

MATTER INTRODUCTION

AFTER we came out of the church," says Boswell in his *Life of Samuel Johnson*, "we stood talking for some time together of Bishop Berkeley's ingenious sophistry to prove the non-existence of matter, and that everything in the universe is merely ideal. I observed that though we are satisfied his doctrine is not true, it is impossible to refute it. I shall never forget the alacrity with which Johnson answered, striking his foot with mighty force against a large stone, till he rebounded from it, 'I refute it thus.' "

But Berkeley's argument anticipated Dr. Johnson's style of refutation. "I do not argue," he says, "against the existence of any one thing that we can apprehend either by sense or reflexion. That the things I see with my eyes and touch with my hands do exist, really exist, I make not the least question. The only thing whose existence I deny is that which *philosophers* call Matter or corporeal substance. And in doing this there is no damage done to the rest of mankind, who, I dare say, will never

be instructed, however, that when they use the word "matter," they speak of *nothing*. They may from careless habit suppose they are referring to the most obvious something there is in the world—the solid, massy, concrete stuff of which tangible, visible, movable, and moving things are made. Of them, Berkeley would ask how they know such stuff exists. It is not itself perceptible.

We perceive a variety of qualities—colors, * shapes, temperatures, textures, sizes, or extensions—but these, Berkeley argues, have their being *in being perceived*. Even if certain of these sensible qualities, sometimes called "pri-

mary," such as figure, size, or weight, are supposed to belong to bodies when they are not actually being sensed, they are not matter, but only its properties. Matter itself is not sensible. Those who assert its existence postulate it as a substratum or support for the sensible qualities they perceive.

The question, therefore, is whether such a substratum is a necessary or an unnecessary hypothesis. Berkeley does not deny the existence of beings which cannot be directly sensed. He affirms the existence of the human spirit or mind, of minds other than his own, and the spiritual being of God. These must be inferred to exist in order to explain the phenomena of our sensible experience and the experience of our own activities in thinking, imagining, willing. If, in addition, the existence of matter or a material substance were necessary to explain the phenomena, Berkeley would not object to affirming its existence by inference, even if it could in no way be directly perceived.

His argument therefore involves, first, a denial of Locke's distinction between primary and secondary qualities. Supposing it to be generally agreed that colors, sounds, odors have no actual existence except in the perceiving mind, he denies that perceptible figure, size, or motion can exist otherwise. "It having been shown that none even of these can possibly exist otherwise than in a Spirit or Mind which perceives them, it follows that we have no longer any reason to suppose the being of Matter."

Matter is not needed as a substratum or support for the qualities we perceive. This is the second main point in Berkeley's argument. "Though we give the materialists their exter-

nal bodies, they by their own confession are never the nearer knowing how our ideas are produced; since they own themselves unable to comprehend in what manner body can act upon spirit, or how it is possible it should imprint any idea in the mind. Hence it is evident that the production of ideas or sensations in our minds can be no reason why we should suppose Matter or corporeal substances, since that is acknowledged to remain equally inexplicable with or without this supposition."

Russell regards Berkeley's argument as fallacious. "But whether valid or not," he writes, "the argument has been very widely advanced in one form or another; and very many philosophers, perhaps a majority, have held that there is nothing real except minds and their ideas. Such philosophers are called 'idealists.' When they come to explaining matter, they either say, like Berkeley, that matter is really nothing but a collection of ideas, or they say, like Leibniz, that what appears as matter is really a collection of more or less rudimentary minds."

BERKELEY'S ARGUMENTS against matter, which occupy the greater part of his *The Principles of Human Knowledge*, may not have the same force when they are applied against different theories of matter. Berkeley seems to regard his attack on materialism as the refutation of an error at the root of skepticism, atheism, and irreligion. He also thinks materialism creates difficulties for the sciences. But are all affirmations of matter to be lumped together as materialism *in the same sense*? Are Aristotle, Plotinus, Descartes, Spinoza, and Locke materialists in the same sense as Lucretius, Hobbes, and perhaps Marx? Does it make no difference whether bodies are said to be the only real existences, or whether, in addition to bodies, immaterial substances or spiritual beings are also said to exist?

Does it make no difference how matter is conceived—whether as a self-subsistent substance in its own right, capable of existing apart from any qualities except extension and motion which belong to its very essence, or merely as one factor in the constitution of bodies, the factor of potentiality which, as

will be presently explained, has no existence apart from the forms which actualize it? Are skepticism, atheism, and irreligion to be associated with all affirmations of matter, in view of the fact that theologians like Augustine and Aquinas seem to think that a sound view of matter supports the truths of religion against the errors of the materialists?

There seem to be, in short, three distinct positions to which Berkeley's blanket denial of matter stands opposed. The diametrically opposite view seems to be the blanket denial of anything except bodies, or of anything which cannot be reduced to a property or function of matter. The atomism of Lucretius, discussed in the chapter on ELEMENT, may be taken as representative of this view, though Engels would insist that materialism can be dialectical rather than atomistic or mechanical.

Between the two extremes, there appear to be two middle positions which are alike insofar as both affirm the immaterial as well as the material. Although they are alike in asserting the existence of spiritual substances, they may, of course, define the nature of these immaterial things differently, and differently interpret their relation to the realm of matter. But, as theories of matter, their principal difference consists in the way in which they conceive the being of bodies, material substances, or the bodily mode of substance.

In the conceptions of Descartes and Locke, for example, it is matter which gives actuality to sensible bodies. We have "no other idea or notion of matter," Locke writes, "but something wherein those many sensible qualities, which affect our sense, do subsist." The entire substance of sensible bodies consists of matter. All their properties derive from the essence or nature of matter. But in the conceptions of Aristotle and Plotinus, bodies would not exist at all if they were composed only of matter, for matter is no more than a capacity for being, not something which by itself actually is. Sensible bodies derive their being and all their attributes from the forms which matter assumes when its potentialities are actualized. Matter totally devoid of form is not the *nothing* Berkeley calls it, but it is so near to nothing that Plotinus says it is "more plausibly called a non-

being ... a bare aspiration towards substantial and those who take his view affirm matter to existence." be an indispensable factor in the constitution

These theories of matter or corporeal being of physical things. They do not question the seem to be as contrary to one another as reality of bodies or their existence apart from together they are contrary to Berkeley's doc-mind. On both of these points they are as trine. Yet each of the two middle positions opposed to Berkeley as they would be if they leans toward one of the opposite extremes. were complete materialists. Nevertheless they

The conception of matter seems to be very lean toward Berkeley rather than toward the much the same in the complete materialism of other extreme in one respect. Where Berkeley Lucretius and Hobbes and in the view of denies the existence of matter, they deny its Descartes, Spinoza, and Locke. In the former, substantiality. Where Berkeley says matter has only bodies exist. In the latter, bodies do not no being, they say it has the lowest grade of comprise the whole of existence, but matter is being—on the very verge of not being!

the whole substance of bodies. The separation of

body and mind, or matter and spirit, into IN SPITE OF ALL the differences noted, the distinct substances, or modes of substance, idea of matter has a certain constant meaning leaves matter the same kind of stuff that it is in throughout the tradition of the great books.

a world which admits of no other reality. It is generally associated with the idea of Atomism, furthermore, may be common to quantity, and especially the basic magnitudes, both theories, at least to the extent that it is held such as time, space, and mass. Sometimes it that the complex bodies we perceive are is said that the essence of matter itself is composed of minute and insensible particles. extension; sometimes that bodies—not matter Unlike Lucretius, Locke may not insist upon the itself—have the property of tridimensionality. absolute indivisibility of the particles, or upon But in either case that which *is* or *has* matter the eternity of the uncreated atoms of matter; in it necessarily occupies space.

but he, like Hobbes and Newton, carries the The manner of that occupation is also gen- division of the familiar bodies of sense- erally agreed upon. Two bodies or two distinct experience down to parts which cannot be quantities of matter cannot occupy the same perceived and yet have, in a way, a more ultimate place at the same time. A body may not be reality as units of matter than the complex impenetrable in the sense of being indivisible, bodies they constitute. but so long as it remains the whole that it is,

"Had we senses acute enough to discern the it offers resistance to other bodies tending to minute particles of bodies, and the real move into the place it occupies.

constitution on which their sensible qualities It is in terms of its occupation of definite depend," Locke writes, "I doubt not but that quantities of space and time that Whitehead would produce quite different ideas in us; and defines matter. In his view, matter, or the ma- that which is now the yellow color of gold, terial, the corporeal, has "the property of sim- would then disappear, and instead of it we ple location in space and time, or, if you adopt should see an admirable texture of parts, of a the more modern ideas, in space-time ... The certain size and figure." characteristic common both to space and time

At the other extreme, Berkeley's complete is that material can be said to be *here* in space denial of matter has less in common with the and *here* in time, or *here* in space-time, in a view of Aristotle, Plotinus, Augustine, and perfectly definite sense which does not require Aquinas than the theory of Descartes, Spinoza, for its explanation any reference to other re- and Locke has with the materialism of Lu- gions of space-time."

cretius and Hobbes. They would appear to be There is another connection between mat- close enough, for one seems to hold that matter ter and quantity. To those who ask what is almost nonbeing and the other that matter is makes two otherwise identical things two in simply nothing at all. But where Berkeley number—or what is involved in the merely denies any role to matter, Aristotle numerical difference of things alike in every

other respect—the usual answer is in terms of "recipient and nurse" is a better description of matter. Matter is traditionally spoken of as "the principle of individuation." Aquinas, matter than the term "mother," for that term "is for example, holds that angels, unlike physical substances, cannot differ from one another to the offspring, as a container only, giving as do numerically distinct individuals. Because nothing to them." In his own view, matter is more they are immaterial, they can differ only as than space or mere receptivity. He is willing to do species or kinds. "Such things as agree admit the "parallel with motherhood" only to the in species," he writes, "but differ in number, extent that "matter is sterile, not female to full agree in form, but are distinguished materially. effect, female in receptivity only, not in If, therefore, the angels be not composed of pregnancy."

matter and form, it follows that it is impossible for two angels to be of one species; just as TRADITIONALLY, the distinction between universal and particular is understood as a distinction between the intelligible and the sensible. This indicates another traditional meaning of matter they are in several substances."

The way in which matter is related to individual differences can be exemplified in works of art. Two coins, stamped out of the same kind of matter by the impression of the same die, may differ in no other discernible respect than that they are *two* of the same kind. Their *intangible* or *imponderable*, but that, because of *twoness* seems to be somehow related to the fact that each consists of a distinct quantity of matter. But it may be asked how two units of matter have the distinction of being two while they differ in no other respect. One answer to this difficult question is that their distinction consists in their occupying different places. In the Platonic theory of the origin of many particulars all participating in the same form, as insensible as it is unintelligible,* yet forms diversity of place seems to play the role which matter plays for Aristotle and Aquinas.

But if we ask about the sensibility of matter itself, rather than of bodies large or small, questions arise which are more difficult to solve. On one theory of matter, matter devoid of form is as insensible as it is unintelligible,* yet forms which are not material, that is, not in matter, are also insensible but not unintelligible. On the contrary, they are regarded as more perfectly intelligible than embodied forms. How, then, does matter which is itself insensible cause the forms which it assumes to become sensible when they are materialized?

Plato's doctrine of the receptacle, which is discussed in the chapter on FORM, is sometimes interpreted by conceiving the receptacle as space, and sometimes by conceiving it as matter. The receptacle, it is said in the *Timaeus*, is that which, "while receiving all things, never departs at all from her own nature and never in any way, or at any time, fronts with a different problem of sensibility. It assumes a form like that of any of the things which enter into her." This, according to Plotinus, means that "its one form is an invincible formlessness."

The theory of matter which does not regard it as a co-principle with form seems to be confronted with a different problem of sensibility. It is supposed that some of the qualities which we sense in bodies are actually in them whether we sense them or not—such properties as size, figure, weight, motion. Other sensible qualities, such as colors, odors, temperatures, or sounds, are supposed to be effects produced by the motions of material particles acting on the sensitive apparatus of animals. This distinc-

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tion between what Locke calls "primary and secondary qualities"—found also in Lucretius and Descartes—is more fully considered in the chapters on QUALITY and SENSE, but here it calls attention to the problem of how matter, devoid of certain sensible qualities, causes these qualities to arise.

For Lucretius the peculiar difficulty of the problem seems to lie in the fact that the sensitive animal is itself nothing but a material system. All its powers and acts are conceived as functions of matter in motion. How, then, does moving matter within the organism generate certain qualities which do not belong to moving matter outside the organism? For Locke the problem raises a difficulty of still another sort. Secondary qualities, such as colors, sounds, odors, exist only as sensations in the mind. In corporeal substances, or bodies, such qualities, he writes, "are nothing but the powers those substances have to produce several ideas in us by our senses; which ideas are not in the things themselves, otherwise than as anything is in its cause." Though they result from the impact of moving particles on the bodily sense organs, they do not belong to the world of matter at all, but to the realm of spirit. How, then, do the motions of matter cause effects which exist only in the immaterial domain of mind?

These questions indicate some of the problems of matter as an object, condition, or cause of knowledge. They also show how the nature of the problem varies with different conceptions of matter, both in itself and in its relation to mind. There are still other problems which confront those theories of mind which separate reason or intellect from the sensitive faculty.

In such theories the consideration of matter's relation to mind goes beyond the question of the origin of sensations. It takes sensations and images as somehow the functions of living matter—the acts of the various sense organs and the brain. But sensations and images, because they are acts of corporeal organs, have the same limitation which belongs to everything material. As matter is said to cause the individuality or numerical diversity of bodies, so is it said to make sensations and

images "particular intentions of the mind"—that is, capable of representing only particular objects, not general kinds or classes. Hence such theories face the problem of the relation of sensations and images to the "universal intentions of the mind," its general concepts or abstract ideas.

ONE MORE TRADITIONAL meaning of matter remains to be mentioned. The sciences of physics or mechanics are concerned with change or motion. They are not concerned with mutability in general, but with the kind of mutability that is manifested by material things. Material things are never conceived as unmovable or unchangeable.

The question whether matter itself is immutable has different meanings for different theories of matter. On the theory (discussed in the chapter on CHANGE) that matter and form are together principles of change in changing substance, it is neither matter nor form but the substance composite of matter and form which changes. Those who think that the motions of the physical world are without beginning and end, attribute a similar eternity to matter and conceive it as imperishable. The theologians who think that God can annihilate whatever He creates, do not hold that matter is indestructible, but they nevertheless attribute everlasting endurance to matter in God's plan. Aquinas, for example, in his treatise on the end of the world, describes the final conflagration which will purge the material universe but leave its matter in existence under the forms of the elements and the heavenly bodies. "The world will be renewed," he writes, "in such a way as to throw off all corruption and remain forever at rest." Hence nothing can be "the subject of that renewal, unless it be a subject of incorruption," such as "the heavenly bodies, the elements, and man." On other theories of matter the fact that motion is regarded as an intrinsic property of bodies seems to be similarly consistent with the notion that matter itself is immutable or indestructible. This indestructibility may be conceived in terms of the absolute indivisibility of the atoms, as in Lucretius and Newton; or, as in Spinoza, it may be established by

the uncreated and eternal nature of God. "By behavior of subatomic particles. In modern body," Spinoza writes, "I understand a mode physics, prior to the introduction of the notion which expresses in a certain and determinate of fields, changes in material things were either manner the essence of God in so far as He is the local motions of bodies or the result of the considered as the thing extended." local motions of their parts. Motions are

In the modern development of the science determined in their magnitude and direction by of mechanics the law of the conservation of the impressed force which one body exerts upon matter seems to be another expression of the another via the fields generated and the same insight. "We may lay it down as an incon- resistance of that other. Motion is itself testable axiom," Lavoisier writes, "that in all completely actual, as matter is; and the only type the operations of art and nature, nothing is cre- of cause to which physics need appeal is the ated; an equal quantity of matter exists both efficient cause, that is, the push or pull of one before and after the experiment." What ap- body upon another through the mediation of the pears to be the destruction of a body is merely fields.

the transformation of its matter into another Physicists who share this conception of physical condition without loss of mass unless matter may not agree, as Descartes and Newton there is an equivalent gain in energy. The total do not, in their mechanical formulations. They quantity of matter and energy remains con- may or may not be atomists. They may, like stant throughout all physical changes. Lucretius, think that local motion is an

But though change or motion seems to be absolutely intrinsic property of the eternal inherent in the material world, the mutability particles; or, like Descartes and Newton, they of bodies, as well as the immutability of mat- may think that God first imparted motion to ter, seems to be differently conceived accord- matter at the world's creation. They may hold ing to different conceptions of matter. The that all subsequent motions issue therefrom in difference between the physics of Aristotle a continuous chain of cause and effect. But and the physics of Descartes can be expressed when matter is the only factor in the in terms of contrary definitions of motion, constitution of bodies, and one body differs or divergent notions of causality, but neither from another only in its quantitative determi- of these differences is fully intelligible apart nations, the consequence for physical theory from the variance of these theories from one seems to be one or another sort of mechanical another on the nature of matter. formulation.

When matter is an actual substance, whose When matter is nothing mbre than a body's essence is extension and whose chief property potentiality for change, and when neither is local motion, the principles of physics are what the body is nor how it changes can be mechanical. The laws of mechanics, with time, explained by reference to its matter alone, space, and mass as their fundamental variables, physical theory seems to be constructed in were adequate for physics until the middle of other than mechanical terms. Its concepts and the 19th century. At this time, through the principles resemble those of biology. It finds work of Faraday and Maxwell, the notion natural tendencies or desires, and ends or final of a field of force entered physics. The first causes, in the motion of inert as well as animate field to be considered was the electromagnetic bodies.

field, of which the electron was considered Central to Aristotle's physics are his theory of the source. Emanating from an electron, this the four causes, discussed in the chapter on field in turn influences the motions of other CAUSE, and his theory of the four types of electrons and causes the fields emanating from change, discussed in the chapter on CHANGE. But them to change in space and time. Like the even more fundamental is his definition of electron, all electrically charged particles gen- motion as the actualization of that which is erate electromagnetic fields. There is also the potential in, a respect in which it is potential. gravitational field generated by all massive ob- With motion so defined, the principles of physics jects as well as other fields that influence the must include the correlative factors of

potentiality and actuality which Aristotle conceives in terms of matter and form.

REMOVE MATTER entirely from a thing and, according to Aristotle, you remove its capacity for physical change. Remove form, and you remove its existence, for nothing can exist without being actual or determinate in certain respects. When a thing changes physically, it loses certain determinate characteristics and acquires others. The determinations it acquires it had previously lacked, yet all the while it must have had a capacity for acquiring them. The thing is "capable both of being and of not being," Aristotle says, "and this capacity," he goes on to say, "is the matter in each." The matter of an existing substance is thus conceived as that which has certain forms (the respects in which the substance is actually determinate), and lacks certain forms which it can assume (the respects in which the substance is both indeterminate and potential).

As the chapter on ART indicates, Aristotle frequently uses artistic production to afford a simple illustration of his theory of matter and form as principles of change. When a man sets out to make a bed, he chooses material, such as wood, which can be shaped in a certain way. The same wood could have been made into a chair or a table. With respect to these various possible determinations in structure, the wood is itself indeterminate and determinable.

Before the artist has worked on it productively, the wood is in a state of both privation and potentiality with regard to the form of a bed, a chair, or a table. The transformation which the artist effects consists in his actualizing certain potentialities in the material for forms or determinations which the material at the moment lacks. When the bed is made, the wood or matter which is now actually in the form of a bed may still have the potentiality for being *remade* into a chair or table.

The wood, of course, remains actually wood throughout these artificial changes, as it does not when it suffers the natural change of combustion. This indicates that though the wood may be called matter or material by the artist, it is not matter, but a substance, a thing composite of matter and form; for when the

wood is reduced to ashes by fire, the matter which had the form of wood assumes another form.

In the analysis of accidental change, which artistic production illustrates, it suffices to treat a composite substance, like wood or iron or bronze, as the material principle. But in the analysis of substantial change, when matter itself changes from being one kind of matter to being another in the coming to be or perishing of composite substances, the material principle must be pure matter—matter totally devoid of form. Where a whole substance can be regarded as the matter or substratum of accidental change (in quality, quantity, or place) the substratum of substantial change, which Aristotle calls "generation and corruption," must be matter in condition of absolute indeterminacy and pure potentiality.

Referring to this ultimate substratum as "the underlying nature," Aristotle says that it "is an object of scientific knowledge by analogy. For as the bronze is to the statue, the wood to the bed, so is the matter and the formless before receiving form to anything which has form, and so also is the underlying nature to substance, *i.e.*, the actually existing."

ARISTOTLE'S DEFINITION of matter as "the primary substratum of each thing, from which it comes to be without qualification, and which persists in the result" not only signifies an object which the physicist must apprehend analogically (*i.e.*, by comparison with substantially formed matter like wood and bronze), but also indicates that matter, by definition, must be in itself both unintelligible and nonexistent. What Aristotle calls "the primary substratum" is later called by Plotinus "primal matter," by Augustine "formless matter," and by Aquinas "prime matter." Since they all agree that that which is without form lacks all determination and actuality, they deny that it can have existence by itself or be an object of knowledge, either by sense or reason.

Augustine and Aquinas go further. They deny even to God's omnipotence the power of creating matter without form. They speak of matter not as created, but as *concreated*, that is, united at the very instant of its ere-

ation with the forms it must assume in order to exist. God "made formless matter of absolutely nothing, and the form of the world from this formless matter," Augustine writes. Yet He "created both simultaneously, so that form came upon matter with no space of time intervening."

IN THE TRADITION of Aristotle's physics and metaphysics, especially as developed by Aquinas, matter and form become basic analytic terms, often having a significance remote from their original meaning in the analysis of change. The conception of prime (or formless) matter as the substratum of substantial change leads to the designation of the formed matter underlying accidental change as "second matter." This, in turn, is called "signate matter" when, considered as the matter of an individual substance, it is viewed as having the limiting determinations of individuality.

"Matter is twofold," Aquinas writes, "common, and signate or individual; common, such as flesh and bones; and individual, as this flesh and these bones." When the intellect forms concepts of different kinds of physical substances, it abstracts "from the individual sensible matter, but not from the common sensible matter." In defining the nature of man, for example, we abstract, Aquinas says, from "this flesh and these bones, which do not belong to the species as such, but to the individual"; but we do not abstract from the fact that man, consisting of body and soul, is a thing of flesh and bones.

To say that man consists of body and soul is to indicate that common matter enters into the definition of man as a physical substance. But in distinction from definitions of this type, which are proper to physics, mathematical and metaphysical definitions carry the abstraction from matter still further. In mathematics, Aquinas declares, the intellect abstracts "not only from individual sensible matter, but also from common sensible matter." In conceiving numbers and figures, the intellect does not, however, abstract from matter entirely, but only from individual intelligible matter. The common intelligible matter which is represented by "substance as subject to quantity"

underlies all mathematical notions. "But some things," Aquinas maintains, "can be abstracted even from common intelligible matter, such as *being, unity, potency, act*, and the like, all of which can exist without matter." Such abstraction characterizes the concepts of metaphysics. Aquinas thus differentiates the three speculative sciences of physics, mathematics, and metaphysics in terms of three grades of abstraction, each distinguished by the type of matter from which the concepts of the science are abstracted.

With one exception physical matter is not said, to be of different kinds when it exists under different forms. The one exception for both Aristotle and Aquinas is the matter of terrestrial and celestial bodies.

Basing his inference on the observations available to him, Aristotle holds that the "heavenly bodies are eternal—"not subject to increase or diminution, but unaging and unalterable and unmodified." Immutable in every other way, they are, however, subject to local motion. Since they are eternal, both their matter and their motion must be different from that of perishable terrestrial bodies. "All things that change have matter," Aristotle writes. "but matter of different sorts; of eternal things those which are not generable but are movable in space have matter—not matter for generation, however, but for motion from one place to another." That motion from place to place is, unlike terrestrial motion, circular; it has the appropriate characteristic of endlessness.

Kepler challenges this theory of a radical difference between celestial and terrestrial matter or motion, and as the chapter on ASTRONOMY AND COSMOLOGY shows, by so doing he not only gives impetus to the Copernican system, but also paves the way for Newton to frame laws of motion applicable to matter everywhere in the universe. Because their matter is the same, it is possible, Kepler insists, to explain the motion of the heavenly bodies by the same principles which account for the motion of bodies on earth.

In contemporary cosmology, the possibility is raised that the universe could continue expanding indefinitely. One may then ask what the ultimate state of matter would resemble.

Until recently one would have imagined it would be material objects such as protons and electrons along with massless objects such as neutrinos and electromagnetic radiation. However, some contemporary theories suggest that the proton decays into other particles which, in turn, decay into massless objects and electrons. Some cosmologies are cyclical in character with alternating phases of expansion and contraction. A fascinating question is whether our present universe would then contain any traces of its ancestors.