its place, Anaximander appeals to the internal or structural symmetry of the world which ensures that there is no preferred direction in which a collapse can take place. He applies the principle that where there are no differences, there can be no change. In this way, he explains the stability of the earth by the equality of its distances from all other things.

This, it seems, was Anaximander's argument. It is important to realize that it abolishes, even though not quite consciously, perhaps, and not quite consistently, the idea of an absolute direction—the absolute sense of ' upwards ' and ' downwards '. This is not only contrary to all experience but notoriously difficult to grasp. Anaximenes ignored it, it seems, and even Anaximander himself did not grasp it completely. For the idea of an equal distance from all other things should have led him to the theory that the earth has the shape of a globe. Instead, he believed that it had the shape of a drum, with an upper and a lower flat surface. Yet it looks as if the remark ' we walk on one of its flat surfaces, while the other is on the opposite side ' contained a hint that there was not an absolutely upper surface,

but that, on the contrary, the surface on which we happened to walk was the one we might *call* the upper.

What prevented Anaximander from arriving at the theory that the earth was a globe rather than a drum? There can be little doubt about the answer to this question: it was *observational experience* which taught him that the surface of the earth was, by and large, flat. Thus it was a speculative and critical argument, the abstract critical discussion of Thales' theory, which almost led him to the true theory of the shape of the earth; and it was observational experience which led him astray.

V

There is an obvious objection against Anaximander's theory of symmetry according to which the earth is equally distant from all other things: the asymmetry of the universe can be easily seen from the existence of sun and moon, and especially from the fact that sun and moon are sometimes not far distant from each other, so that they are on the same side of the earth, while there is nothing on the other side to balance them. It appears that Anaximander met this objection by another bold theory—his theory of the hidden nature of the sun, the moon, and the other heavenly bodies.

He envisages the rims of two huge chariot wheels rotating round the earth, one 27 times the size of the earth, the other 18 times its size. Each of these rims or circular pipes is filled by fire, and each has a breathing-hole through which the fire is visible. These holes we call, respectively, the sun and the moon. The rest of the wheel is invisible, presumably because it is dark (or misty) and far away. The fixed stars (and presumably the planets) are also holes on wheels which are nearer to the earth than the wheels of the sun and the moon. The wheels of the fixed stars rotate round a common axis (which we now call the axis of the earth) and together they form a sphere round the earth, in accordance with the postulate that all things are positioned at similar distances from the earth. In this way, Anaximander also became the founder of the theory of spheres.

VI

There can be no doubt whatever that Anaximander's theories are critical and speculative rather than empirical: and considered as approaches to truth, his critical and abstract speculations served him better than observational experience.

But this, a follower of Bacon may reply, is precisely why Anaximander was not a scientist. This is precisely why we speak of early Greek *philosophy* rather than of early Greek *science*. Philosophy is speculative: everybody knows this. And as everybody knows, science begins only when the speculative method is replaced by the observational method, and when deduction is replaced by induction.

This reply, of course, amounts to the thesis that scientific theories should be defined by reference to their origin—their origin in observations, or in so-called 'inductive procedures'. Yet I believe that few, if any, physical theories would fall under this definition. And I do not see at all why the question of origin should be important. What is important about a theory is its explanatory power, and whether it stands up to criticism and to tests. The question of its origin, of how it is arrived at—whether by an 'inductive procedure' as some say, or by an act of intuition —may be extremely interesting from a point of view of the biography of its originator, but it has little to do with its scientific character.

VII

As to the Pre-Socratics, I assert that there is the most perfect possible continuity of thought between their theories and the later developments in physics. Whether they are called philosophers, or pre-scientists, or scientists matters very little, I think. But I do assert that Anaximander's theory broke the way for the theories of Aristarchus, Copernicus, Kepler and Galileo. It is not that he merely 'influenced' these latter thinkers: 'influence' is a very superficial category. I would rather put it like this: Anaximander's achievement is valuable in

itself like a work of art. Besides, his achievement made other achievements possible : among them those of the great scientists mentioned.

But are not Anaximander's theories false, and therefore non-scientific? They are false, I admit, but so are many theories, based upon countless experiments, which were held by modern science until recently, and to which nobody would deny the character of scientific theories, even though they are false. (An example is the theory that there is one and only one kind of atom—the lightest of all atoms—with the typical chemical properties of hydrogen.) There were historians of science who tended to regard as unscientific (or even as superstitious) any view no longer accepted at the time they were writing; but this is an untenable attitude. A false theory may be as great an achievement as a true one. And many false theories have been more helpful in our search for truth than some less interesting theories which are still accepted. For false theories can be helpful in many ways: they may suggest some more or less radical modifications, and they may stimulate criticism. Thus Thales' theory that the earth floats on water reappeared in a modified form in Anaxemines, and in more recent times in the form of Wegener's famous theory of continental drift. How Thales' theory stimulated Anaximander's criticism has been shown already.

Anaximander's theory, similarly, suggested a modified theory—the theory of an earth globe, freely poised in the centre of the Universe, and surrounded by spheres on which heavenly bodies were mounted. And by stimulating criticism, it also led to the theory that the moon shines by reflected light; to the Pythagorean theory of a central fire; and ultimately to the heliocentric world-system of Aristarchus and Copernicus.

VIII

I believe that the Milesians, like their oriental predecessors who took the world for a tent, envisaged the world as a kind of house, the home of all creatures—our home. Thus there was no need to ask what it was for. But there was a real need to inquire into its architecture. The questions of its structure, its

ground-plan, and its building material, constitute the main problems of Milesian cosmology. There is also a speculative interest in its origin, the question of cosmogony. It seems to me that the cosmological interest of the Milesians far exceeded their cosmogonical interest, especially if we consider the strong cosmogonical tradition, and the almost irresistible tendency to describe a thing by describing how it has been made, and thus to present a cosmological account in a cosmogonical form. The cosmological interest must be very strong, as compared with the cosmogonical one, if the presentation of a cosmological theory is even partially free from these cosmogonical trappings.

I believe that it was Thales who first discussed the architecture of the cosmos—its structure, ground-plan, and building material. In Anaximander we find answers to all three questions. I have briefly mentioned his answer to the question of structure. As to the question of the ground-plan of the world, it was studied and expounded by Anaximander, as indicated by the tradition that he drew the first map of the world. And of course, he had a theory of its building material—of 'the unformed' or 'the unbounded' (the *apeiron*).

In Anaximander's world all kinds of *changes* were going on. There was a fire which needed air and breathing-holes, and these were at times blocked up, so that the fire was smothered: this was his theory of eclipses, and of the phases of the moon. There were winds, which were responsible for the changing weather, and indeed for all other changes within the cosmic edifice.

We have here the first hint of what was soon to come: of the *problem of change* which became the central problem of Greek cosmology, and which led, with Leucippus and Democritus, to *a universal theory of change* that was accepted by modern science almost up to the beginning of the twentieth century. (It was given up only with the breakdown of Maxwell's models of the ether, an historical event that was little noticed before 1905.)

IX

The exciting story of the development of the problem of change appears to me in danger of being completely buried under the

mounting heap of the minutiae of textual criticism. The story cannot, of course, be fully told in one short paper, and still less in one of its many sections. In briefest outline, the story is this.

For Anaximander, our own world, our own cosmic edifice, was only one of an infinity of worlds—an infinity without bounds in space and time. This system of worlds was eternal, and so was motion. There was thus no need to explain motion, no need to construct a general theory of change. But there was a need to explain the well-known changes occurring in our world. The most obvious changes—the change of day and night, of the winds and of the weather, and of the seasons, from sowing to harvesting, and of the growth of plants and animals and men—were all connected with the contrast of temperatures, with the opposition between the hot and the cold, and with that between the dry and the wet. ' Living creatures came into being from moisture evaporated by the sun ', we are told; and the hot and the cold also administer to the genesis of our own world edifice. The hot and the cold were also responsible for the winds which were conceived as the agents of all change.

Anaximenes, a pupil of Anaximander and his successor, developed these ideas in much detail. Like Anaximander he was interested in the opposition of the hot and the cold, of the moist and the dry, and he explained the transitions between these opposites by a theory of condensation and rarefaction. Like Anaximander, he believed in eternal motion and in the action of the winds; and it seems not unlikely that one of the two main points in which he deviated from Anaximander was reached by a criticism of the idea that what was completely boundless and formless (the *apeiron*) could be in motion. At any rate, he replaced the *apeiron* by air—something that was almost boundless and formless, and yet, according to Anaximander's old theory of the winds, not only capable of motion, but the main agent of motion and change. A similar unification of ideas was achieved by Anaximenes' theory that ' the sun consists of earth, and that it gets very hot owing to the rapidity of its motion '. The replacement of the more abstract theory of the unbounded *apeiron* by the less abstract and more common-sense theory of air is matched by the replacement of Anaximander' bold theory

of the stability of the earth by the more common-sense idea that the earth's 'flatness is responsible for its stability; for it . . . covers like a lid the air beneath it'. Thus the earth rides on air as the lid of a pot may ride on steam, or as a ship may ride on water: Thales' question and Thales' answer are both re-instituted, and Anaximander's epoch making argument is not understood. Anaximenes is an eclectic, a systematiser, an empiricist, a man of common sense. Of the three great Milesians, he is least creative of new ideas; he is the least philosophically minded.

The three Milesians all looked at our world as our home. There was movement, there was change in this home, there was hot and cold, fire and moisture: it was exposed to the winds, and a bit draughty, to be sure; but it was home, and it meant security and stability of a sort. But for Heraclitus, the house was on fire.

There was no stability left in the world of Heraclitus. 'Everything is in flux, and nothing is at rest.' *Everything* is in flux, even the beams, the timber, the building material of which the world is made: earth and rocks, or a bronze cauldron—they are all in flux. The beams are rotting, the earth is washed away and blown away, the very rocks split and wither, the bronze cauldron turns into green patina, or into verdigris: 'all things are in motion all the time, even though . . . this escapes our senses', as Aristotle expressed it. Those who do not know and do not think, believe that only the fuel is burned, while the bowl in which it burns remains unchanged; for we do not see the bowl burning. And yet, it burns: it may be eaten up by the fire it holds. We do not *see* our children grow up, and change, and grow old, but they do.

Thus there are no solid bodies. Things are not really things, they are processes, they are in flux. They are like fire, like a flame which, though it may have a definite shape, is a process, a stream of matter, a river. All things are flames: fire is the very building material of our world; and the apparent stability of things is merely due to the laws, the measures, which the processes in our world are subject to.

This, I believe, is Heraclitus' story; it is his 'message', the 'true word' (the '*logos*'), to which we ought to listen: 'Listening

not to me but to the true account, it is wise to admit that all things are one': they are 'an everlasting fire, flaring up in measures, and dying down in measures'.

I know very well that the traditional interpretation of Heraclitus' philosophy here restated is not accepted at present. But the critics have put nothing in its place—nothing, that is, of philosophical interest. I shall briefly discuss their new interpretation in the next section. Here I wish only to stress that Heraclitus' philosophy, by appealing to thought, to the word, to argument, to reason, and by pointing out that we are living in a world of things whose changes escape our senses, though we *know* that they do change, created a new problem—*the problem of change*. This problem was the more urgent as his own account of change was difficult to understand. But this, I believe, is due to the fact that he saw, more clearly than his predecessors, the problem that was involved in the very idea of change.

For all change is the change of something: change presupposes something that changes. And it presupposes that, while changing, this something must remain the same. We may say that a green leaf changes when it turns brown; but we do not say that the green leaf changes when we substitute for it a brown leaf. It is essential to the idea of change that the thing that changes retains its identity while changing. And yet, it must become something else: it was green, and it becomes brown; it was moist, and it becomes dry; it was hot, and it becomes cold.

Thus every change is, in a way, the transition of a thing into something with opposite qualities (as Anaximander and Anaximenes had seen). And yet, the changing thing must remain identical during change.

This is the problem of change. It led Heraclitus to a theory which (partly anticipating Parmenides) distinguishes between reality and appearance. 'The real nature of things loves to hide itself. An unapparent harmony is stronger than the apparent one.' Things are *in appearance* (and for us) opposites to us, but in truth (and for God) they are the same. 'Life and death, being awake and being asleep, youth and old age, all these are the same . . . for the one turned round is the other and the other turned round is the first . . . The path that leads up and the path

that leads down is the same path . . . Good and bad are identical . . . For God, all things are beautiful and good and just, but men assume some things to be unjust, and others to be just . . . It is not in the nature or character of man to possess true knowledge, though it is in the divine nature.'

Thus in truth (and for God) the opposites are identical; it is only to man that they appear as non-identical. And all things are one—they are all part of the process of the world, the everlasting fire.

This theory of change appeals to the 'true word', to the *logos*, to reason. Nothing is more real for Heraclitus than change. Yet his doctrine of the oneness of the world, of the identity of opposites, and of appearance and reality threatens his doctrine of the reality of change.

For change is the transition from one opposite to the other. Thus if in truth the opposites are identical, though they appear different, then change itself might be only apparent. If in truth, and for God, all things are one, there might be, in truth, no change.

This consequence was drawn by Parmenides, the pupil (*pace* Burnet and others) of the monotheist Xenophanes who said of the one God: 'He always remains in the same place, never moving. It is not fitting for Him to go to different places at different times . . . He is in no way similar to mortal men, neither in body nor in thought.'

Xenophanes' pupil, Parmenides, taught that the real world was one, and that it always remains in the same place, never moving. It was in no way similar to what appeared to be to mortal men. The world was one, an undivided whole, without parts, homogeneous, and motionless: motion was impossible in such a world. In truth, there was no change. The world of change was an illustion.

Parmenides based this theory of an unchanging reality on something like a logical proof; a proof which can be presented as proceeding from the single premiss 'What is not is not'. From this, we can derive that the nothing—that which is not—does not exist; a result which Parmenides interprets to mean that the void does not exist. Thus the world is full: it consists

of one undivided block, since any division into parts could only be due to separation of the parts by the void. (This is ' the well-rounded truth ' which the goddess revealed to Parmenides.) In this full world, there is no room for motion.

Only the delusive belief in the reality of opposites—the belief that not only *what is* exists but also *what is not*—leads to the illusion of a world of change.

Parmenides' theory may be described as the first hypothetico-deductive theory of the world. The atomists took it as such; and they asserted that it was refuted by experience, since motion does exist. Accepting the formal validity of Parmenides' argument, they inferred from the falsity of his conclusion the falsity of his premiss. But this meant that the nothing—or the void—existed. Consequently, there was now no need to assume that ' what is '—the full, that which fills some space—had no parts; for its parts could now be separated by the void. Thus there are many parts which are all ' full ': there are full particles in the world, separated by empty space, and able to move in empty space, each of them being ' full ', undivided, indivisible, and unchanging. In this way the atomists arrived at a *theory of change* —a theory that dominated scientific thought until 1900. It is the theory that *all change, and especially all qualitative change, has to be explained by the spatial movement of unchanging bits of matter.*

The next great step in our cosmology was made when Maxwell, inspired by ideas of Faraday, replaced this theory by a theory of changing intensities of fields.

X

I have sketched the story, as I see it, of the Pre-Socratic theory of change. I am of course well aware of the fact that my story (which is based on Plato, Aristotle, and the doxographic tradition) clashes at many points with the views of the experts, English as well as German, and especially with the views expressed

by G. K. Kirk and J. E. Raven in their book, *The Pre-Socratic Philosophers*, 1957. I cannot, of course, examine their arguments in detail here, and especially not their minute exegesis of various passages some of which are relevant to the differences of interpretation. (See, for example, Kirk and Raven's discussion of the question whether there is a reference to Heraclitus in Parmenides; *cf.* their note 1 on pp. 193f., and note 1 on pp. 272.) But I wish to say that I have examined their arguments and that I have found many which seem to me unacceptable.

I will mention here only some points in connexion with Heraclitus (although there are other points of equal importance, such as their comments on Parmenides).

The traditional view, according to which Heraclitus' central doctrine was that all things are in flux, was attacked forty years ago by Burnet. His main argument (discussed by me at length in note 2 to Chapter 2 of my *Open Society*) was that the theory of change was not new, and that only a new message could explain the urgency with which Heraclitus speaks. This argument is repeated by Kirk and Raven when they write (pp. 186f.): ' But all Pre-Socratic thinkers were struck by the predominance of change in the world of our experience.' About this attitude I said in my *Open Society:* ' Those who suggest . . . that the doctrine of universal flux was not new . . . are, I feel, unconscious witnesses to Heraclitus' originality, for they fail now, after 2,400 years, to grasp his main point.' In brief, they do not see the difference between the Milesian message: ' There is a fire in the house ' and Heraclitus's somewhat more urgent message: ' The house is on fire '. An implicit reply to this criticism can be found on p. 197 of the book by Kirk and Raven, where they write: ' Can Heraclitus really have thought that a rock or a bronze cauldron, for example, was invariably undergoing invisible changes of material? Perhaps so; but nothing in the extant fragments suggests that he did.' But is this so? Heraclitus' extant fragments about the fire (Kirk and Raven, fragments 220–222) are interpreted by Kirk and Raven themselves as follows (p. 200): ' Fire is the archetypal form of matter.' Now I am not at all sure what ' archetypal ' means here (especially in view of the fact that we read a few lines later ' Cosmogony . . . is not to be found

in Heraclitus'). But whatever 'archetypal' may mean, it is clear that once it is admitted that Heraclitus says in the extant fragments that all matter is somehow (whether archetypically or otherwise) fire, he also says that all matter, like fire, is a process; which is precisely the theory denied to Heraclitus by Kirk and Raven.

Immediately after saying that 'nothing in the extant fragments suggests' that Heraclitus believed in continuous invisible changes, Kirk and Raven make the following methodological remark: 'It cannot be too strongly emphasized that before Parmenides and his apparent proof that the senses were completely fallacious . . . gross departures from common sense must only be accepted when the evidence for them is extremely strong.' This is intended to mean that the doctrine that bodies of all materials constantly undergo invisible changes represents a gross departure from common sense, a departure which one ought not to expect in Heraclitus.

But to quote Heraclitus: 'He who does not expect the unexpected will not detect it: for him it will remain undetected, and uncomprehended.' In fact, Kirk and Raven's last argument is invalid on many grounds. Long before Parmenides, we find ideas far removed from common sense in Anaximander, Pythagoras, Xenophanes, and especially in Heraclitus. In fact, the suggestion that we should test the historicity of Heraclitus' ideas—as we might indeed test those of Anaximenes—by standards of 'common sense' is a little surprising (whatever 'common sense' may mean here). For this suggestion runs counter not only to Heraclitus' notorious obscurity and oracular style, confirmed by Kirk and Raven, but also to his burning interest in antinomy and paradox. And it runs counter, last but not least, to the (in my view quite absurd) doctrine which Kirk and Raven finally attribute to Heraclitus (the italics are mine): '. . . that natural changes of all kinds [and thus presumably also earthquakes and great fires] are regular *and balanced*, and *that the cause of this balance is fire, the common constituent of things that was also termed their Logos*.' If this is Heraclitus' philosophy, then I see no reason to take any interest in it; at any rate, it is much further removed from common sense (as I see it) than the inspired

philosophy which, in the name of common sense, is rejected by Kirk and Raven.

But the decisive point is, of course, that this inspired philosophy is *true*, for all we know. With his uncanny intuition, Heraclitus saw that things are processes, that our bodies are flames, that ' a rock or a bronze cauldron was invariably undergoing invisible changes '. Kirk and Raven say (p. 197, note 1), ' Every time the finger rubs, it rubs off an invisible portion of iron; yet when it does not rub, what reason is there to think that the iron is still changing? ' The reason is that the wind rubs, and that there is always wind; or that iron turns invisibly into rust—by oxidation, and this means, by slow burning; or that old iron looks different from new iron, just as an old man looks different from a child. This was Heraclitus' teaching, as the extant fragments show.

I suggest that Kirk and Raven's methodological principle ' that gross departures from common sense must only be accepted when the evidence for them is extremely strong ' might well be replaced by the clearer and more important principle that *gross departures from the historical tradition must only be accepted when the evidence for them is extremely strong.* This, in fact, is a universal principle of historiography. Without it, history would be impossible. Yet it is constantly violated by Kirk and Raven: when, for example, they try to make Plato's and Aristotle's evidence suspect, with arguments which are partly circular and partly (like the one from common sense) in contradiction to their own story. And when they say that ' little serious attempt seems to have been made by Plato and Aristotle to penetrate his [*i.e. Heraclitus'*] real meaning ' then I can only say that the philosophy outlined by Plato and Aristotle seems to me a philosophy that has real meaning and real depth. It is a philosophy worthy of a great philosopher. Who, if not Heraclitus, was the great thinker who first realized that men are flames and that things are processes? Are we really to believe that this great philosophy was a ' post-Heraclitean exaggeration ' (p. 197), and that it may have been suggested to Plato, ' in particular, perhaps, by Cratylus '? Who, I ask, was this unknown philosopher—perhaps the greatest and certainly the boldest thinker among the Pre-Socratics? Who was he, if not Heraclitus?

XI

The early history of Greek philosophy, especially the history from Thales to Plato, is a splendid story almost too good to be true. In every generation we find at least one new philosophy, one new cosmology of staggering originality and depth. How was this possible? Of course, one cannot explain originality and genius. But one can try to throw some light on it. What was the secret of the ancients? I suggest that it was a *tradition—the tradition of critical discussion.*

I will try to put the problem more sharply. In all or almost all civilizations, we find something like religious and cosmological teaching, and in many societies we find schools. Now schools, especially primitive schools, have all, it appears, a characteristic structure and function. Far from being places of critical discussion, they make it their task to impart a definite doctrine, and to preserve it, pure and unchanged. It is the task of a school to hand on the tradition, the doctrine of its founder, its first master, to the next generation, and to this end the most important thing is to keep the doctrine inviolate. A school of this kind never admits a new idea. New ideas are heresies, and they lead to splits: should a member of the school try to change the doctrine, then he is expelled as a heretic. But the heretic claims, as a rule, that his is the true doctrine of the founder. Thus not even the inventor admits that he has introduced an invention; rather, he believes that he is returning to the true orthodoxy which has somehow been perverted.

In this way, all changes of doctrine—if any—are surreptitious changes. They are all presented as re-statements of the true sayings of the master, of his own words, his own meaning, his own intentions.

It is clear that, in a school of this kind, we cannot expect to find a history of ideas, or even the material for such a history. For new ideas are not admitted to be new. Everything is ascribed to the master. All we might reconstruct is a history of schisms, and perhaps a history of the defence of certain doctrines against the heretics.

There cannot, of course, be any rational discussion in a school

of this kind. There may be arguments against dissenters and heretics, or against some competing schools. But in the main, it is with assertion and dogma and condemnation rather than argument that the doctrine is presented.

The great example of a school of this kind among the Greek philosophic schools is the Italian School founded by Pythagoras. Compared with the Ionian school, or with that of Elea, it had the character of a religious order, with a characteristic way of life, and a secret doctrine. The story that a member, Hippasus of Metapontum, was drowned at sea because he revealed the secret of the irrationality of certain numbers, is characteristic of the atmosphere surrounding the Pythagorean school, whether or not there is any truth in this story.

But among Greek philosophic schools, the early Pythagoreans were an exception. Leaving them aside, we could say that the character of Greek philosophy, and of the philosophic schools, is strikingly different from the dogmatic type of school here described. I have shown this by an example: *the story of the problem of change which I have told is the story of a critical debate, of a rational discussion.* New ideas are propounded as such, and arise as the result of open criticism. There are few, if any, surreptitious changes. Instead of anonymity we find a history of ideas and of their originators.

Here is a unique phenomenon, and it is closely connected with the astonishing freedom and creativeness of Greek philosophy. How can we explain this phenomenon? Clearly, *what we have to explain is the rise of a tradition.* It is a tradition that allows or encourages critical discussions between various schools and, more surprisingly still, within one and the same school. For nowhere outside the Pythagorean school do we find a school devoted to the preservation of a doctrine. Instead, we find changes, new ideas, modifications, and outright criticism of the master.

(In Parmenides we even find, at an early date, a most remarkable phenomenon—that of a philosopher who propounds *two* doctrines, one which he says is true, and one which he himself describes as false: yet he makes the false doctrine not simply an object of condemnation or of criticism; rather he presents it

as the best possible account of the delusive opinion of mortal men, and of the world of mere appearance—the best account which a mortal man can give.)

How and where was this critical tradition founded? This is a problem deserving serious thought. This much is certain: Xenophanes who brought the Ionian tradition to Elea was fully conscious of the fact that his own teaching was purely conjectural, and that others might come who knew better. I shall refer to this point again in my next and last section.

If we try to search for the first signs of this new critical attitude, this new freedom of thought, then we are led back to Anaximander's criticism of Thales. Here is a most striking fact. Anaximander criticizes his master and kinsman, one of the Seven Sages, the founder of the Ionian school. He was, according to tradition, only about fourteen years younger than Thales, and he must have developed his criticism and his new ideas while his master was alive. (They seem to have died within a few years of each other.) But there is no trace, in the sources, of a story of dissent, of any quarrel, or of any schism.

This suggests, I think, that it was Thales who founded the new tradition of freedom—based upon a new relation between master and pupil—and who thus created a new type of school, utterly different from the Pythagorean school. He seems to have been able to tolerate criticism. And what is more, he seems to have created the tradition that one ought to tolerate criticism.

Yet I like to think that he did even more than this. I can hardly imagine a master-pupil relation in which the master merely tolerates criticism without actively encouraging it. It does not seem to me possible that a pupil who is being taught in the dogmatic attitude would ever dare to criticize the dogma (least of all that of a famous sage), and to vent his criticism. It seems to me an easier and simpler explanation to assume that the master encouraged a critical attitude—possibly not from the outset, but only after he was struck by the pertinence of some questions asked by the pupil without any critical intention.

However this may be, the conjecture that Thales actively encouraged criticism in his pupils would explain the fact that the

critical attitude towards the master's doctrine became part of the Ionian school-tradition. I like to think that Thales was the first teacher who said to his pupils: 'This is how I see things—how I believe that things are. Try to improve upon my teaching!' (Those who believe that it is 'unhistorical' to attribute this undogmatic attitude to Thales may again be reminded of the fact that, only two generations later, we find a similar attitude consciously and clearly formulated in the fragments of Xenophanes.) At any rate, there is the historical fact that the Ionian school was the first in which pupils criticized their masters, in one generation after the other. There can be little doubt that the Greek tradition of philosophical criticism had its main source in Ionia.

It was a momentous innovation. It meant a break with the dogmatic tradition which permits only *one* school doctrine, and the introduction in its place of a tradition that admits a *plurality* of doctrines which all try to approach the truth, by means of critical discussion.

It thus leads, almost by necessity, to the realization that our attempts to see, and to find, the truth, are not final, but open to improvement; that our knowledge, our doctrine, is conjectural; that it consists of guesses, of hypotheses, rather than of final and certain truths; and that criticism and critical discussion are our only means of getting nearer to the truth. It thus leads to the tradition of bold conjectures and of free criticism, the tradition which created the rational or scientific attitude, and with it our Western civilization, the only civilization which is based upon science.

In this rationalist tradition, bold changes of doctrine are not forbidden. Rather, innovation is encouraged, is regarded as success, as improvement, if it is based on the result of a critical discussion of its predecessors. And the very boldness of an innovation is admired; for it can be controlled by the severity of its critical examination. Thus changes of doctrine, far from being made surreptitiously, are traditionally handed down together with the older doctrines and the names of the innovator. Thus the material, at least, for a history of ideas becomes part of the school tradition.

To my knowledge, the critical or rationalist tradition was invented only once. It was lost after two or three centuries, perhaps owing to the rise of the Aristotelian doctrine of *episteme*, of certain and demonstrable knowledge. It was re-discovered and consciously revived by the Renaissance, especially by Galileo Galilei.

XII

I now come to my last and most central contention. It is this. The rationalist tradition, the tradition of critical discussion, represents the only practicable way of expanding our knowledge —conjectural or hypothetical knowledge, of course. There is no other way. More especially, there is no way that starts from observation or experiment. In the development of science, observations and experiments play only the rôle of critical arguments. And they play this rôle alongside other, non-observational arguments. It is an important rôle; but the significance of observations and experiments depends *entirely* upon the question whether or not they may be used to *criticize theories.*

According to the theory of knowledge here outlined, there are in the main only two ways in which theories may be superior to others: they may explain more, and they may be better tested— that is, they may be more fully and more critically discussed, in the light of all we know, of all the objections we can think of, and especially also in the light of observational or experimental tests which were designed with the aim of criticizing the theory.

There is only one element of rationality in our attempts to know the world: it is the critical examination of our theories. These theories themselves are guesswork. We do not know, we only guess. If you ask me ' How do you know ' my reply would be ' I don't: I only propose a guess. If you are interested in my problem, I shall be most happy if you criticize my guess, and if you offer your counter-proposals which I, in turn, will try to criticize.'

This, I believe, is the true theory of knowledge (which I wish to submit for your criticism): the true description of a practice which arose in Ionia and which is incorporated in modern science, though there are many scientists who still believe in the Baconian myth of induction.

Two of the greatest who clearly saw that there was no such thing as an inductive procedure, and who clearly understood what I regard as the true theory of knowledge, were Galileo and Einstein. Yet the ancients also knew it. Incredible as it sounds, we find a clear recognition and formulation of this theory of rational knowledge almost immediately after the practice of critical discussion had begun. Our oldest extant fragments in this field are those of Xenophanes. I will present them here in an order that suggests that it was the boldness of his attack and the gravity of his problems which made him conscious of the fact that all our knowledge was guesswork and that, notwithstanding this fact, we may, by searching for the better, find it in the course of time. Here are four of the fragments from Xenophanes' writings.

> But if cattle or horses or lions had hands and could draw
> And sculpture like men, then the horses would draw their gods
> Like horses, and cattle like cattle, and all would then shape
> Bodies of gods in the likeness, each kind, of its own.
>
> The gods did not reveal, from the beginning,
> All things to us; but in the course of time,
> By seeking for it, men find out the better.
>
> Let us conjecture that this is like truth.
>
> But as for certain truth, no man has known it,
> Nor will he know it; neither of the gods
> Nor yet of all the things of which I speak.
> And if by any chance he were to utter
> Finality, he would himself not know it:
> For all is but a woven web of guesses.

To show that Xenophanes was not alone, I may also repeat here two of Heraclitus' sayings which I have quoted before in a different context. Both express the conjectural character of human knowledge, and the second refers to its daring, to the need to anticipate boldly what we do not know.

> It is not in the nature or character of man to possess true knowledge, though it is in the divine nature . . . He who does not expect the unexpected will not detect it: for him it will remain undetected, and uncomprehended.

My last quotation is a very famous one from Democritus:

> Nothing do we know from having seen it; for the truth is hidden in the deep.

This is how the critical attitude of the Pre-Socratics prepared and made possible the ethical rationalism of Socrates. I am alluding to his belief that the search for truth through critical discussion was a way of life—in fact, the best he knew.