

Whitehead: Process and Cosmology

Introduction

Alfred North Whitehead (1861–1947) occupies a remarkable position in twentieth century philosophy. Though he co-authored the seminal *Principia mathematica* with his former student Bertrand Russell, and later supervised W. V. Quine, his influence on later analytic philosophy has been minimal, while in other circles his work enjoyed cult status. Largely ignored by professionals in his native Britain, he is respected in his adopted America, and receives interest in continental Europe. Trained as a mathematician, he moved into logic and the foundations of mathematics. In his fifties he began writing about the philosophy of science, physics, and education, and at 63 emigrated to the United States, teaching as Professor of Philosophy at Harvard University for a further thirteen years. His chief work, *Process and Reality: An Essay in Cosmology* (1929) has been compared, for length, difficulty, and importance, to Kant's *Critique of Pure Reason*. This work—we will refer to it as 'PR'—completed Whitehead's transformation into a metaphysician, and it is the focus of our attention.

PR crowned a flourishing period of metaphysical philosophy, but as analytic philosophy fell under the anti-metaphysical spell of logical positivism and linguistic philosophy, *PR*'s frankly speculative metaphysics came to seem outmoded. Its reception was not helped by Whitehead's often arcane terminology, the unclarity of crucial passages, and the offputtingly abstract opening chapter. In America, with Whitehead on hand to expound his views in person, his influence blossomed, but in his native land he was largely written off. The process philosophy and theology that *PR* set in train frequently outdid the master in obscurity, and Whitehead's reputation suffered by association. He was also unfortunate that his work consistently fell into the cracks between mathematics, philosophy and physics.

In my judgement *PR* is the greatest single metaphysical work of the twentieth century. Despite its difficulties its message can be put clearly; despite Whitehead's shifts of interest it represents the culmination of a metaphysical odyssey he had pursued since his twenties; and despite its age we can take lessons from its content and method even today.

Early Writings

Whitehead studied mathematics in Cambridge. In 1884 he submitted a dissertation on James Clerk Maxwell's epochal *Treatise on Electricity and Magnetism* (1873), which earned him election as a fellow of Trinity College. Maxwell's work is famous for proposing that electromagnetic waves radiate at the speed of light, and for the equations which draw electricity and magnetism together into a unified theory. Whitehead's dissertation was unfortunately not preserved: it might have given a picture of his earliest encounters with the themes of fundamental physical processes, space and time, to which his writings return throughout his career. The transmission of energy in electromagnetic radiation is very different from the picture of energy, found in Newtonian physics, as carried by moving material particles, and reflection on this may have led Whitehead to his criticisms of Newton and traditional mechanics.

Whitehead's first book was *A Treatise on Universal Algebra with Applications* (1898), a systematic compendium of the algebraic revolution of the nineteenth century, covering Hamilton's quaternions, Grassmann's geometric calculus of extensions, and Boole's algebra of logic. Its principal focus is the algebra of geometry. He intended to continue the work but when his former student Bertrand Russell completed a first draft of *The Principles of Mathematics* in 1900 they found they had enough in common to pool their projects. The road to a common "Volume 2" was stony, being interrupted in mid-1901 by Russell's discovery of the paradox of set theory that bears his name. Their unexpectedly extended collaboration produced a three-volume epic: *Principia mathematica* (1910-13). Its relevance for Whitehead's metaphysics is twofold. Firstly, it schooled him as nothing else could in concocting new definitions and using symbolic logic to give rigorous proofs. Secondly, there was supposed to be a fourth volume of *Principia*, on geometry, which it was agreed Whitehead would write alone. For various reasons this was never completed, but the subject of geometry and its relation to reality drove much of Whitehead's later work.

Whitehead's interest in geometry showed itself in the publication of two textbooks, *The Axioms of Projective Geometry* (1906) and *The Axioms of Descriptive Geometry* (1907). But nothing from his early period so presaged his later metaphysical concerns as the remarkable sixty-page memoir "On Mathematical Concepts of the Material World" (MC), published in the *Philosophical Transactions*

of the Royal Society of London in 1906. This memoir links his early interest in Maxwell, his *Principia* work on geometry, and his later work on space, time, physics and cosmology.

In MC, Whitehead put forward several different axiomatic models of a world of material entities in space and time, from each of which the principles of Euclidean geometry could be derived. Each concept is based on a number of different fundamental relations: the *essential* relation, the *time* relation, and the *extraneous* relation.

In the first, Newtonian concept, points of space are the field of the essential relation, and material particles the field of the extraneous relation. This is Newton's absolute space with its occupying matter. Whitehead disapproves of the dualism of space and matter, preferring a monistic account in which space and matter form a single field of entities. The next two concepts are monistic revisions of the first. For example in Concept III the four-placed essential relation $R(a,b,c,t)$ means 'the objective reals a , b and c stand in the R -relation at t '. The points of this Concept are not static, but move, like particles. In Concepts IV and V the objective reals are not pointlike but linear. The linear basic entities are used to define points as certain classes, anticipating Whitehead's later use of extensive abstraction. The preference for linear over punctual basic entities is related to Faraday's conception of *lines of force* as physically basic.

Each of the five main concepts is developed axiomatically, using a modified Peano notation which would become familiar only four years later with *Principia*, and so presented a challenge to which few contemporary readers could rise. The memoir was generally overlooked, but Whitehead thought it one of his best pieces.

Philosophy of Nature

In working on the abortive fourth geometry volume of *Principia*, Whitehead intended to incorporate the new Lorentz–Einstein–Minkowski theory of relativity into his account of geometry. His criticism of Newton's dynamics was now clear. Newton's separation of an absolute space and time from its contingent filler, inert matter, constituted an unacceptable "bifurcation of nature" embodying the "fallacy of simple location": the idea that material stuff is simply passively at a place at a time. Like Leibniz, Whitehead regarded matter as active and inseparable in reality from its

spatiotemporal location. In expressing this he needed to take account of the revolutionary interweaving of space and time brought about by Einstein's theories of relativity and their formalization by Minkowski. Whitehead's response to the challenge was *An Enquiry Concerning the Principles of Natural Knowledge (PNK)*, published in 1919. This, the most polished of his middle-period works, is an attempt at "providing a physical basis for the more modern views" (*PNK* vi) consonant with Whitehead's emerging philosophy. The result is a work juxtaposing lucid prose with sketched mathematical developments. The principle aim is to articulate a unified mathematical account of the related basic entities of nature, in such a way that both relativistic dynamics and classical geometry are adequately represented. It thus continues the thrust of MC, but in a less rigorous presentation.

To overcome the "bifurcation" and incorporate the interweaving of space and time, Whitehead takes the basic entities to be four-dimensional *events*, which was a step beyond Minkowski, whose world-lines represented the "everlasting careers" of material and electrical points. The challenge is to explain how events are related so as to give rise to the dynamics and geometry we expect. In order to do this Whitehead employs the idea of one event *B's extending over* another event *A*, or as we would say, event *A's* being *part of* event *B*. Whitehead rapidly sketches a formal theory of part and whole, or *mereology*, before proceeding to his new *method of extensive abstraction* for using events to define various geometrical entities. We can illustrate this method by the simple example of a spatial point. Ignore time, and just consider the events happening at one instant. Suppose we take one event, and find another which is part of it, then another which is a part of that, and so on without end, like an unending succession of nested Russian dolls. Suppose also that no event is a part of every one of the series, so they get ever smaller without limit. Intuitively, they converge to a spatial point. But we could have got to the same point by many such sequences. Whitehead cunningly shows how we can say that two such sequences co-converge, without actually mentioning the point. Any two co-convergent sequences give us the same point, but this is not a real thing nesting inside all the sequences: Whitehead turns the idea on its head and *defines* the point as the collection of all those co-converging sequences. The point is then a mathematical abstraction, not a real entity. All that really exists are the events, and "Every element of space or of time ... is an abstract entity formed out of this relation of extension ... by means of a determinate logical procedure." (*PNK* 75). Using this method to define various other

geometrical entities makes up the bulk of the book. But Whitehead knows that his events are unlike the familiar objects of everyday, so he explains that objects are not fundamental things, but items that can be “recognized” among certain sequences of events, intuitively, those that “involve” the object in question. While we name events after their participants, the events are more fundamental.

PNK replaced axioms by prose, perhaps to appeal to a wider readership, but Whitehead nevertheless failed to gain the attention of physicists, perhaps because the work was seen by them as too philosophical. *The Concept of Nature* (1920) repeated Whitehead’s position less technically. Whitehead then published *The Principle of Relativity, with Applications to Physical Science* (1922), which unlike Einstein presented relativity theory within a Euclidean framework, separating the tensor of spacetime from the tensor of gravity, whereas in Einstein these are unified. It showed Whitehead at the forefront of British reception of relativity theory and prepared to grapple with physicists on their own terms, but again they did not take it seriously, and it is now believed to have been empirically refuted, making predictions which diverged from those of Einstein. *Science and the Modern World (SMW, 1926)*, based on the Lowell Lectures delivered in Harvard, is a readable historical cruise through the after-effects of the scientific revolution of the seventeenth century. It continues and deepens Whitehead’s critique of post-Newtonian mechanistic materialism, deploring the various dualisms of mind and matter, science and art, mechanism and purpose that pervade the modern world-view. He traces the problems to what he calls the *fallacy of misplaced concreteness*, which consists in treating mathematical abstractions like instants of time or point-particles as if they were the realest things. Whitehead’s aim is to replace mechanistic materialism by a new metaphysics true to our experience, which yields the right (modern) physical results, explains the applicability of mathematics, and satisfies his philosophical rejection of dualisms. The later chapters of *SMW*, added after the lectures, set about this task, plunging us into his mature metaphysical view, which Whitehead called the *philosophy of organism*.

The Mature Metaphysics: Process and Becoming

In 1924 Whitehead became a professional philosopher at the advanced age of 63, with his appointment to a chair at Harvard. He loved America, and America loved him in return: he continued to teach until 1937, and his Sunday soirées in Cambridge

Massachusetts became legendary. After the lectures which became *SMW*, he was invited to give a 1927 series of Gifford Lectures in Edinburgh. Lord Adam Gifford (1820-87) had stipulated in his will that money from his estate be used to fund periodic lectures at the Scottish universities on natural theology. Whitehead had been much impressed by Samuel Alexander's 1917-18 Glasgow series, published in 1920 as *Space, Time and Deity*, and agreed. The result was published in 1929 as *Process and Reality*, and it is Whitehead's greatest philosophical work. Unfortunately it is also his hardest. The lectures were well attended at first, but dwindled to single-figure attendances, which Whitehead seems not to have noticed.

The first thing to note is that Whitehead seems, if we go by the title, to replace *events* as the principal items of his metaphysics by *processes*. This has misled many commentators. In fact there are no items in Whitehead's ontology called 'processes'. Rather the term 'process' refers to the way in which the basic things—which still *are* events—come into existence and cease to exist. Whitehead calls this *becoming*.

The principal difference between the events of the nature philosophy and those of *PR* and afterwards is that the earlier events are complex: they have parts, their parts have parts, and so on without end: every event has some other event as a proper part, so there are no atomic events. The events of *PR* on the other hand are all atomic: they have no proper parts. To distinguish them from the earlier events, Whitehead renames them 'actual occasions': 'actual' because they are real. Apart from these atomic events, there is one other actual item in Whitehead's ontology, and that is God. Because God is eternal and not an event, Whitehead calls God and occasions taken together *actual entities*.

Why did Whitehead change his mind on whether events have parts? It turns on an argument in *SMW* (158-60), related to Zeno's Paradoxes. Recall that Whitehead rejected the idea of temporal instants as real entities: instants are abstract limits. So all times are finite in extent. Also there are no empty times or spaces: they are given with their occupants. Now imagine some event occurring. It cannot occur in an instant, since there is no such thing. So it occurs over an interval. But if the occurring has a first half, and this in turn has a first half, and so on, and an event cannot start unless its first instant occurs first, then no event can occur over an interval. Time becomes impossible. But time clearly is possible, so we must reject part of the reasoning. Whitehead rejects the view that an event which occurs over an interval comes into being gradually, instant by instant, as the interval unfolds. Rather the event *simply*

occurs, and brings a small bubble of spacetime into existence with it. This bubble has earlier and later parts, but the event itself is atomic. “There is a becoming of continuity, but no continuity of becoming. ... the ultimate metaphysical truth is atomism. The creatures are atomic.” (PR 35) Each event “enjoys” a small bubble of spacetime, and they cannot be separated, but they have different properties. Whitehead therefore transfers his mereology from events to spatiotemporal regions. The Zenonian argument must have been convincing to Whitehead since it forced him to disjoin the continuity of spacetime from the atomicity its occupants, something he had previously opposed. As to the cogency of the argument, it seems to me that there is no absurdity in supposing that even miniscule events unfold continuously, and acquire new temporal phases as time goes by. Whitehead might as a matter of empirical fact be right that the most basic events are atomic, but it is not mandated by his argument. And while it is conceptually liberating to uncouple the parts of spacetime from the parts of their occupants, it is not self-evidently correct.

If events do not unfold, why then, when they become, does Whitehead talk about ‘process’? Although events come about all at once, their becoming can be analysed in regard to their antecedents. This analysis Whitehead calls “genetic”, since it comprises “stages” whose sequence is logical rather than temporal, and the analysis is essentially backward-looking. Every new event has its own universe, out of which it is generated. This universe comprises two kinds of thing. Firstly, there are all the ideal kinds or universals, what Whitehead calls *eternal objects*. Being outside space and time, these are equally accessible to all events. Secondly, there are all the previous events which are accessible to the new event. This accessibility is restricted by the relativistic principle that no causal influence can travel faster than the speed of light. So the events accessible to a new event are all those in its backward light-cone. The description of how events come to be on the basis of their antecedents is the central theme of Whitehead’s metaphysics. Although in concrete detail it varies from one event to another, the general scheme of becoming is the same for all, so I call it the *basic cell* of Whitehead’s metaphysics.

The key to understanding the basic cell is that events are what they are solely in virtue of their relations to other things. It is instructive to compare Whitehead’s events with Leibniz’s monads. The first difference is that Leibniz’s monads are enduring things which have a history, whereas Whitehead’s actual occasions are over and done in a flash. But more importantly, Leibniz’s monads are as they are because of their

qualities, and they do not depend on anything outside them, except God, for being the way they are. Leibniz denies that there is any real interaction between monads, describing them as “windowless”. Whitehead’s events by contrast are all window: they are as they are because of how they relate to other things. The first way in which they are is that they have certain qualities. But they have them not in themselves, as in Leibniz, but because they stand in a relation to certain eternal objects. This relation, which in traditional philosophy is called *instantiation*, in Whitehead is called *ingression*. Eternal objects ingress into individual events to make them what they are. Apart from the terminological difference from Plato, Whitehead’s theory stresses two additional points. The first is that eternal objects are not actual or real in themselves, but only in so far as they ingress into actual events. In themselves they are nothing but pure potentialities for ingression. The second point is that for describing the genesis of events we should see the relation of ingression not from the eternal object’s end of the relation but from that of the event. The genesis of the events is described in quasi-psychological terms. We imagine a would-be event striving to come into existence. It surveys all the eternal objects, is related to them by a relation Whitehead calls *conceptual prehension*. We might say the would-be event is “aware of” all the eternal objects. But it cannot be all ways, for example it cannot have an energy of 1 Joule and also an energy of 2 Joules. So it must “select” among the eternal objects the ones it is going to have ingress. The selection means it prehends some eternal objects positively and others negatively. Positive prehension Whitehead calls *feeling*. An event’s feeling a universal is the same as the universal’s ingressing into the event. But an event is determined as what it is not just by its relations to eternal objects, but also by its relations to all events in its universe. Whitehead again calls these relations ‘prehensions’, but because the entities prehended are real, he calls them *physical prehensions*. Again physical prehensions are positive or negative: a positive prehension of an event *E* by a becoming event *B* constitutes *E*’s affecting the way *B* is when it becomes, so *B* being like *E* in some way, whereas if *B* negatively prehends *E* it becomes unlike *E* and *E* does not influence the way it is. Since influence can pass through events to later events, prehensions can be ramified to any degree of complexity, and each new event becomes what it is through the sum total of its prehensions. In general the physical prehensions have a far greater say in determining how an event is, conceptual prehensions being generally mediated by physical ones. Roughly speaking, like tends to engender like.

When an event comes to pass, it does so as a small burst of novelty in the world, integrating all the objects and events in its universe in a new synthesis which it embodies. Since no two events have the same universe from which to arise, each event is in some respect new. For this reason Whitehead thinks there is a supreme category which encapsulates the essence of the basic cell: he calls it *creativity* and describes it as *the category of the ultimate*. Creativity consists in a new individual (one) coming into being through a novel (creative) synthesis of its antecedents (many). As soon as an event comes into being, it ceases to exist, or “dies”, and the quantum of spacetime it brings with it is succeeded by others. Hence Whitehead describes time, in Locke’s phrase, as a ‘perpetual perishing’. But in coming to be, or becoming concrete (Whitehead also calls becoming ‘concrecence’), the event not only advances the world a little and enriches it with its novel character, in dying it becomes available for later generations of events toprehend: its influence lives on in subsequent events, in a way reminiscent of causal influence, though Whitehead uses the term ‘cause’ with reluctance.

This is basically all there is to Whitehead’s cosmology: the rest plays out the implications of the countless repetitions of the basic cell of becoming throughout time and space. The account is so schematic that it can fit parts of the life of the universe, what Whitehead calls *epochs*, which may differ in many respects from our own, for example in having more or fewer spatial dimensions, or different laws of nature. The term ‘process’ then, paradoxically, refers principally to the atemporal genetic analysis of events, and Whitehead calls events *organisms* because his account of them is ecological, based on their relationships to their surrounding universes. Secondly of course ‘process’ can refer to the rich tapestry of happenings unfolding as ever new generations of events come into being.

Human beings and other enduring objects are obviously not events or even collections of events, so as in his nature philosophy, Whitehead tries to explain what they (and we) are. Again he does so in terms of a kind of inherited order among families of (more or less) simultaneous events. Families of events may have what Whitehead calls a ‘social order’: the social order of enduring objects like people is called ‘personal order’.

The spatiotemporal arena which is advanced with novel events is subject to similar principles of part/whole that Whitehead employed in *PNK*, but now not events but their regions are what stand in those relations. Whitehead integrates his part/whole

theory or mereology with the topological notions of connectedness and boundary, and so becomes perhaps the first to pursue what is now called *mereotopology*. Points and instants remain as abstract as before: Whitehead is concerned throughout to build his cosmology out of kinds of entities which can be experienced or perceived.

Perception, or rather its pre-conscious analogue, prehension, forms the cement out of which Whitehead's cosmos is built. Whitehead's use of psychological terms like 'prehend', 'feel' and 'subject' is deliberate. Like Leibniz, he is a *panpsychist*, considering all actual entities to be in some way mental, if only at a rudimentary level. This marks him out from Alexander, who saw the mental as emerging from mere matter. Whitehead loses the categorial difference between the mental and the physical that besets Descartes, but the price of this is supposing that even electrons have feelings, just not the kind of conscious ones we know.

Whitehead rounds out his metaphysics, as befits a Gifford lecturer, with God. In Whitehead's scheme God has two aspects, or natures: a primordial nature, which consists in God's eternal characteristics, forming a repository for all eternal objects (which are potentialities, only actualized when something of their kind comes to be), and a consequent nature, in which God keeps pace with the evolution of the universe, providing a memory store for all actual occasions, including those that are no longer in existence, to retain a form of immortality beyond the more or less faint traces they leave in subsequent events. Whitehead's views, which are somewhat sketchily laid out in *PR*, became the fountainhead of a whole movement called 'process theology', which has portrayed Whitehead as more of a theologian than he was—I personally regard the teleological or purposive aspect of Whitehead's metaphysics, including God, as a sentimental throwback that can be dispensed with.

Whitehead's God crowned his metaphysics, which retains elements of purpose even within the inanimate. In this as in many other respects Whitehead's metaphysics recalls that of Plato. He acknowledged this and declared that European philosophy "consists in a series of footnotes to Plato" (*PR* 39), not in the sense that platonism dominated, but that Plato's many rich ideas, particularly those of his cosmology, the *Timaeus*, had been repeatedly taken up, echoed and modified throughout European history. The only cosmology to stand comparison with Plato's is that of the *Scholium* to Newton's *Principia*, a work whose title he and Russell had borrowed. But while Whitehead accepts that Newton's science was more advanced than Plato's, he regards

Plato's cosmology overall as deeper and philosophically more satisfactory. It is in Plato's footsteps that he aspired to tread.

Speculative Metaphysics and the Categories

Metaphysics, the noblest of all philosophic enterprises, is the attempt to give an account of everything. Unlike the special sciences, metaphysics does not descend into detail for its own sake. Rather its job is to provide a universal framework within which anything whatever can take its place. That framework consists of a scheme of most general concepts or *categories*, within which all classifications of things are to be situated, together with a collection of general principles or *archai* which describe the way in which the things falling under the various categories are interrelated and interwoven.

Whitehead marked his awareness of these different basic things by distinguishing *four* different conceptions of category. The category of the ultimate, creativity, epitomizes becoming as the creation of a new one from a prior many. It is intended to supplant Aristotle's first substance as the most important single metaphysical notion. But unlike substance, creativity is not an entity in the world. Not even God is the ultimate in Whitehead, since God is an entity. "In all philosophic theory", he writes, "there is an ultimate which is actual in virtue of its accidents." (*PR* 7) In Whitehead this is creativity, of which God is the first, non-temporal accident: Whitehead considered Spinoza, Bradley and others wrongly elevated God to the position of the ultimate, which no actual thing could be. In taking the ultimate not to be an entity Whitehead is close to some pre-Socratic philosophers.

What others call 'categories', most general classes of entity, Whitehead calls 'categories of existence'. They comprise actual entities (God and events) and eternal objects, but also prehensions, multiplicities (classes), *nexūs* (interlinked groups of events), subjective forms (roughly, perceptual complexes), propositions, and contrasts, which form an infinite class of kinds and are somewhat like Russell's types of propositional function. Of these, actual entities and eternal objects "stand out with a certain extreme finality" (*PR* 22). In addition, there are twenty-seven *categories of explanation*, which are not classes of things but sorts of general explanatory principles specific to Whitehead's cosmology. Finally there are nine *categorial obligations*, which are partly terminological, partly again explanatory principles. The first chapter

of *PR*, 'Speculative Philosophy', in which these categories and principles are listed, is one of the most dizzyingly abstract in all philosophy, and offputting to most readers.

Despite this, the chapter repays patient study. Whitehead gave here perhaps the clearest account of the systematic role of metaphysics of any philosopher in recent centuries. He wrote, "Speculative philosophy is the endeavour to frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted. By ... 'interpretation' ... I mean that everything of which we are conscious ... shall have the character of a particular instance of the general scheme." (*PR* 3) Whitehead's soaring ambition impelled him to attempt just such a system, covering everything, though the cosmology of *PR* was concerned principally with the physical universe rather than with biology, society, history, culture, art, religion, or mathematics. Some of these topics he addressed in other late writings, especially *Adventures of Ideas* (1933). At the same time he was acutely conscious of his human and personal limitations, and, mindful of the demise of Newton's cosmology, he warns "There remains the final reflection, how shallow, puny, and imperfect are efforts to sound the depths in the nature of things. In philosophical discussion, the merest hint of dogmatic certainty as to finality of statement is an exhibition of folly." (*PR* xiv)*

* I am indebted for discussion on Whitehead and relativity to Mr Ronny Desmet.

References and Further Reading

Principal Metaphysical Works by Whitehead

(MC) On Mathematical Concepts of the Material World. *Philosophical Transactions of the Royal Society Series A*, 205, 465–525; reprinted in Northrop, F. C. and Gross, M. W., (eds.) *Alfred North Whitehead. An Anthology*. Cambridge: Cambridge University Press, 1953, 11–82.

Five axiomatic cosmologies. Still astonishing.

(PNK) *An Enquiry Concerning the Principles of Natural Knowledge*. Cambridge Uni. Press, 1919, 2nd ed, 1925.

The Concept of Nature. Cambridge: Cambridge University Press, 1920.

Science and the Modern World. Cambridge: Cambridge University Press, 1926.

Why Newton's cosmology was wrong, and what to do about it.

(PR) *Process and Reality. An Essay in Cosmology*. Originally published 1929.

Corrected edition, ed. D. R. Griffin and D. W. Sherburne. New York: Macmillan, 1978.

This edition corrects the hundreds of typographical and other errors of the original. Like Mount Everest, worth the effort.

Adventures of Ideas. New York: Macmillan, 1933.

Covering a wider range than *PR*, the most accessible of Whitehead's late philosophical works.

Selected Secondary Literature

Lowe, Victor, *Understanding Whitehead*. Baltimore: Johns Hopkins University Press, 1962.

Lowe was Whitehead's student and his most balanced commentator.

— 1985. *A. N. Whitehead: The Man and His Work, Vol. 1. 1861–1910*, 1985; *Vol. 2 1910–1947* with J. B. Schneewind, 1990. Baltimore: Johns Hopkins University Press.

Insightful and sadly incomplete biography.

Mays, Wolfe, *Whitehead's Philosophy of Science and Metaphysics: An Introduction to his Thought*. The Hague: Martinus Nijhoff, 1977.

Showing the continuity of Whitehead's concerns, and the importance of MC, Mays strives to put Whitehead into plain terms.