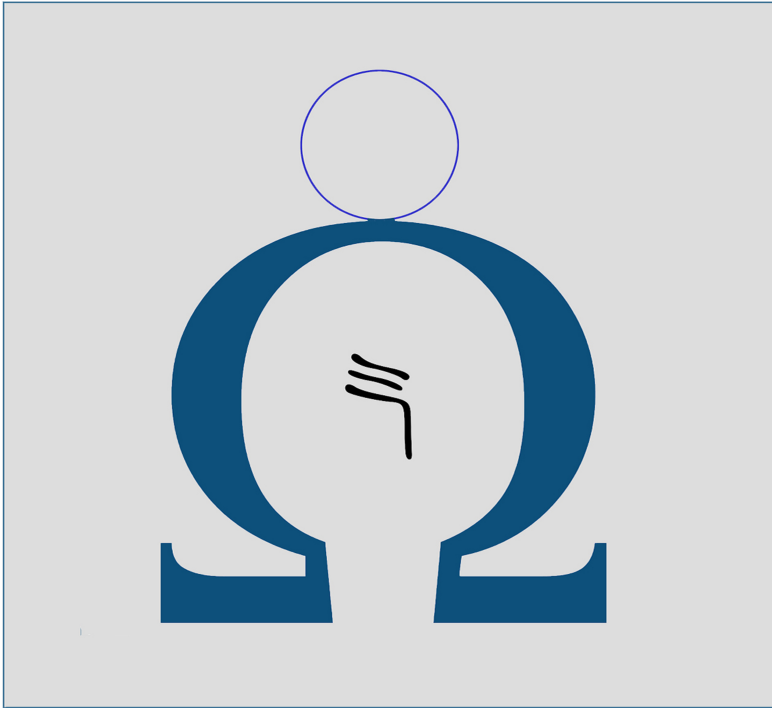


WIM VAN DEN DUNGEN



Critical Metaphysics of Process

Volume II : Actuality, Cosmos,
and the Divine

Critical Metaphysics of Process

Volume II : Actuality, Cosmos, and the Divine

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Two things fill the mind with ever new and increasing admiration and awe, the more often and steadily we reflect upon them : the starry heavens above me and the moral law within me.

Kant, I. : *Critique of Practical Reason*, Conclusion.

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Volume II begins from what remains.

The true method of discovery is like the flight of an aeroplane. It starts from the ground of particular observation ; it makes a flight in the thin air of imaginative generalization ; and it again lands for renewed observation rendered acute by rational interpretation.

Whitehead, A.N. : *Process and Reality : An Essay in Cosmology*, 1978, p. 5.

From Critique to Reconstruction

This second volume does not begin a new inquiry. It continues an argument whose critical conditions were established in Volume I. The division between the two volumes marks a change of task rather than a break in method.

Volume I asked what metaphysics may legitimately claim once the limits of conceptual knowledge are taken seriously. It distinguished science, normative philosophy, immanent metaphysics, and transcendent metaphysics ; examined the conditions under which speculative thought remains admissible ; developed a processual account of actuality ; and subjected persons and phenomena to ultimate analysis. The decisive result was negative only in a carefully delimited sense : no inherently existing substance, essence, self, phenomenon, or self-grounding foundation could be established. Yet conventional existence, dependent arising, causal efficacy, organization, conscious presence, and the world in which these occur were not thereby abolished. Critique removed an imagined mode of existence. It did not empty actuality of its operations.

Volume II begins from what remains. Its task is predominantly constructive. If actuality is processual and empty of inherent existence, how may it nevertheless be thought comprehensively without turning the concepts used to understand it into new substances ? The answer proposed here is a critical metaphysics of process : speculative and arguable rather than experimentally testable, informed by valid scientific and experiential knowledge, corrigible in its constructions, and governed throughout by the prohibition against reification.

The first part develops general metaphysics. It asks what positive reconstruction remains possible after ultimate analysis and articulates the principal modes through which actuality operates. Matter, information, and consciousness are treated as three irreducible but interdependent operators : energetic efficacy, formative organization, and mere cognizing presence. They are not separate substances or independent worlds. They distinguish modes of operation within one processual actuality and are finally considered in their conjunction within aggregates, organizations, societies, and the world-system.

The second part turns from general to special metaphysics. The general scheme is brought to bear upon two encompassing objects that cannot themselves be isolated and experimentally inspected as ordinary objects can : cosmos and the Divine. Metaphysical cosmology asks what contemporary cosmological knowledge permits philosophy to say about the world-system, its development, possibilities, and limits. Metaphysical theology asks whether, and under what conditions, Divine agency may be admitted within a process metaphysics without restoring substance, supernatural intervention, or an independently existing ground. The inquiry closes with full-emptiness : the conjunction of the dependent fullness of actuality with its complete absence of inherent existence.

Volume I establishes the critical boundary conditions ; **Volume II** works within them. Together they form one movement : analysis clears the field, reconstruction articulates what remains, and special metaphysics asks how far this reconstruction may extend without violating the conditions making metaphysics possible.

PART I

General Metaphysics

Chapter 1 | Critical General Metaphysics

Ultimate analysis does not leave metaphysics with nothing. It establishes that neither persons nor phenomena can be found to possess inherent existence. No substantial identity appears under analysis ; no independently existing whole remains after its alleged identity with or difference from its parts has been examined.

Yet this failure to establish substantial existence does not abolish conventional existence, dependent arising, causal efficacy, organization, or mere cognizing presence. Emptiness removes an imagined mode of existence. It does not remove what dependently arises and functions.

The task now changes.

Volume I, chapter 6, proceeded analytically, removing substantial instantiation from the objects of thought. The present chapter proceeds constructively, asking what kind of general metaphysics remains possible once this removal has been completed. The transition is not a return to foundational ontology. No self-sufficient ground is sought beneath or behind the world, and no ultimate constituent is introduced to replace the substances already rejected. Positive metaphysical construction is possible only under the condition established by ultimate analysis : whatever is proposed must itself *remain empty of inherent existence*.

General metaphysics belongs to the immanent register. It considers the *most comprehensive features* of actuality and seeks an arguable totalization of the world-system, but it neither tests propositions as science does nor identifies binding conditions as normative philosophy does. Nor does it cross the transcendent limit and claim conceptual possession of reality-as-such. Its propositions are speculative : they are not testable, but they remain answerable to logic, semantic clarity, coherence, valid scientific knowledge, explanatory adequacy, and the prohibition against reification.

Speculation is therefore not *unrestrained invention*. It is hyper-conceptual totalization. Hyper-concepts gather distinct fields of knowledge into an encompassing and revisable scheme, but they remain conceptual constructions. They may disclose relations, identify *lacunae*, organize possibilities, and guide inquiry. They do not reproduce the *noumenon*, intuit the Absolute, or reveal how reality exists independently of every possible mode of apprehension. Their force is heuristic and argumentative, never foundational.

Such speculation arises within a relation.

Its subject is the pliant mind capable of moving between perspectives, integrating heterogeneous materials, and revising its constructions without converting them into fixed identities. Its object is the world-system : the widest immanent totalization of the exhaustive field of actualities together with the conditioned virtual possibilities of further actuality, considered as one open and internally differentiated process. Neither pole may absorb the other. The speculative subject does not create the world-system, while the world-system does not dictate its own complete conceptual representation. The metaphysical scheme is produced within

their relation and remains corrigible under the resistance offered by facts, arguments, and the limits of conceptual thought.

The process orientation adopted earlier now receives its most comprehensive articulation. The differential-extensive actual occasion remains the *elementary unit* of the ontological scheme, but an account of individual occasions, aggregates, and societies does not yet explain the general modes through which actuality becomes efficacious, organized, and consciously present. For this purpose, three operators are proposed : matter, information, and consciousness.

These operators are not substances, separate worlds, or entities acting behind actual occasions. Matter names energetic efficacy and efficient determination. Information names formative organization, differentiated constraint, and architecture. Consciousness names mere cognizing presence and, where individualized, supports meaning, valuation, intent, and choice. The operators are distinguishable without being isolated and interdependent without being identical. Their triadic articulation rejects materialism, informationalism, and mentalism alike. None can absorb the other two without explanatory loss.

The chapter first clarifies the possibility and limits of general metaphysics after ultimate analysis. It then examines existence, non-existence, potentiality, and virtuality before presenting the argument for the three-operator thesis. Matter, information, and consciousness are subsequently treated in their own right and finally brought together within aggregates, organizations, societies, and the world-system. The virtual world-ground will appear only as formative possibility : not as an entity, cosmic agent, primordial substance, or self-sufficient cause.

General metaphysics thus reconstructs what ultimate analysis has desubstantialized. It affirms operation without operator-substances, organization without independently existing forms, sentient presence without a substantial mind, and a world-system without a self-grounding totality. What exists is full in its dependent operations and empty of existence from its own side.

A. Positive Reconstruction

This section establishes the conditions under which positive metaphysical reconstruction remains possible after ultimate analysis has *dissolved every claim to inherent existence*. Its task is neither to restore a hidden ground nor to replace rejected substances with new ones, but to determine the legitimate scope of general metaphysics once persons, phenomena, and totalities are understood as dependently arisen and empty.

The inquiry proceeds from the transition itself, then defines the world-system as the speculative object of immanent metaphysics, clarifies hyper-conceptual totalization as its constructive method, and concludes by stating the criteria, corrigibility, and limits governing every claim that follows.

1. From Ultimate Analysis to Positive Reconstruction

Ultimate analysis clears rather than grounds. It removes the attribution of inherent existence without abolishing the objects to which that attribution had been added.

When no substantial identity can be found in a person or phenomenon, the conclusion is not that nothing exists. It is that the object exists conventionally and dependently while lacking existence from its own side :

$C(A) \wedge \neg SV(A)$

The negation ($\neg$) of inherent existence (or *svabhāva* – **SV**), does not entail the negation of conventional existence. Nor does the failure to discover an independently existing bearer eliminate identity, organization, causal efficacy, or function. What remains is the process person, the process phenomenon, and the network of conditions through which each arises, changes, operates, and ceases.

This result establishes the condition for positive reconstruction. Metaphysics may continue to identify relations, distinguish modes of operation, propose comprehensive schemes, and inquire into the organization of the world-system. What it may no longer do is convert these constructions into substances, essences, self-sufficient grounds, or ultimate descriptions of reality-as-such. Every positive determination must therefore remain compatible with the emptiness established by ultimate analysis.

Positive reconstruction is not kataphatic discourse concerning the ultimate. It does not claim to describe the Absolute, establish an onto-semantic bridge to the transcendent, or identify the final constituents of reality independently of all cognition and designation. Its positivity is immanent and functional. It concerns what conventionally exists, how it functions, upon what it depends, and through which relations and organizations its efficacy becomes intelligible.

The distinction is decisive. Ultimate analysis asks whether an object possesses an analytically discoverable identity establishing it from its own side. General metaphysics asks how conventionally existing objects may be comprehensively understood once such inherent identity has been rejected. The first inquiry dissolves substantial instantiation. The second constructs a speculative account from logical, functional, conventional, and mere existential instantiation. The change of direction does not cancel the result of the analysis ; it applies it.

Accordingly, the concepts introduced in general metaphysics must remain empty as well. *Process, actual occasion, world-system, matter, information, consciousness, and world-ground* are not exempt from the analysis applied to persons and phenomena. They are hyper-concepts through which dependent actuality is organized in thought. Their explanatory usefulness does not confer inherent existence upon them. Even the preferred language of relation, process, and dependence may become reified when its terms are treated as ultimate things rather than as revisable conceptual instruments.

This does not weaken metaphysical construction. It specifies its legitimate force. A metaphysical scheme can be coherent, comprehensive, scientifically consonant, and explanatorily fruitful without being foundational or absolutely true. It may disclose patterns that specialized sciences consider only within restricted domains, articulate relations among otherwise separated fields, and propose a general orientation for understanding actuality. Its claims remain arguable rather than testable, but they are not arbitrary. They are constrained by logic, semantic clarity,

valid knowledge, explanatory adequacy, and the requirement that no concept be transformed into a self-grounding reality.

Ultimate analysis and positive reconstruction are therefore complementary. Without analysis, construction readily hardens into substantialism. Without reconstruction, analysis may be mistaken for nihilism and leave the dependent fullness of actuality unarticulated. Emptiness prevents metaphysical concepts from becoming substances ; dependent functioning supplies the material from which general metaphysics may build. The present chapter begins from this conjunction and asks how the world-system can be thought positively without attributing inherent existence to the actual world, the virtual world-ground, their processes, or the concepts through which they are understood.

2. The Scope of General Metaphysics

General metaphysics asks how the most comprehensive features of conventional actuality may be thought together. It does not seek an inventory of every object, event, or law, nor does it claim a superior form of knowledge encompassing the results of the sciences from above. Its scope is general because it *crosses* specialized domains and *considers the relations* among their objects within one world. Physics investigates physical processes ; biology investigates living organization ; psychology investigates mental functioning ; the social sciences investigate collective structures and practices. General metaphysics asks how these distinct domains *belong together*, which modes of operation they disclose, and what conceptual scheme can render their differences and interdependence intelligible.

Generality concerns scope, not certainty. A proposition does not acquire greater epistemic force merely because it covers more objects. On the contrary, the widening of scope increases the speculative element of the inquiry. Scientific propositions concern determinate objects under specified conditions and can be tested. General-metaphysical propositions concern relations and patterns extending across several domains and therefore cannot be tested as totalizations. They remain arguable, corrigible, and constrained by valid knowledge, but their comprehensiveness does not transform them into facts.

The present use of *general metaphysics* must also be distinguished from an unrestricted inquiry into being as such. Ultimate analysis has shown that no common property of inherent being can be discovered beneath conventionally existing objects. General metaphysics therefore does not seek the universal essence shared by everything that exists. It asks instead which concepts are required to understand the dependent operations through which different kinds of actuality arise, function, interact, and cease. Its object is not an abstract being emptied of all determination, but the differentiated process of conventional existence.

Chapter 4 of Volume I established the ontological scheme. It identified the differential-extensive actual occasion as the elementary unit of actuality and examined aggregation, organization, individualization, efficient and final determination, and the conjoint operation of matter, information, and consciousness. Chapter 5 developed the individualized mind, embodiment, mental

causation, personhood, and mental pliancy. Chapter 6 then subjected persons and phenomena to ultimate analysis and rejected every attempt to establish their inherent existence. General metaphysics begins from these results. It does not replace or repeat them. It asks how they may be gathered into a comprehensive account of existence and its principal operations.

Its scope includes the distinction between existence and non-existence, the relation between actuality and virtuality, the conditions under which something may arise from prior processes, and the general modes through which actuality becomes efficacious, organized, and consciously present. These modes will be articulated as matter, information, and consciousness.

Matter concerns energetic efficacy and efficient determination ; information concerns formative organization, differentiated constraint, and architecture ; consciousness concerns mere cognizing presence and, where individualized, supports meaning, affect, volition, valuation, intent, and choice. General metaphysics must determine whether these operators are irreducible, how they depend upon one another, and how they function conjointly within actual occasions, aggregates, organizations, societies, and the world-system.

The word *operator* must be handled carefully. It does not designate a hidden agent acting behind phenomena. Matter, information, and consciousness are not three substances, primordial beings, or independently existing regions. They name distinguishable modes of operation abstracted from concrete actualities. Their generality consists in their proposed applicability across domains, not in their separation from the objects in which they operate. General metaphysics must therefore establish the triad without reifying its members.

The inquiry draws upon several kinds of material. Scientific knowledge supplies testable accounts of physical interaction, living organization, communication, cognition, and cosmic development. First-person awareness supplies access to mental objects and conscious presence. Intersubjective discourse makes persons, meanings, institutions, and shared practices available for interpretation. Historical experience reveals transformations not captured by an account limited to elementary physical processes. General metaphysics gathers these materials without confusing their epistemic status. It may interpret and integrate them ; it may not silently convert scientific results, first-person reports, or cultural meanings into proofs of its general scheme.

Its scope is comprehensive but not closed. The proposed operators need not exhaust every distinction future inquiry may require. Their adequacy depends upon whether they integrate the principal domains of actuality without suppressing their differences, whether they perform identifiable explanatory work, and whether an additional operator would be necessary to account for phenomena the triad cannot accommodate. The claim advanced will therefore be one of minimal sufficiency rather than absolute completeness. Matter, information, and consciousness are proposed as the least extensive set capable of preserving energetic efficacy, formative organization, and sentient presence without reducing one to another.

General metaphysics remains immanent throughout. It concerns the world-system as the conjunction of the actual world — the exhaustive field of actualities — and

the virtual world-ground of conditioned possibilities implicated in further becoming. It does not infer an independently existing ground outside the world, describe the Absolute, or claim conceptual access to reality-as-such. The virtual world-ground belongs within its scope only as the possibility-aspect of the world-system, not as another actuality standing beneath or before it. Transcendent terms mark the limit of the inquiry rather than enlarging its inventory.

Nor does general metaphysics include every specific question that can be posed within the scheme. The origin, large-scale development, and possible futures of the universe belong to metaphysical cosmology. God*, the Divine, mystical experience, and the transcendent limit belong to metaphysical theology. These inquiries apply and extend the general scheme to *specific totalizing objects*.

They follow only after existence and its operators have been clarified.

The scope of general metaphysics is both wide and exact. It encompasses the most general relations among conventional actualities while excluding scientific pretension, normative grounding, substantial foundations, and transcendent description. It seeks a coherent account of how the world operates without claiming to possess the world as it is in itself. Its task is totalization without closure : to think the widest possible conjunction while leaving every term empty, functional, and open to correction.

3. The World-System as Speculative Object

The object of general metaphysics is the *world-system*. This does not mean that it is presented to thought as an ordinary object alongside other objects. A stone, organism, person, institution, or galaxy can be selected from a wider field and investigated under determinate conditions. The world-system *cannot* be isolated in this way, because *every* object, investigator, method, and act of investigation already occurs within it. No external standpoint is available from which the world-system could be observed as a completed whole.

It is therefore a *speculative object*. Specialized sciences investigate restricted domains within the world : physical interactions, living organization, mental processes, social formations, or the observable universe. General metaphysics seeks to think how such domains *belong together within the widest possible field*. Its object is not supplied by one observation or experiment but constructed through the critical totalization of what the different domains disclose. This construction remains answerable to them without becoming another specialized science.

The term *actual world* designates the exhaustive field of actualities. All actual occasions, aggregates, organisms, persons, societies, and historical formations belong to it. The term *world-system* is wider : it totalizes this actual field together with the virtual world-ground of conditioned possibilities opened and transformed through actual becoming. The world-system consequently adds neither a second actuality nor a third entity ; it names the one world considered conjointly under actual and virtual aspects.

Actualities arise through relations, inherit conditions, enter organizations, and contribute to subsequent processes. The world-system is the encompassing relational organization within which actualities become possible and effective. Yet

its unity must not be substantialized. It possesses no inherent identity over and above the actualities, relations, and conditions through which it is conventionally constituted. It is numerically non-identical with every actuality occurring within it, but this non-identity is dependent and organizational. It does not warrant the inference to an independently existing whole. The world-system is neither identical with one of its parts nor different from all its parts in the sense of existing separately from them. Like every other conventional object, it exists through dependence, designation, and function while lacking inherent existence.

Nor should the world-system be confused with the *physical* universe alone. The physical universe is indispensable to it, but it does *not* exhaust it. Mental objects, first-person presence, meanings, values, actions, institutions, and histories also occur within the world. These cannot be placed outside the world merely because they are not reducible to physical descriptions. The world-system encompasses material, informational, sentient, psychological, social, and cultural actuality *without converting their differences into separate worlds*.

The observable universe must likewise be distinguished from the world-system. The former is a scientifically investigated cosmic domain bounded by the conditions of observation and current physical theory. The latter is the metaphysical totalization of all actualities belonging to the one world. Metaphysical cosmology may later inquire into the relation between the observable universe, possible unobservable cosmic domains, and the world-system. General metaphysics may not simply identify them in advance.

The world-system is a totality, but *not a closed* totality. Closure would imply that every actuality, relation, and possibility had been completely determined and could in principle be gathered into a final conceptual representation. Such completion is unavailable. Why ? Because the world *continues to become* ; new actualities arise ; inherited organizations change ; and the possibilities relevant to subsequent becoming are altered by what becomes actual. The object of general metaphysics is therefore *total without being finished* and *comprehensive without being exhaustively known*.

This requires a distinction between *totality* and *totalization*. Totality is the world-system considered as the encompassing field within which every actuality and act of cognition occurs. Totalization is the finite conceptual activity through which the metaphysician attempts to coordinate knowledge of that field. The former is not given as a completed object ; the latter never exhausts what it seeks to articulate. The speculative object must not be confused with the conceptual panorama constructed of it.

The openness of the world-system is both epistemic and ontological. It is epistemic because no speculative scheme can include all possible knowledge, anticipate every scientific development, or eliminate the prospect of conceptual revision. It is ontological because actuality is processual : what has become conditions but does not completely contain what may next become. Novelty is not an appearance caused solely by ignorance of an already finished whole. The future remains conditionally open.

This openness introduces the virtual aspect of the world-system. The actual world consists of what happens. The virtual world-ground names what may happen

under the conditions, relations, and constraints established by what has happened. Together, the actual world and this virtual aspect constitute the world-system. Their distinction is modal rather than substantial : actuality and virtuality are not two worlds, regions, or kinds of cosmic material.

The virtual world-ground must therefore not be treated as an entity existing prior to the world, a storehouse of fully formed possibilities, a primordial substance, an agent selecting outcomes, or a self-sufficient source from which actualities emerge. It is the actual world considered under the aspect of its conditionally available possibilities of further formation. Every actuality closes some possibilities, preserves others, and opens new ones. Virtuality changes with actuality because it is immanent to the process it qualifies.

The ontological duplication of the world into a concrete realm of actualities and a *separately* existing primordial realm is rejected. This does not exclude the triadic specification of the world-ground. Proceeding by a controlled reversal from the three operators discerned in concrete actuality, general metaphysics speculates their *primordial* correlates as dimensions of the virtual world-ground.

Primordial matter names the possibility of energetic actualization ; primordial information names possible architecture, constraint, order, and organization ; primordial consciousness names the possibility of sentient actualization, including the possible development of individualized forms capable of valuation and choice. Whether actuality warrants, in addition to these virtual correlates, the admission of an actual continuing Divine subject under the hyper-concept God* belongs to metaphysical theology. These correlates are not three substances, independently actual domains, or ready-made contents stored in another world. They are inferred modal specifications corresponding to operations manifested in concrete actuality. Concrete operators and primordial correlates are therefore structurally corresponding but modally distinct : the former operate within determinate actuality, while the latter articulate conditioned possibilities of further instantiation. The world-ground is thus triadically specified without becoming an independently existing ground beneath or outside the world.

The world-system is consequently neither self-sufficient nor grounded by something outside itself. To ask for an additional ground beneath the whole is to repeat the foundational demand already rejected. Whatever is invoked as its ground must either belong to the world-system, in which case it is not an external foundation, or stand outside it, in which case it cannot be conceptually established as an actuality.

General metaphysics instead seeks the relations and conditions through which the world-system operates *without* converting those conditions into a final cause or independent bearer.

As speculative object, the world-system thus has a precise status. It is the one, open, dependently organized field of actual and virtual existence considered under the widest immanent horizon. It is not a substance, completed set, cosmic organism, omniscient mind, or object viewed from nowhere. It is what general metaphysics seeks to articulate through a corrigible scheme while remaining within the world it thinks.

4. Hyper-Conceptual Totalization

The method of general metaphysics is hyper-conceptual totalization. Chapter 2 of Volume I established the nature of creative thought, hyper-concepts, and panoramic totalization. Their function here is no longer preparatory. They provide the operative means through which the world-system becomes a speculative object and positive reconstruction can proceed after ultimate analysis.

An ordinary concept identifies, differentiates, classifies, or relates objects within a relatively determinate field. Its meaning may be refined by definition, use, contrast, and inferential position. A hyper-concept has a wider architectonic function. It is organized around a sufficiently stable semantic center while opening into a field of relations, analogies, implications, contrasts, and possible applications that cannot be exhaustively enumerated in advance. It does not merely classify what is already known. It enables heterogeneous domains to be interpreted together.

The prefix *hyper-* does not indicate a departure from conceptual cognition. Hyper-concepts remain linguistic, dualistic, intentional, communicable, arguable, and revisable. They do not provide intellectual intuition of essences, direct access to reality-as-such, or non-conceptual cognition of the transcendent. Their distinctiveness lies in their semantic density and architectonic reach. They gather more than an ordinary concept can gather while remaining concepts throughout.

Process, *actual occasion*, *world-system*, *virtual world-ground*, *matter*, *information*, and *consciousness* function in this manner. None designates a self-contained object whose identity can be isolated independently of the scheme in which it operates. Each organizes a field. *Process* coordinates becoming, dependence, inheritance, novelty, and perishing. *Actual occasion* gathers the elementary conditions of differential-extensive actualization. *Matter*, *information*, and *consciousness* will coordinate energetic efficacy, formative organization, and sentient presence. Their meanings emerge through the relations they establish and the explanatory work they perform.

No single hyper-concept is sufficient for general metaphysics. Taken alone, even the most fertile concept readily becomes imperial. Matter may be enlarged into materialism, information into informationalism, consciousness into mentalism, process into a universal substance, and the world-ground into a hidden substrate. Hyper-conceptual totalization therefore operates by coordinating several semantic fields rather than allowing one privileged concept to translate every other domain into its own vocabulary.

The resulting construction is panoramic.

This does not mean that a speculative subject surveys the world from nowhere or apprehends every actuality simultaneously. The panorama is comprehensive in organization, not infinite in cognition. It brings physical, biological, sentient, psychological, social, historical, and cultural processes *into a common field of comparison while preserving their differences*. What appears as one coordinated view has been constructed through successive acts of study, abstraction, selection, comparison, argumentation, and revision.

Three terms must consequently be distinguished.

Totality is the world-system considered as the regulative horizon within which every actuality and every act of cognition occurs.

Totalization is the finite constructive activity through which the speculative subject seeks to coordinate available knowledge of that field.

Panorama is the provisional configuration produced by this activity. Totality is never given as a completed object ; totalization never exhausts it ; and the panorama is never identical with the world it presents.

This distinction prevents a recurrent speculative illusion. Because a panorama integrates numerous domains into one intelligible configuration, the unity of the construction may be projected into its object as the unity of a self-existing whole. The semantic coherence of *process*, for example, may be mistaken for proof that process is an independently existing universal. The integration achieved through the three operators may be converted into a cosmic triad existing from its own side. Or the virtual world-ground may be reified as a primordial entity containing the possibilities later realized by the world.

Ultimate analysis excludes these conversions. Hyper-concepts exist conventionally as constructions and function within metaphysical discourse, but they possess no inherent existence :

$C(H) \wedge \neg SV(H)$

where H designates any hyper-concept. Their absence of inherent existence does not deprive them of meaning or efficacy. It prevents their successful performance within a scheme from being mistaken for the discovery of a corresponding metaphysical substance.

Hyper-conceptual totalization must also preserve *distinct perspectives*. Third-person scientific accounts disclose publicly testable processes, but they do not exhaust first-person presence, meaning, valuation, deliberation, or action. First-person experience cannot replace public investigation, while intersubjective practices of language, criticism, cooperation, conflict, and institutional organization cannot be reduced to either private consciousness or external physical description. The panorama coordinates objective, subjective, and intersubjective articulations within one world without converting them into three separate realities.

The relation between the idea of the Real and the idea of the Ideal governs this coordination. The former directs totalization toward factual openness, enlarged scope, and sensitivity to whatever resists the preferred scheme. The latter directs it toward coherence, intelligibility, and architectonic unity. Without the idea of the Real, metaphysics closes around its own constructions and treats every fact as confirmation. Without the idea of the Ideal, it becomes an accumulation of disconnected materials. Advancement requires both : widening the field and reorganizing the scheme through which the widened field becomes intelligible.

Process remains the leading orientation of the present totalization. It allows stability, individuality, organization, and unity to be interpreted as achievements within becoming rather than as manifestations of substances. Yet this preference

does not establish that reality-as-such is process. Process is adopted because of its anti-reifying yield, its capacity to coordinate change and relative stability, and its consonance with valid scientific knowledge. It remains a critically controlled hyper-concept rather than an ultimate ontological discovery.

The three-operator thesis will be developed within this processual panorama. Matter, information, and consciousness are proposed neither as independent substances nor as exhaustive divisions imposed upon the world in advance. They are hyper-conceptual centers coordinating three irreducible explanatory requirements : energetic efficacy, formative organization, and sentient presence. Their adequacy will depend upon the distinctions they preserve, the relations they clarify, the reductions they prevent, and the range of actualities they enable the scheme to interpret.

Hyper-conceptual totalization therefore achieves neither a final system nor a view from nowhere. It produces a sufficiently comprehensive, coherent, and open world-picture for metaphysical inquiry to proceed. Its unity is constructed, its concepts are empty, and its results remain corrigible. Precisely for these reasons, it can venture beyond specialized knowledge without pretending to surpass the conditions of conceptual thought.

5. Criteria, Corrigibility, and Limits

Positive reconstruction is admissible only when its speculative freedom is matched by *critical* discipline. Because general metaphysics cannot submit its totalizations to experimental testing, it cannot appeal to factual verification as the final arbiter of its claims. Yet the absence of testability does not release it from *rational appraisal*. Its concepts, inferences, presuppositions, integrations, and exclusions remain open to argument. The criteria governing general metaphysics are therefore comparative rather than testable : they do not establish correspondence with reality-as-such, but permit one speculative construction to be judged more adequate than another.

The present criteria have already been prepared by the earlier treatments of metaphysical advancement and creative totalization. A metaphysical scheme should be logically coherent, semantically determinate, sufficiently comprehensive, economical in its commitments, integrative without becoming reductive, compatible with valid scientific knowledge, resistant to reification, explanatorily articulate, heuristically fertile, reflexively transparent, and corrigible. These criteria form a *profile of adequacy*. No single virtue can certify the scheme, and no numerical measure can settle every comparison among alternatives.

Logical coherence requires that the propositions of the scheme can stand together without generating contradictions that destroy their intended meanings. This does not demand that every tension be eliminated in advance. Some oppositions arise because different perspectives, scales, or epistemic registers are being coordinated. But where an actual contradiction occurs, it must be acknowledged and repaired rather than hidden beneath metaphor, ambiguity, or an appeal to ineffability. A totalization that cannot state what follows from its central commitments cannot be critically assessed.

Semantic determinacy requires the leading terms to remain sufficiently stable for their claims to be reconstructed and challenged. *Process, actual occasion, world-system, operator, matter, information, consciousness*, and *world-ground* must not change meaning whenever an objection arises. Their meanings may develop through the argument, but each development must be made explicit. Semantic richness is admissible ; equivocation is not.

Comprehensiveness concerns the range of actuality a scheme can accommodate. General metaphysics must take account of physical efficacy, formative organization, living systems, first-person presence, meaning, action, society, and the widest cosmic relations without reducing the less tractable domains to those most easily described. Its scope need not include every fact or theory. It must nevertheless represent every principal kind of actuality relevant to its claim to generality.

Integration concerns the relations established among these domains. A scheme does not become metaphysical merely by placing scientific, psychological, social, and spiritual materials beside one another. It must clarify how they belong within one world-system. Integration, however, must not be purchased by reduction. Matter, information, and consciousness may be shown to be interdependent without being identified. Physical realization does not by itself explain organization ; organization does not by itself explain sentient presence ; sentient presence does not generate physical actuality merely by apprehending it.

Economy concerns commitments rather than brevity. A scheme should not multiply operators, levels, grounds, realms, or intermediary entities without explanatory need. Yet parsimony cannot justify eliminating what the phenomena require. A single-operator theory may be simpler only because it has redescribed or suppressed the objects it cannot explain. The appropriate aim is therefore minimal sufficiency : the least extensive set of distinctions capable of preserving the principal modes of actuality without reduction.

The three-operator thesis will be assessed under this criterion. Matter, information, and consciousness are proposed as *minimally sufficient* to coordinate energetic efficacy, formative organization, and sentient presence. This proposal does not demonstrate that a fourth operator could never be required. Absolute exhaustiveness would exceed the available argument. The triad remains adequate only while it integrates the relevant domains without forcing irreducible phenomena into one of its existing categories.

Scientific responsibility requires the scheme to remain compatible with valid conventional knowledge. A metaphysical proposal contradicted by well-established science cannot ordinarily be preserved merely because it is elegant, traditional, or spiritually attractive. At the same time, compatibility must not be confused with confirmation. Relativity, quantum theory, evolutionary biology, information theory, neuroscience, and complexity science may constrain and inform the present scheme, but they do not experimentally *establish* the three operators or the process ontology within which they are interpreted.

This distinction requires every major claim to display its epistemic status. An established scientific result must be distinguished from its philosophical interpretation ; a structural analogy from an explanatory identity ; heuristic

consonance from empirical confirmation ; a speculative extrapolation from a testable hypothesis ; and a metaphysical proposal from a description of fact. Technical vocabulary does not convert metaphysics into science, and reference to science does not transfer factual authority to a totalization.

Resistance to reification applies to the entire construction. Matter must not become an underlying material substance ; information must not become disembodied form ; consciousness must not become an independently existing cosmic mind ; process must not become a universal entity behind processes ; and the world-system must not become a self-sufficient whole existing over and above its actualities. The same control applies to the primordial correlatives inferred from the concrete operators. Primordial matter, primordial information, and primordial consciousness specify the virtual world-ground only as *speculative conditions of possible further actualization*. They are not a second set of actual substances contained in a hidden realm.

The world-ground is subject to a particularly stringent control. It may be triadically specified by a controlled reversal from the operators manifest in concrete actuality. Primordial matter names the possibility of energetic actualization ; primordial information names possible organization, architecture, and constraint ; primordial consciousness names the possibility of sentient actualization, including the possible development of individualized forms capable of valuation and choice. Whether actuality warrants the further admission of an actual continuing Divine subject under the hyper-concept God* belongs to metaphysical theology. These primordial correlates remain inferred modal specifications. Their systematic usefulness does not establish their separate actuality.

Explanatory articulation requires every introduced distinction to perform identifiable work. To name three operators is insufficient. The argument must show what each explains that the other two do not, why their differences do not entail substantial separation, and how their conjunction becomes intelligible within actual occasions, aggregates, organisms, persons, and the world-system. A concept that merely renames the phenomenon without clarifying its relations, conditions, or consequences adds vocabulary but not explanation.

Heuristic fertility concerns the capacity of a scheme to disclose questions, relations, and possibilities that narrower accounts leave unseen. A fertile hyper-concept may coordinate findings across domains, expose hidden reductionisms, suggest distinctions, and guide further scientific or philosophical inquiry. Fertility, however, is not proof. A metaphysical picture can be suggestive and still be wrong, inflated, or insufficiently constrained. Its capacity to generate inquiry must therefore remain subordinate to coherence, scientific responsibility, and anti-reification.

Methodological transparency requires the totalization to include an account of its own construction. The present scheme arises from a process orientation, strict nominalism, critical realism, dependent arising, ultimate analysis, and the distinction among matter, information, and consciousness. These are not observations made from outside the world-system. They are adopted and argued commitments formed by a historically situated speculative subject. The scheme

must therefore identify what it selects, what it excludes, which analogies guide it, and where inherited vocabularies continue to shape its conceptual field.

The same methodological self-explication applies to the ideas regulating totalization. The idea of the Real directs the scheme toward factual openness, resistance, and enlargement by what is not produced by the preferred conceptual architecture. The idea of the Ideal directs it toward coherence, consensus, intelligibility, and systematic unity. Neither idea becomes a constitutive object or ontological pole. Both regulate the construction without supplying it with a self-existing ground.

Corrigibility follows from this profile. A metaphysical scheme is corrigible when objections can lead to actual changes in its propositions, distinctions, relations, and scope. A doctrine that translates every criticism into confirmation has been immunized. Conversely, a construction abandoned whenever one local claim fails lacks architectonic stability. Critical metaphysics must distinguish local from structural correction.

A local correction may withdraw an analogy, refine a definition, revise an interpretation of scientific findings, relocate material between sections, or qualify an unnecessarily strong assertion. An architectonic correction alters the relation among the leading hyper-concepts, removes an operator, adds one, revises the conception of the world-ground, or changes the process orientation governing the totalization. The possibility of architectonic revision must remain open, although such revision requires stronger reasons because it affects the entire scheme.

Corrigibility also applies retrospectively. The earlier version of this metaphysics sometimes treated the world-ground as a sufficient underlying determinant containing primordial matter, primordial information, and primordial consciousness in language approaching a separately actual realm. It also associated speculative physical mechanisms too closely with informed information and the primordial field. The present reconstruction does not simply discard the underlying intent. It retains the primordial triadic specification while correcting its modal status: the primordial correlatives are inferred possibilities of the world-system, not substances situated beneath it.

Correction may arise from several directions. Logical criticism may expose contradiction or invalid inference. Semantic criticism may reveal equivocation. Scientific development may render an inherited model obsolete or show that the metaphysical interpretation exceeded the relevant facts. Comparative criticism may demonstrate that another scheme preserves more distinctions with fewer unsupported commitments. Ultimate analysis may reveal that an apparently functional concept has again been treated as inherently existent. Corrigibility means remaining answerable to all these forms of resistance.

The limits of general metaphysics follow from the same conditions. First, it cannot experimentally establish its totalization. Particular claims used within it may be testable, but the scheme as a whole remains arguable rather than testable. Second, it cannot claim conceptual possession of reality-as-such. Its object is the world-system as speculatively totalized, not the noumenon as directly known. Third, it cannot ground the norms of truth, beauty, or action. Normative bindingness arises

reflexively from the necessary conditions of thought, feeling, and action, not from a metaphysical worldview.

Fourth, general metaphysics cannot convert comprehensiveness into closure. The actual world is exhaustive as the field of actualities, while the world-system is total as the widest immanent articulation of actuality together with conditioned virtual possibility. New scientific findings, forms of organization, modes of consciousness, or rival conceptual schemes may require revision. The panorama is always smaller than the world it organizes.

Fifth, general metaphysics cannot cross the transcendent limit. It may formulate limit-concepts and approach the point at which conceptual validation ends, but it cannot describe the Absolute or infer a transcendent entity from the incompleteness of immanent explanation. God*, when introduced later, must remain an immanent-metaphysical hyper-concept. The Absolute remains a limit-signifier rather than another member of the metaphysical inventory.

Sixth, virtuality must not be converted into concealed actuality. The virtual world-ground names the possibility-aspect of the world-system and may be specified through the primordial correlatives of the concrete operators. It does not follow that every possibility already exists as a formed object, that the future is completely contained in a cosmic storehouse, or that primordial consciousness is an independently actual subject selecting all events. Possibility conditions actuality without becoming a second actuality.

Finally, positive reconstruction remains bound by ultimate analysis. Every object and every hyper-concept introduced in the following sections exists conventionally and lacks inherent existence. The operators, their primordial correlatives, their conjunction, and the world-system itself receive no exemption. The criterion governing the entire reconstruction may therefore be stated simply : the scheme must explain dependent fullness without converting any of its explanatory terms into a self-existing ground.

Under these conditions, metaphysical commitment and fallibility are compatible. General metaphysics may advance determinate claims, defend a process orientation, propose three operators, and triadically specify the virtual world-ground. But it must also state where these claims remain scientifically underdetermined, comparatively warranted, or openly speculative. Corrigibility is not the weakness of the construction. It is the form taken by strength when metaphysics refuses dogma.

With these criteria and limits in place, positive reconstruction can turn from its method to its first substantive problem : how existence is to be distinguished from non-existence, and how actuality is related to potentiality and virtuality.

B. Existence, Non-Existence, and Virtuality

Before the three operators can be introduced, the modal field within which they operate must be clarified. Ultimate analysis established that conventionally existing objects lack inherent existence. It did not eliminate actuality, explain the cessation of particular objects, or determine how unrealized possibilities are related to what becomes actual. Nor did it establish that absolute nothingness was

once, or could become, an actual state. The present section therefore distinguishes relative non-existence from absolute nothingness, both from potentiality and virtuality, and the actual world from its virtual world-ground. Its task is not to derive existence from a self-sufficient source, but to identify the conceptual differences required to think arising, actuality, cessation, and further possibility without reifying either existence or nothingness.

1. The Question of Questions Reframed

‘Why is there something rather than nothing ?’ appears to ask the first and most comprehensive metaphysical question. It reaches beyond the explanation of any particular object and asks *why actuality as such obtains*. Yet its apparent simplicity conceals several distinct questions. Unless these are separated, the inquiry shifts unnoticed among causality, condition, temporal origin, possibility, and sufficient ground, allowing an answer to one problem to appear as an answer to all. So we have to move carefully.

The term *something* is initially indeterminate. It may designate a particular object, any actuality whatever, the observable universe, the complete cosmic order, or the world-system as the sole field of actualities. These are not interchangeable objects of explanation. Why a tree exists, why a particular universe arose, and why there is any actuality at all are questions of *different* scope. An account answering the first may identify biological and environmental conditions. An account answering the second may propose a cosmological history.

Neither thereby answers why the world-system exists rather than not.

The term *nothing* is equally equivocal. It may signify the absence of a particular object, the cessation of something that formerly existed, an empty spatial region, a numerical value of zero, the absence of presently actual determination, or the absolute absence of every actuality and every possibility. Only the last meaning stands in strict opposition to *something* taken in its most comprehensive sense. But this absolute nothingness must not be confused with any determinate absence. An empty room remains a room with spatial, material, and relational determinations. A physical vacuum remains a physically structured condition. Zero remains a mathematically instantiated object performing formal operations. The non-existence of this or that object presupposes a field within which its absence can be identified. None amounts to nothing whatsoever.

The word *why* introduces a third ambiguity. It may request an antecedent cause, a set of constitutive conditions, a logical reason, an explanatory ground, a function, or an aim. Why a particular actuality arose can often be answered by identifying preceding actualities and relevant conditions. Why it continues may be answered by identifying the processes conserving it. Why it has one organization rather than another may require formative and functional explanation. Why it was chosen may require intent and valuation. These explanatory forms cannot simply be transferred to the existence of the world-system as a whole.

A cause is already something. A condition is already determinate. A reason belongs to a conceptual order. An aim presupposes sentient valuation. Whatever is introduced as the explanation of all actuality must either belong to the world-

system or be placed outside it. If it belongs to the world-system, it may explain another actuality or a particular order within the world, but it does not explain why the complete field to which it belongs exists. If it is placed outside the world-system, it becomes a transcendent object endowed with determinate explanatory relations and thereby *violates* the critical boundary established earlier. No conceptual explanation can stand *wholly outside* the field of conceptual relations and nevertheless enter that field as its cause.

The traditional question also presupposes that nothingness is the simpler or more natural alternative. Something is treated as exceptional and therefore in need of explanation, whereas nothing is taken as requiring none. But this asymmetry is not self-evident. Absolute nothingness is not a neutral background upon which actuality appears. A background is already something. Nor is absolute nothingness a prior state from which a transition might occur. A state has determinations, and transition requires conditions connecting what precedes with what follows. Absolute nothingness, strictly understood, contains neither.

Accordingly, the question cannot be reconstructed as a temporal sequence :

absolute nothingness → actuality

The first term could not stand in a causal, temporal, modal, or logical relation to the second without *ceasing* to be absolute nothingness. It could not persist before actuality, because persistence is already *a mode of existence*. It could not contain the possibility of actuality, because contained possibility would be a *determination*. It could not be transformed, because transformation requires something that undergoes transformation. It could not cause, permit, resist, or receive the emergence of anything.

This establishes an important restriction, but not yet the conclusion that something has always existed. From the impossibility of describing a transition from absolute nothingness to actuality, it does not follow that the temporal succession of actualities has no beginning. The former is a conceptual and modal point. The latter is a cosmological thesis. Moving directly from one to the other would convert the failure of one explanatory model into proof of a particular cosmic history.

A universe may have a finite temporal past without having arisen from absolute nothingness. Conventional spacetime may begin as one determination within a wider process or modal field. Conversely, an indefinitely extended or cyclic cosmology would not by itself explain why actuality exists at all. Questions concerning the beginning of conventional spacetime, previous cosmic phases, or the possible absence of a first physical event belong to metaphysical cosmology. They cannot be decided merely by analyzing the concept of nothingness.

The *Question of Questions* must therefore be divided into at least four inquiries.

First : Why does this particular actuality exist ? This asks for antecedent conditions, constituent processes, relations, and perhaps intentions. It is answerable, at least in principle, within the world-system.

Second : Under what conditions is further actuality possible ? This asks how the actual world bears possibilities exceeding what is presently actual. It leads from actuality to potentiality and virtuality and therefore to the virtual world-ground.

Third : Did the observable universe or conventional spacetime have a beginning, and what could such a beginning mean ? This is a cosmological question requiring scientific knowledge and metaphysical interpretation. It must not be answered in advance by semantic analysis.

Fourth : Why is there a world-system at all rather than the absolute absence of every actuality and possibility ? This is the strict form of the *Question of Questions*. It does not request the cause of one actuality by another. It asks for an explanation of the complete field within which every possible cause, condition, reason, and explanation occurs.

The final question may be legitimate without being conventionally answerable. It discloses the pressure exerted by reason's demand for an unconditioned explanation, but this demand does not establish that a self-sufficient answer exists. The expectation that every conditioned actuality should have conditions does not entail that the world-system as a whole must possess an external ground. To insist upon such a ground is to revive the *foundational requirement* already rejected and to treat the need of explanation as evidence for an explanatory entity.

Nor should the question be dismissed as meaningless. It becomes defective only when nothingness is treated as an available alternative state or when the grammar of causal explanation is extended without qualification to the world-system as a whole. Properly reframed, the question performs a critical function. It requires metaphysics to distinguish *the absence of an object* from *the absence of all actuality*, *non-actuality* from *impossibility*, *potentiality* from *relative non-existence*, and the *virtual ground* of further formation from *absolute nothingness*.

The answer will therefore not take the form of a first substance from which actuality is derived. Nor will the virtual world-ground be introduced as something filling a gap left by the rejection of nothingness. It is not an entity that defeated, replaced, or temporally followed absolute nothingness. It is the world-system considered under the aspect of the possibilities implicated in its actual process. Its primordial specifications will be *inferred* from the operators discerned in concrete actuality, *not* posited as *independently existing contents preceding the world*.

The *Question of Questions* is thus reframed rather than solved by decree.

For determinate actualities, one may inquire into causes, conditions, relations, and functions. For cosmic origins, one may construct scientifically constrained metaphysical hypotheses. For the world-system as a whole, one may clarify its actual and virtual aspects *without claiming an external explanation*. Absolute nothingness remains the limiting contrast through which these distinctions become visible, but *not* a state from which the world must somehow have emerged.

The proper first step is consequently more modest and more exact : determine what it means for a particular object not to exist. Only after relative non-existence has been distinguished from absolute nothingness can potentiality and virtuality be introduced without allowing either to become another name for the void.

2. Relative Non-Existence

Relative non-existence is not a kind of *absolute* nothingness. It is the non-existence of a *determinate* object under *specified* conditions. Something is absent here, has not yet arisen, no longer exists, cannot be instantiated, or is found only as a conceptual construction without a corresponding sensate object. In every case, what is negated is limited and identifiable. Relative non-existence therefore concerns *this or that object*, not the absence of the world-system and all its possibilities.

The expression is relational because an object can be said not to exist only in relation to a domain, time, place, mode of instantiation, or set of identifying conditions. A book may not exist in a particular library while existing elsewhere. A species may not yet exist at one stage of evolution and arise later. A person who once lived no longer exists as a living person, although traces, effects, memories, and records remain. A proposed machine may not presently exist but may be possible under realizable conditions. A square circle cannot be conventionally instantiated because its defining predicates are contradictory in the same respect. These are different forms of non-existence and must not be compressed into one *undifferentiated nothing*.

Relative non-existence is therefore indexed, even when the relevant index remains implicit. To say simply that A does not exist usually abbreviates a more determinate assertion : A does not exist now, here, within this domain, under this description, or in the mode of instantiation being considered. Without such determination, the proposition remains *ambiguous*. It may deny present actuality, past actuality, physical realization, logical possibility, or conventional instantiation, each of which raises a different question.

The distinction can be related to the notation established in ultimate analysis. $C(A)$ states that A exists conventionally. Its negation, $\neg C(A)$, states that A does not exist conventionally under the conditions relevant to the claim.

This differs fundamentally from : $C(A) \wedge \neg SV(A)$

The latter means that A exists conventionally while lacking inherent existence. It expresses emptiness, not relative non-existence. The former denies the conventional existence of A under the selected conditions. Confusing these formulas would turn the absence of inherent existence into the absence of the object itself and would repeat the nihilistic error already excluded.

Emptiness concerns *how an object exists*. Relative non-existence concerns whether the object exists *under the relevant conditions*.

This distinction applies equally to sensate and mental objects. A sensate object may cease to be presented because the organization sustaining it has ended. A mental object may no longer occur because the relevant act of volition, affection, thought, or consciousness has ceased. Yet the non-occurrence of one mental object does not imply the absence of mind, and the cessation of one sensate object does not imply the absence of the physical field in which its constituents and effects continue. The negation remains local.

Some descriptions treat the cessation of an object as the successive subtraction of its properties until no properties remained. This image captures one possible form of dissolution, but it is too rigid as a *general* account. Conventional identity does not depend upon the possession of an exhaustive set of fixed properties. An object exists conventionally because a sufficient organization of components, relations, functions, and identifying conditions permits it to be distinguished and used as that object. It ceases to exist when this organization can no longer sustain the relevant identity.

A table does not need to lose every material property before it ceases to be a table. Its wood, molecules, mass, and spatial extension may remain after it is broken or burned. What ends is the organization through which those constituents formed an identifiable table and performed the functions attributed to it. The former table does not pass into absolute nothingness. Its constituent processes continue under *other* organizations, while the table as a conventionally identifiable object no longer exists.

The same applies to organisms. Death does not mean that every material constituent disappears or that every causal consequence is erased. It means that the coordinated organization sustaining the living organism has irreversibly ceased. Components and traces remain, but the organism no longer operates as the living individual it was. Relative non-existence therefore concerns the termination of organized identity, not the annihilation of every constituent and effect.

Cessation must also be distinguished from mere alteration. An object may lose properties and remain conventionally identifiable. A person ages, a building is repaired, a river changes course, and an institution revises its rules without necessarily ceasing to exist. Whether continuity remains depends upon the relevant criteria of identity, the degree and organization of change, and the practices through which the object is identified. Conventional identity is sufficiently stable for knowledge and action, but its boundaries are neither inherent nor independent of context.

This relativity does not make existence arbitrary. One cannot preserve the identity of an object merely by deciding to continue using its name. Identification remains answerable to observable continuity, retained organization, causal history, functional recurrence, and intersubjective recognition. A shattered cup may still be called 'the cup' while its pieces are being collected, but this linguistic continuity does not restore its former *capacity* to contain liquid.

Designation participates in conventional identity ; it does not create the functioning object at will.

Relative non-existence therefore has both an *ontological* and an *epistemic* aspect. Ontologically, the conditions and organization through which A existed no longer obtain, do not yet obtain, or cannot obtain. Epistemically, a community of sign-interpreters can no longer validly identify a conventionally instantiated A under the relevant criteria. Neither aspect is sufficient alone. The cessation of function is not always immediately recognized, while a change of designation does not by itself abolish the process designated.

Several principal forms of relative non-existence can now be distinguished.

A first form is local absence. The object exists but is absent from a selected place, system, or relation. A key may exist but not be in the lock, a person may exist but not be present at the meeting, and a chemical element may exist but not occur in a selected sample. What is denied is presence within a delimited field, not the existence of the object without qualification.

A second form is temporal non-existence. An object does not yet exist or no longer exists. The former concerns unrealized possibility ; the latter concerns cessation. Neither tense entails absolute nothingness. What has not yet arisen may remain possible under the world's conditions, while what has ceased may leave effects entering subsequent processes.

A third form is failed conventional instantiation. A concept is formed, but no corresponding conventionally existing object is found. Fictional objects belong here when they organize thought or narrative without corresponding to independently existing sensate objects. The fiction is not nothing : the concept, text, image, or mental object exists and performs functions. What does not exist is the object *as the fiction presents it*.

A fourth form is impossible instantiation. A contradictory determination such as a square circle can be linguistically or logically formulated, but it cannot be conventionally instantiated *under the same interpretation of its predicates*. The expression exists as an object of thought. The object it purports to designate cannot exist. The contradiction prevents transition from logical formulation to conventional instantiation.

A fifth form is functional cessation. Components remain, but the system no longer satisfies the conditions required for its operation as that system. A broken instrument, extinct institution, dead organism, or forgotten language may retain remnants and effects while no longer functioning in its former mode. Here, relative non-existence is best understood through the loss of organized continuity.

A sixth form is merely apparent absence. An object is not detected, remembered, recorded, or consciously presented, although it may continue to exist. Failure of knowledge must not be converted into non-existence. The inference from 'A has not been found' to 'A does not exist' requires additional premises concerning the completeness and reliability of the search. Ignorance, concealment, and non-observation are epistemic conditions, not modes of non-existence.

These forms show why non-existence cannot be reduced to a numerical value. Zero is a formally instantiated mathematical object with determinate functions. It can represent the absence of a counted quantity within a model, but it is not itself nonexistent. The statement that a container holds zero apples expresses the absence of apples from the container. It does not turn the container, the formal operation, or the world into nothing.

Nor does an object literally 'return to zero' when it ceases. Such language may serve as a quantitative shorthand, but it obscures the processual character of cessation. A system ceases when the conditions sustaining its identity and operation no longer obtain. Its components, energy, informational traces, causal effects, or remembered meanings may continue. Relative non-existence is therefore not a numerical state into which an object falls.

Absences may nevertheless be effective within explanations. A plant may die because water is absent, an organism may suffocate because oxygen is lacking, and an institution may collapse because indispensable cooperation has ended. The absence does not operate as a positive entity exerting efficient causation. It identifies the failure of a necessary condition. What occurs results from the processes continuing without the missing condition.

This distinction prevents the reification of absence. The lack of water is not an invisible object acting upon the plant. It is the non-instantiation of a relation required for the plant's continued organization. Relative non-existence can therefore be explanatorily relevant without becoming an existent thing.

The same principle applies to loss, deprivation, and omission in human life. The absence of assistance, information, recognition, or restraint can alter an outcome. Yet such absences acquire significance only relative to expected, required, or possible conditions. Their force is relational and normative, not substantial. They indicate what failed to occur within an existing field of action.

Relative non-existence consequently presupposes the world-system. To identify the absence of A, there must be a field within which A could be distinguished, conditions in relation to which it is absent, and a conceptual act through which the negation is articulated. Even impossible objects presuppose language, logical rules, and a subject capable of recognizing the contradiction. Relative non-existence never amounts to the absence of every actuality and every condition.

For this reason, no accumulation of relative absences yields absolute nothingness. The non-existence of one object, many objects, or even every member of a selected domain remains a determinate claim made within a wider field. An empty set is still a formally instantiated set. An empty region remains a region. A time without a selected class of events remains a temporal determination. The field in which absence is stated has not disappeared merely because its selected contents are absent.

A quantifier must not be transformed into an ontology. To deny each member of a delimited class is not yet to deny the conditions under which the class, its members, and their negation can be thought. Relative non-existence therefore cannot be generalized without remainder into the absolute absence of the world-system.

The principal conclusion is exact. Particular objects may fail to arise, may be absent, may cease, may exist only fictionally, or may be impossible. Statements concerning such non-existence can be valid and important. Yet what they identify is always an absence within existence, not an alternative to existence as a whole.

Relative non-existence removes an object from a determinate field. It does not remove the field.

3. Absolute Nothingness as a Limit-Concept

Absolute nothingness is not the most extensive instance of relative non-existence. Relative non-existence negates a determinate object within a field of actualities, conditions, possibilities, and acts of identification. Absolute nothingness would

negate the field itself. It signifies the absence of every actuality, every relation, every condition, every possibility, every distinction, and every standpoint from which such absence could be apprehended or stated.

For this reason, absolute nothingness cannot be treated as an empty object. An empty object would still be an object possessing the determination of emptiness. Nor can it be conceived as an empty place, interval, vacuum, background, or receptacle. Each of these retains a structure within which something could be located or occur. Absolute nothingness excludes not merely contents but also every field capable of containing them.

The concept must therefore be distinguished from the object it appears to designate. The concept of absolute nothingness exists as a mental and linguistic object. It can be formulated, examined, compared with relative absence, and used within an argument. What cannot be instantiated is the alleged object of that concept : an absolute absence standing before thought as something determinately absent.

The distinction may be formulated through the modes of instantiation established in Chapter 6. Absolute nothingness is logically instantiated insofar as the expression can function as an object within discourse. It is not conventionally instantiated as an actuality, state, field, or condition. The concept exists ; absolute nothingness does not thereby exist as what the concept signifies.

This prevents a common objection. To speak of absolute nothingness does not immediately refute the concept by turning its alleged referent into an actuality. What becomes actual in the act of speaking is the concept and its expression, not absolute nothingness itself. The contradiction arises only when the concept is treated as describing an instantiated state, source, or condition. Thought can negate every determinate object in succession. It cannot thereby place before itself the absolute absence of the thought, the negation, and the field in which both occur.

Absolute nothingness is consequently a limit-concept. It marks the point reached when negation is extended beyond every determinate object and applied to actuality and possibility as such. At this limit, conceptual determination no longer supplies an object corresponding to the negation. The concept remains intelligible through the operation that generates it, but its intended referent cannot become part of the metaphysical inventory.

This status differs from simple impossibility. A square circle is impossible because its predicates contradict one another under the same interpretation. Absolute nothingness is not constructed by joining incompatible positive predicates. It results from the unrestricted removal of every predicate, object, relation, condition, and possibility. Its defect is not that mutually exclusive determinations are asserted together, but that the completion of the negation would eliminate the field required for the negation itself to have meaning or application.

Absolute nothingness is therefore not a possible world. A possible world, however minimally understood, remains a determinate modal configuration. It contains possibilities, relations of compatibility and incompatibility, and conditions under which propositions could be true or false. Absolute nothingness contains no possibilities and supplies no conditions. It is not one possibility alongside others

but the cancellation of the modal field within which alternatives could be distinguished.

Nor is it an actual state. A state must obtain, persist, or occur. These terms already imply existence and determination. To say that absolute nothingness once obtained would therefore attribute actuality, temporal position, and duration to what is defined by the absence of every actuality and determination. The expression “a state of absolute nothingness” defeats its intended meaning.

The same applies to temporal priority. Absolute nothingness cannot be situated *before* the world. Before and after are temporal relations, and absolute nothingness includes no temporal field. It could not last until actuality appeared, because lasting is already a process. It could not be interrupted, because interruption presupposes continuity. It could not be replaced, because replacement requires at least two terms and a relation between them.

Accordingly, actuality cannot arise *from* absolute nothingness. The preposition already introduces a relation of derivation. For something to arise from something else, the source must possess or sustain a condition relevant to the transition. Absolute nothingness possesses nothing, sustains nothing, and cannot stand in any relation. The formula

absolute nothingness $\rightarrow$ actuality

is therefore not a primitive cosmological sequence. It is an illicit representation in which the first term is treated as a state capable of entering a transition.

This criticism applies equally to physical, metaphysical, and theological versions of such a transition. A physical vacuum is not absolute nothingness because it retains physical structure and admissible processes. A virtual world-ground is not absolute nothingness because it concerns formative possibility. A Divine act cannot operate upon absolute nothingness as though nothingness were a prior medium, material, or state. Where creation *ex nihilo* is represented as a temporal passage from absolute nothingness to actuality, the representation is incoherent. Where the expression merely denies preexisting material independent of the Creator, it advances a different theological claim whose status must be examined later.

Yet the impossibility of deriving actuality from absolute nothingness does not establish that the universe or conventional spacetime has an infinite past. The argument is modal, not cosmological. It shows that absolute nothingness cannot function as the antecedent state, source, or material of actuality. It does not determine whether conventional spacetime began, whether another cosmic phase preceded it, or whether the succession of actualities is beginningless.

This restriction is decisive. The older formulation inferred that because absolute nothingness cannot be instantiated, something has always existed and always will exist. That conclusion exceeded the argument. From the failure of absolute nothingness as a possible antecedent, it does not follow that every cosmological series must be temporally infinite. A finite temporal series might arise from conditions not themselves situated within its conventional time. Whether such a proposal is coherent belongs to metaphysical cosmology and cannot be settled here.

Nor can it be inferred that something must always continue to exist. The cessation of every presently known object or cosmic structure would not by itself establish absolute nothingness, because the relevant modal and cosmological conditions would first have to be clarified. Conversely, the concept of absolute nothingness cannot prove the everlasting continuation of actuality merely because it fails to designate an instantiated state.

Absolute nothingness also differs from emptiness. Emptiness is the absence of inherent existence in conventionally existing persons and phenomena :

$$C(A) \wedge \neg SV(A)$$

Absolute nothingness would deny every conventional actuality :

$$\neg \exists x C(x)$$

Even this formula remains only an imperfect conceptual approximation, because it still presupposes a domain of quantification, logical rules, and a proposition asserting the absence. Emptiness concerns the mode in which actualities exist. Absolute nothingness concerns the imagined absence of all actualities and every field of possible instantiation. To confuse them converts the Middle Way into nihilism.

The distinction also blocks the expression *the Void* when it is treated as an entity. Capitalization, symbolic elevation, or negative predication can turn absolute absence into a quasi-substance : an empty ground into which objects dissolve or from which they arise. The Void then becomes something possessing sterility, depth, power, permanence, or generativity. This is reification by negation. What was introduced as the absence of all determination acquires the properties required to perform metaphysical work.

The same error appears when nothingness is granted causal force. Nothingness cannot annihilate, absorb, produce, permit, or oppose. When an object ceases, its cessation follows from changing conditions, loss of organization, destructive interaction, or failure of conservation. Nothingness does not arrive and remove it. The object becomes relatively non-existent because the processes sustaining its conventional identity no longer obtain.

Absolute nothingness is therefore neither passive nor active. Passivity remains a mode of actuality in which something undergoes or fails to initiate change. Activity is the production of effects. Absolute nothingness can perform neither role. The older contrast between passive and active nothingness usefully distinguished sterile absence from productive virtuality, but the second term should no longer be called nothingness. Virtuality is not an active void. It is a positive modal aspect of the world-system and will be treated as such in the next subsection.

Likewise, zero is not passive nothingness. Zero is a mathematically instantiated object with formal functions. It may represent the absence of a selected quantity within a determinate system, but it does not represent the absence of the system itself. An empty set, zero value, null result, or unoccupied position remains logically and conventionally operative. None approaches absolute nothingness merely by containing no members of a selected kind.

The critical function of absolute nothingness can now be stated positively. First, it prevents relative absence from being inflated into the absence of the world-system. Second, it blocks the representation of cosmogenesis as a transition from a prior void. Third, it exposes the reification involved whenever nothingness is endowed with permanence, causality, fertility, or power. Fourth, it prepares the distinction between absence and virtuality. What is not actual may still be possible ; what is absolutely nothing cannot contain possibility.

Absolute nothingness also marks the limit of explanatory demand. The question “Why is there something rather than absolute nothingness ?” cannot be answered by comparing two available states and identifying why one became actual. Absolute nothingness was never available as a state within the relevant modal field. Nor can the world-system be explained by positing an external actuality that selected existence over nothingness, because such an actuality already belongs to the side of something and leaves the original question intact.

The limit-concept therefore does not solve the Question of Questions. It clarifies what cannot count as its solution. Absolute nothingness cannot be the source from which actuality emerges, the destination into which all process falls, or the alternative state against which the world was selected. It is the conceptual limit reached when negation removes the very conditions under which a determinate negation could be instantiated.

The verdict is exact. Absolute nothingness can be thought as a limiting negation, but it cannot be instantiated as an actuality, possibility, state, field, source, or outcome. Its value is critical rather than ontological. It guards the distinction between relative absence and the virtual possibilities of the world-system.

Nothingness marks the limit. It does not ground what lies within it.

4. Potentiality and Virtuality

The rejection of absolute nothingness does not entail that everything possible is already actual. Between determinate actuality and impossibility lies the modal field of what may become actual. Potentiality and virtuality articulate this field. Neither is a species of nothingness. Both concern possible actuality under conditions, although they do so at different levels.

An actuality is what has become determinate. It occurs, functions, enters relations, and contributes to subsequent process. A possibility is not yet actual in this sense, but neither is it therefore absolutely absent. It is thinkable as a possible determination, capacity, development, relation, or organization. The decisive question is whether the conditions required for its actualization obtain, may obtain, or cannot obtain.

Not everything that is not actual is possible. A square circle is not presently absent in the way an unbuilt house is absent. The house may become actual if suitable materials, agents, knowledge, permissions, and circumstances converge. The square circle cannot become actual under the ordinary meanings of its predicates, because its determination is contradictory. Non-actuality therefore divides into at least possible non-actuality and impossible non-actuality.

Logical possibility supplies only the weakest condition. A proposition is logically possible when its determinations do not contradict one another within the adopted logical system. This does not establish that the corresponding object can become physically, biologically, psychologically, socially, or metaphysically actual. A perpetual-motion machine may be describable without immediate formal contradiction while remaining physically excluded. A biological form may be imaginable while unavailable under any viable developmental history. A social arrangement may be institutionally conceivable while impossible under the actual distribution of power and resources.

Possibility is therefore domain-relative. Logical, mathematical, physical, chemical, biological, psychological, practical, social, and metaphysical possibilities cannot be gathered into one undifferentiated class. Each concerns different conditions of admissibility. What is possible within an abstract formal system may be unavailable within the physical world. What is physically possible may remain biologically unrealizable. What an embodied person can in principle do may remain practically unavailable because the necessary capacities or circumstances are absent.

Potentiality concerns the capacity of a determinate actuality or organized system to undergo, produce, sustain, or participate in a further determination. A seed has the potential to develop into a plant, an organism to acquire a skill, an institution to reform its procedures, and a physical system to occupy another admissible state. Such potentialities do not float independently of the actualities whose organization makes them available. They are anchored in present conditions, capacities, relations, and constraints.

This anchoring must not be interpreted substantialistically. A potentiality is not a hidden miniature actuality contained inside an object, waiting to unfold according to an inherent essence. The seed does not contain the mature plant as a completed form. Its development requires genetic organization, metabolic processes, water, nutrients, temperature, ecological relations, and a history of interactions. The potential belongs to the conjunction of these conditions rather than to a self-sufficient core existing from the seed's own side.

Potentiality is therefore relational. An organism has the potential to perform an action only relative to its bodily organization, environment, acquired abilities, and available alternatives. A material configuration has the potential to transform only relative to the forces, fields, energies, and constraints affecting it. A concept has the potential to reorganize inquiry only within a linguistic, historical, and argumentative setting capable of taking it up.

A potentiality may accordingly arise or disappear. A developmental capacity can be acquired. A technical invention can make previously unavailable actions possible. Environmental destruction can eliminate possibilities formerly open to a species. A political transformation can enlarge or restrict the available field of collective action. Potentiality is not a fixed inventory attached eternally to an object. It changes with the relations through which the object itself changes.

Nor should potentiality be identified with probability. A possibility may be available while extremely improbable, and an event may be assigned a high probability without being necessary. Probability represents or measures relative

likelihood within a specified model or evidential situation. Potentiality concerns whether the relevant transition or determination is available at all. Probability orders possibilities ; it does not create them.

A propensity is more determinate than bare possibility. It names a tendency or disposition of an actual process to develop in one way rather than another under specified conditions. Such tendencies may be represented probabilistically, but they remain rooted in the actual organization of the process. The language of propensity is therefore legitimate when it refers to identifiable tendencies. It becomes inflated when propensities are detached from actual conditions and placed in an independently existing realm.

Virtuality has a wider scope than the potentiality of a particular object. It names the formative horizon of non-actual determinations available within the world-process. A potentiality concerns what this actuality or organized system may become or do. Virtuality concerns the wider field of possible formations opened, restricted, or transformed by the conjunction of actual processes.

Every potentiality contributes to the virtual field, but not every virtual possibility belongs to one isolated bearer. The emergence of a new organization may depend upon the convergence of several systems, environmental conditions, historical developments, and acts of selection. No single actuality contains the complete potential. The possibility belongs to their possible conjunction.

The development of language illustrates this difference. A single organism may possess capacities for vocalization, memory, discrimination, and imitation. These are potentialities of that organism. Language, however, requires a social field of signs, repeated interactions, shared discriminations, inherited practices, and collective retention. Its emergence belongs to a virtual possibility opened by the conjunction of biological and social processes. It is not the unfolding of a completed linguistic form hidden inside one individual.

Virtuality is thus formative rather than voidal. It concerns possible organization, differentiation, relation, development, and action. What is virtual is not absolutely absent. Neither is it already actual in a concealed state. It is conditionally available for actualization.

The expression *virtual existence* may be retained if its restricted meaning is made explicit. It does not designate conventional existence in the same sense as the actuality of a sensate or mental object. It names possible actualization within the world-system. Actuality is what happens. Virtuality is what may happen. The difference is modal, not a division between two independently existing kinds of reality.

Virtuality must also be distinguished from fiction and imagination. A fiction may organize thought without corresponding to an available possibility. Imagination may combine predicates freely and generate worlds unconstrained by physical or historical conditions. Virtuality, by contrast, remains answerable to the conditions of possible actualization. Not everything imaginable belongs to the virtual field of the actual world-process.

The idea of the Real regulates this restriction. It requires proposed possibilities to remain answerable to actual conditions, valid knowledge, and factual resistance.

The idea of the Ideal permits these possibilities to be organized into a coherent metaphysical account. Neither idea determines in advance which possibilities exist. Together, they prevent virtuality from collapsing either into unrestricted fantasy or into the repetition of what is already actual.

The virtual is wider than the presently actual because achieved determination does not exhaust further formation. Yet it is not independent of actuality. What has become actual establishes conditions, capacities, constraints, and relations affecting what may next become actual. The past does not contain the future as a completed object, but it structures the field within which subsequent actualization occurs.

This relation is not one-directional. Actuality conditions virtuality, and new actuality can alter the field of subsequent possibility. The emergence of living organization opened evolutionary developments unavailable in a prebiotic world. Nervous systems made new modes of behavior and coordination possible. Individualized consciousness opened deliberate evaluation and choice. Language made cumulative conceptual culture possible. Institutions created forms of collective action unavailable to isolated individuals.

Novelty can therefore modify not only which possibility becomes actual but also which possibilities become available afterward. The virtual field is historically articulated. It is not necessarily a fixed phase space in which every future form has already been defined. Some domains permit precise state spaces and probabilistic models. The metaphysical field of possible formation cannot simply be identified with one completed catalogue containing every possible configuration of the world.

This rejects the image of virtuality as an infinite warehouse. A warehouse contains already formed objects awaiting removal. Were possibilities stored as complete determinations before their actualization, novelty would amount only to selection from a finished inventory. The process orientation requires a more open account : inherited conditions constrain becoming, but new conjunctions and organizations may transform the field of relevant possibilities itself.

Virtuality is not causal merely because it is formative. A possible event does not bring itself about. A possible organization does not reach forward and cause its own actualization. Actualization requires actual processes. Energetic efficacy must sustain the transition, formative organization must constrain it, and, where individualized sentience participates, alternatives may be evaluated and selected.

The operators anticipated in this chapter therefore correspond to distinct conditions of actualization. Matter concerns the energetic efficacy through which a transition becomes physically effective. Information concerns the formative organization through which one determination rather than another becomes structured and sustained. Consciousness concerns sentient presence, meaning, valuation, intent, and choice where these participate in the selection and direction of what becomes actual.

Potentiality and virtuality do not constitute a fourth operator. They articulate the modal field within which the operators function. Nor do they operate by themselves. Matter, information, and consciousness will name distinguishable

modes of determination within actuality. Potentiality and virtuality name what may become actual through their conjunction.

The former expression *active nothingness* must therefore be abandoned. Nothingness cannot be active. Activity presupposes actuality, efficacy, relation, and effect. Virtuality supplies no exception. It is not a void exercising generative power but the non-actual field of conditionally available formation. Calling it nothingness obscures its positive modal determination ; calling it active reifies it as an agent.

The old formula according to which actuality emerges from virtuality, returns to potentiality, and reemerges as new actuality can nevertheless be preserved after correction. An actuality arises through the actualization of available possibilities. When it perishes, it does not fall into a void or literally return as the same object to a reservoir of potential being. Its effects, organization, traces, and transmitted determinations enter subsequent actuality. In doing so, they condition a revised field of further possibilities.

The movement is therefore not :

actuality → nothingness → actuality.

It is :

determinate actuality → transmission and transformation of conditions → altered potentiality and virtuality → further determinate actuality.

This sequence remains schematic. The transitions are not separate cosmic stages, and the virtual does not intervene between two actualities as an independent temporal interval. Actuality and virtuality are simultaneous aspects of the process considered modally. At every determinate moment, something is actual, while further formations remain available, unavailable, or undecided relative to what is actual.

The virtual field may later be specified through the primordial correlates of the three operators. Proceeding by controlled reversal from matter, information, and consciousness as discerned in concrete actuality, general metaphysics may speculate primordial matter as the possibility of energetic actualization, primordial information as possible architecture and formative organization, and primordial consciousness as the possibility of sentient actualization, including the possible development of individualized forms capable of valuation and choice. These specifications do not introduce three substances existing before the world. They articulate the virtual conditions corresponding to the three modes of operation encountered within it.

The inference runs from concrete actuality toward its speculative modal condition. It does not begin from an independently known primordial realm and deduce the actual world from it. The primordial set remains a hyper-conceptual reconstruction : arguable, non-testable, corrigible, and empty of inherent existence. Its fuller defense depends upon the subsequent argument for the three operators.

Potentiality and virtuality therefore occupy a precise middle position. They are not actualities, but neither are they nothing. They are not self-existing forms, yet they

cannot be reduced to arbitrary concepts. They are conditioned possibilities of further formation within the world-process.

The world is not exhausted by what has happened. What may happen is not another world.

5. The Actual World and the Virtual World-Ground

The distinctions among actuality, potentiality, and virtuality culminate in the relation between the actual world and the virtual world-ground. Together they constitute the world-system. They are not two worlds, two ontological levels, or two independently existing domains. They are modally distinct aspects of one process : the world considered according to what determinately happens and the same world considered according to what may become actual.

The actual world consists of all actual occasions and of the aggregates, organizations, societies, persons, and historical formations constituted through them. It includes sensate and mental objects, physical processes, living systems, meanings, actions, institutions, and every other conventionally existing actuality. It is not limited to the observable physical universe, although every conventionally actual object belongs to the one world within which physical embodiment, informational organization, and sentient presence occur.

The expression *actual world* therefore does not designate a finished cosmic totality. It names the world insofar as its processes have become determinate. Actuality is what occurs, functions, interacts, and contributes to further becoming. Every actuality has inherited conditions, a determinate organization, and a limited range of effects. It arises, persists for an interval, enters relations, and perishes or changes into subsequent configurations.

Actuality is full but empty. It is full because actual occasions operate, organize, affect, experience, and transmit. It is empty because no actuality possesses inherent existence, self-power, or an identity independent of its conditions, parts, relations, and designation. The actual world is therefore neither an illusion in the sense of non-existence nor a self-sufficient realm grounded in substances. It is the dependently arisen fullness of what happens.

The virtual world-ground concerns the same world under the aspect of its formative possibilities. It names what may happen under the conditions, relations, constraints, capacities, and organizations established by what has happened. It is virtual because these formations are not yet actual. It is called a ground because it articulates the modal horizon within which further determination remains conditionally available.

The word *ground* must be restricted accordingly. It does not name an underlying bearer supporting the actual world, an ultimate cause producing it, or a primordial substance from which actualities are manufactured. It indicates the formative conditions presupposed whenever several continuations remain available, one actual process can develop otherwise, or novelty exceeds the exact repetition of the past.

The world-ground is therefore sufficient only in a restricted sense. It is sufficient as the speculative articulation of the possibilities relevant to further actualization. It is not a sufficient efficient cause of what becomes actual, and it is not self-sufficient. No possibility actualizes itself. Actual processes, relations, constraints, and, where individualized consciousness is involved, valuation and choice are required for one available determination to become actual rather than another.

The actual world and the virtual world-ground must be distinguished without being separated. If only the actual world were admitted, becoming would be reduced to what is already determinate, and novelty would become either unintelligible or merely apparent. If the world-ground were separated from actuality, possibility would become another realm whose relation to the world would itself require explanation. The process orientation avoids both reductions.

The distinction is modal :

the actual world is what happens ;

the virtual world-ground is what may happen.

This difference does not imply that the world-ground lies spatially beneath the world or temporally before it. Spatial and temporal relations belong to determinate actual processes. The world-ground is not located elsewhere, nor does it wait before actuality begins. It is simultaneous with the actual world as its possibility-aspect. At every moment of determinate process, further formations remain available, unavailable, or undecided relative to what has become actual.

The world-ground may nevertheless be described as logically prior to a particular actualization. Before a determinate possibility becomes actual, it must be available under the relevant conditions. This priority is modal and explanatory, not temporal. The possibility of A is presupposed in the actualization of A, but it need not have existed earlier as a formed object awaiting realization.

Actuality and virtuality also determine one another asymmetrically. The virtual field conditions what may become actual, but its content is itself conditioned by the actual world. What has happened establishes capacities, exclusions, relations, and paths of continuation. Every actualization closes certain possibilities, retains others, and opens possibilities not previously available.

The development of life illustrates this movement. Prebiotic physical and chemical conditions permitted certain forms of organized complexity. Once living organization became actual, new possibilities of metabolism, reproduction, adaptation, and evolution emerged. The later development of nervous systems opened new possibilities of behavior. Individualized consciousness opened new forms of meaning, deliberation, and choice. Language and institutions opened possibilities of cultural and collective action unavailable to isolated organisms.

The world-ground therefore evolves with the actual world. It is not an eternal inventory of completely formed possibilities. The available field of further formation changes because actualization changes the conditions from which later processes proceed. The new actuality does not merely select an item from a timeless catalogue. It may reorganize the modal field itself.

This does not mean that the world-ground is an actual process undergoing change beside the world. The change belongs to the possibilities attributable to the developing world-system. As actual conditions alter, the relevant virtual possibilities alter with them. The world-ground is dynamic because the world is dynamic, not because a separate virtual entity performs its own hidden evolution.

The relation is therefore recurrent :

actual conditions delimit a virtual field ;

a possibility becomes actual through determinate processes ;

the new actuality modifies subsequent conditions ;

the virtual field is correspondingly reorganized.

This movement must not be interpreted as a temporal alternation between actuality and virtuality. The world does not first become actual, then fall into a virtual interval, and later reappear. Every actual process possesses both an achieved determination and a horizon of possible continuation. Actuality and virtuality remain simultaneous while their determinate contents change.

Nor does every unrealized possibility survive unchanged. Some become unavailable because the necessary conditions disappear. Others remain open. New possibilities arise through unprecedented conjunctions. The world-ground is therefore not a memory retaining every possibility eternally, although actual processes may leave material, informational, sentient, historical, or cultural traces affecting what can later occur.

The older account spoke of propensities. This term may be retained when it names structured tendencies within the virtual field. A propensity is not a merely conceivable alternative but a possibility rendered more or less likely by actual conditions. Different arrangements of matter, information, and consciousness can make some transitions highly probable, others remote, and others unavailable. Yet propensity must not be reified as a force reaching from the virtual realm into actuality. It expresses how actual conditions incline further process.

The world-ground is not exhausted by the potentialities of presently identifiable objects. Particular potentialities belong to organisms, systems, persons, or situations. The world-ground gathers the wider possibilities arising from their conjunction within the world-system. A possibility may depend upon relations among numerous actual processes and may not be attributable to any single bearer.

For this reason, the world-ground is a hyper-concept rather than a scientific object. No experiment encounters the virtual world-ground as a whole. Sciences investigate particular capacities, state spaces, tendencies, constraints, probabilities, and possible transitions. General metaphysics gathers these domain-specific possibilities into a totalizing modal horizon. The resulting construction is argued, scientifically constrained, and corrigible, but not itself experimentally established.

The world-ground can now be specified more precisely. The actual world displays three distinguishable modes of operation : energetic efficacy, formative organization, and sentient presence. These will be articulated as matter, information, and consciousness. Proceeding by controlled reversal from these

concrete operators, general metaphysics speculates three primordial correlatives specifying the virtual world-ground.

Primordial matter names the potential for energetic actualization. It does not designate a primordial material substance, a preexisting particle-field, or a physical medium located beneath observable processes. It concerns the most general virtual condition under which energetic efficacy can become actual.

Primordial information names the possibilities of organization, architecture, constraint, order, differentiation, and creative advance. It does not consist of disembodied codes, eternal forms, or ready-made structures stored outside actuality. It specifies the formative possibilities through which actual processes may acquire determinate organization.

Primordial consciousness names the virtual correlate of mere cognizing presence : the conditioned possibility of sentient actualization. It does not establish an independently actual cosmic subject, and it does not itself perceive, value, choose, intend, remember, or act. It specifies only the possibility that sentient presence may become actual and, under sufficiently organized material-informational conditions, individualized in forms capable of valuation and choice. Whether actuality warrants the further admission of an actual continuing Divine subject under the hyper-concept God* belongs to metaphysical theology.

- conscious operator → sentient presence
- definition of consciousness → mere cognizing presence
- primordial correlate → primordial consciousness

These primordial correlatives form a set only in the architectonic sense. They articulate three distinguishable dimensions of formative possibility corresponding to the three operators of concrete actuality. They are not separate members contained within a cosmic receptacle, nor are they substances existing from their own side. Their unity belongs to their conjunction within the virtual specification of one world-system.

The inference is retrospective and speculative. Matter, information, and consciousness are first distinguished through their operations in concrete actuality. Their primordial correlatives are then projected as the corresponding conditions of possible further actualization.

The argument does not begin with independently known primordial entities and derive the actual world from them.

The direction is : concrete operators → speculative primordial correlatives.

This direction preserves critical restraint. The actual world provides the only field in which the operators become discernible. The world-ground is their reconstructed modal horizon, not a second domain observed directly or disclosed from outside the world. Its triadic specification is therefore arguable rather than factual and remains dependent upon the success of the three-operator thesis developed in the following section.

Concrete operators and primordial correlatives are structurally corresponding but modally distinct. Matter, information, and consciousness operate within determinate actualities. Primordial matter, primordial information, and primordial

consciousness specify what may become actual under the virtual conditions of the world-system. The former belong to what happens ; the latter to the formative possibility of further happening.

This distinction does not imply a one-way relation from world-ground to world. The actual world actualizes possibilities, but its achieved determinations also reorganize the world-ground. The relation is therefore bidirectional without becoming interaction between two entities. Virtuality conditions actuality ; actuality transforms virtuality. These are two directions within one process.

The actual world and the world-ground are consequently non-identical but inseparable. Their non-identity is modal and functional. Actuality cannot be reduced to possibility, because what happens possesses determinate efficacy unavailable to what merely may happen. Virtuality cannot be reduced to actuality, because achieved determination does not exhaust the possibilities of further becoming. Yet neither exists independently of the other within the present scheme.

The world-system is their conjunction. It is the one, open process considered in its determinate actuality and formative virtuality. Its unity is organizational rather than substantial. The world-system does not exist over and above the actual world and its virtual world-ground as a third entity uniting them. It is the hyper-conceptual totalization under which their modal conjunction becomes intelligible.

The requirements of ultimate analysis remain unchanged here. The actual world lacks inherent existence. The virtual world-ground lacks inherent existence. Their distinction, conjunction, and triadic specification are themselves conventional and hyper-conceptual. None provides a hidden foundation exempt from dependence, designation, and correction.

The actual world is therefore not grounded in the world-ground as an effect is grounded in a self-sufficient cause. It is grounded only in the restricted sense that further actuality presupposes available possibilities under inherited conditions. The world-ground, conversely, does not exist independently of the actual processes whose modal openness it articulates.

The final relation can be stated precisely. The actual world is the dependently arisen fullness of determinate operation. The virtual world-ground is the dependently specified horizon of further formation. Together they constitute the open world-system, within which what happens continually transforms what may happen next.

The actual gives the virtual its conditions. The virtual gives the actual its openness.

C. The Three-Operator Thesis

The distinction between the actual world and the virtual world-ground establishes the modal field of becoming, but it does not yet specify how actuality becomes determinate. An available possibility does not actualize itself. Concrete actualization becomes energetically effective and formatively organized. The present metaphysics further proposes that every actual occasion includes an infinitesimal conscious dimension, a proposal to be argued later under evolutionary panexperientialism. Matter, information, and consciousness are

accordingly advanced as the three operators articulating energetic efficacy, formative organization, and sentient presence. The claim is neither that three substances compose the world nor that every concrete process can be divided into three separable parts. It is that the present scheme interprets actualization through three distinguishable and irreducible modes of operation whose conjunction must be clarified before the domains of matter, information, and consciousness can be examined separately.

1. What Is an Operator ?

The term *operator* names a *distinguishable mode* through which actuality becomes *determinate* and *effective*. It does not designate an entity standing behind an event, a bearer possessing operations as properties, or an agent intervening from outside the process. An operator exists only in and through *concrete operation*. Matter, information, and consciousness do not first exist independently and subsequently enter an actual occasion. The actual occasion ‘becomes’ through their conjoint functioning.

The term is chosen to place operation *before* substance. A substance-based metaphysics asks what self-existing thing carries properties, undergoes change, or produces effects. The present process metaphysics asks what occurs, how it becomes determinate, through which relations it functions, and what it contributes to subsequent process. An operator identifies one general manner in which such functioning takes place without adding an immutable bearer beneath it.

An operator is therefore not *another kind* of object. A particle, organism, person, institution, sensation, or thought can become an object of scientific or philosophical inquiry. Matter, information, and consciousness, taken as operators, are hyper-concepts *coordinating families of operations across many such objects*. They identify recurrent explanatory roles without implying that one universal entity is numerically present in every instance.

The nominal form must not obscure this point. Grammar invites reification. Because matter, information, and consciousness occur as nouns, they can easily be treated as three stuffs, realms, or cosmic beings. The term ‘operator’ counters this tendency by returning attention to what the relevant actualities do. Material processes *transmit* energetic efficacy. Informational processes *organize* differentiated states and constrain possible outcomes. Conscious processes *instantiate cognizing presence* and, where consciousness is individualized, support meaning, valuation, intent, and choice. The nouns abbreviate these modes of operation.

The distinction between an operator and an operation must nevertheless remain clear. An operation is a concrete functioning occurring within a determinate actuality. A physical interaction, cellular regulation, act of attention, or deliberate choice is an operation. An operator is the general metaphysical concept under which operations of a certain kind are coordinated. No operator appears apart from its operations, but no single operation exhausts the operator’s semantic range.

The operator is thus second-order. It does not replace descriptions of particular processes. Physics must still investigate fields, forces, interactions, and energetic

exchanges. Biology must investigate metabolism, genetic regulation, adaptation, and organismic organization. Psychology and first-person inquiry must distinguish awareness, attention, affect, thought, intention, and choice. General metaphysics asks what wider mode of operation these determinate processes exemplify and how this mode relates to the others.

This relation to the sciences determines the epistemic status of the term. Science does not experimentally discover *the material operator*, *the informational operator*, or *the conscious operator* as three objects. It discovers and investigates determinate physical, organizational, biological, neurological, behavioral, and experiential processes. The grouping of these findings under three general operators is a metaphysical totalization. It is scientifically constrained and may be scientifically consonant, but it is not itself a scientific result.

Nor is *operator* being used in its strictly mathematical sense. A mathematical operator is formally defined by the transformation it performs upon objects within a specified domain. No comparable calculus has yet been supplied for matter, information, and consciousness as metaphysical operators. The present use is functional and architectonic. It identifies modes of determination rather than formal mappings. Mathematical representations may later clarify particular operations, but technical notation cannot by itself establish the metaphysical triad.

An operator must also be distinguished from a cause. A cause identifies something relevant to the production of a determinate effect. An operator identifies the mode in which causal or formative efficacy functions. Matter is not one universal cause of all physical effects. It names energetic efficacy as a general mode of operation. Information is not an additional efficient cause acting beside matter. It names the organization, differentiation, and constraint through which energetic processes acquire determinate pathways and functions. Consciousness is not an occult force added to material and informational causation. It names sentient presence and, in its individualized form, the valuation and choice through which an actuality may be intentionally directed.

The three operators should therefore not be pictured as three forces converging upon an otherwise passive occasion. *The actual occasion is nothing apart from its actualization*. Energetic efficacy, formative organization, and sentient determination are aspects or properties of that one actualization, distinguished according to the explanatory work they perform. Their conjunction does not require a fourth entity to combine them.

An operator is likewise not identical with a vector. Chapter 4 of Volume I distinguished efficient and final determination as two inseparable directions within the actual occasion. Efficient determination concerns the inheritance and transmission of achieved actuality. Final determination concerns the integration of inherited conditions into one determinate outcome. Matter is predominantly associated with efficient determination, while information and consciousness predominantly articulate final determination. Yet these associations are not strict identities.

Material processes are always organized, and their organization participates in how energetic efficacy is transmitted. Information requires actual carriers and can become effective only through material processes. Consciousness in its

individualized forms depends upon material embodiment and informational architecture, while intention and choice can redirect the embodied processes through which they are enacted. The operators cross the distinction between efficient and final determination even while exhibiting different affinities with its two directions.

Nor is an operator identical with a domain. The material, informational, and conscious domains are composed of actual occasions, aggregates, organizations, and societies *in which one operator becomes dominant*. The operator is the *mode* of functioning ; the domain is the *field* of actualities characterized by its dominance. Matter is not the material domain, information is not the informational domain, and consciousness is not the conscious domain. The same operator functions beyond the domain in which it predominates.

This distinction prevents the world from being divided into three autonomous regions. A material actuality is not devoid of organization or sentience. An informational actuality is not detached from energetic realization. A conscious actuality is not disembodied or unstructured. Domains are distinguished by *operational dominance*, not by the exclusive presence of one operator and the absence of the others.

The relation between operator and actuality is therefore one of functional instantiation. An operator becomes manifest where a concrete process performs the corresponding role. Energetic transmission instantiates material operation. Differentiated organization and constraint instantiate informational operation. Cognizing presence instantiates conscious operation. Where consciousness becomes individualized, meaning, valuation, affect, intent, and choice may arise as developed conscious operations. The hyper-concept gathers these instances without becoming an additional object instantiated beside them.

Functional instantiation must not be confused with substantial instantiation. The occurrence of material operations does not establish an underlying material substance. The occurrence of informational operations does not establish an independently existing realm of form. The occurrence of conscious operations does not establish a substantial soul or universal mind. The operators are real in their functioning, but their reality does not require existence from their own side.

Each operator is therefore empty of inherent existence. It depends upon concrete actualities, the distinctions through which its operations are identified, and the metaphysical scheme coordinating these operations. Yet this dependence does not make the operator arbitrary. The distinction must answer to genuine explanatory differences. Matter, information, and consciousness earn their place only if the relevant operations cannot be redescribed without loss under one another.

The anti-reifying status of the term also applies to the primordial correlatives of the operators. Primordial matter, primordial information, and primordial consciousness do not operate as concrete actualities within the virtual world-ground. They specify the corresponding dimensions of formative possibility inferred from the operators discerned in the actual world. The relation between operator and primordial correlate is structural and modal, not one of identity.

Matter as operator concerns actual energetic efficacy. Primordial matter concerns the virtual possibility of energetic actualization. Information as operator concerns actual organization, differentiation, and constraint. Primordial information concerns possible architecture and formative order. Consciousness as operator concerns cognizing presence within actuality and, where individualized, supports valuation and choice. Primordial consciousness concerns the virtual possibility of sentient actualization, including the possible development of such individualized forms. The primordial set does not duplicate the operators in another realm. It specifies the world-ground by controlled reversal from concrete operation.

The term *operator* also carries no normative force. Matter does not determine what is true, information does not determine what is beautiful, and consciousness does not determine what is ethically good merely by operating. The operators belong to immanent metaphysics. The rules of truth, beauty, and action belong to normative philosophy and are already presupposed whenever the operator thesis is formulated or defended. Ontological operation must not be converted into normative bindingness.

The definition can now be stated precisely.

An operator is a non-substantial, functionally instantiated, hyper-conceptual mode of determination through which concrete actuality becomes efficacious, organized, or sentiently present.

It operates only in conjunction with the other operators, can become dominant without becoming isolated, and remains distinguishable by the explanatory role it performs.

This definition imposes four controls upon everything that follows. An operator may not be treated as a *substance*. It may not be detached from *concrete actualization*. It may not be confused with a *domain, vector, cause, or primordial correlate*. And it may not be retained *unless it performs explanatory work irreducible to the other proposed operators*.

Matter, information, and consciousness must now earn their status under these controls. The next step is to show why an adequate account of actuality requires the distinctions among energetic efficacy, formative organization, and sentient presence.

2. Efficacy, Organization, and Presence

An operator has been defined as a non-substantial mode through which actuality becomes determinate and effective. The next question concerns why three such modes are proposed. Why are matter, information, and consciousness required rather than one operator or an indefinite plurality? The argument begins neither from three preexisting domains nor from an inherited metaphysical triad. It begins from what must be distinguished if concrete actuality is to be understood without reducing its principal features to one another.

Actuality differs from unrealized possibility because it makes a difference. What is merely possible may belong to the virtual field, but it does not yet interact, resist, alter conditions, or contribute to what follows. An actuality enters the world-

process by becoming effective. It affects other actualities, changes the situation inherited by subsequent processes, and leaves consequences that would not obtain had it remained merely possible.

This first requirement is energetic efficacy. The term *energetic* does not restrict the argument in advance to one scientific theory of energy. It indicates that actuality must possess sufficient physical realization to enter causal relations and produce effects. An actuality without any efficacy would be indistinguishable from an unrealized possibility, an abstract description, or a fiction. Whatever becomes actual must be capable of participating in the transmission and transformation of the world.

Energetic efficacy supplies public actuality. It gives an occasion a place within the causal history of the world, allowing its occurrence to affect conditions beyond itself. Fields interact, particles exchange momentum, molecules react, organisms alter environments, bodies act, and artifacts intervene in subsequent processes. These operations differ scientifically, but they share one restricted metaphysical feature : something actual makes a difference to something further.

This efficacy is inherited as well as exercised. Every new actuality arises within conditions established by previous actualities. What has occurred does not remain present as an enduring substance, but its effects enter the situation from which further actuality becomes possible. Actuality therefore possesses a horizontal dimension : achieved determinations become conditions of later determinations.

Yet efficacy alone does not explain what becomes actual. Energy may be transferred, distributed, accumulated, or dissipated only through determinate configurations. Physical interaction requires fields, relations, boundary conditions, symmetries, quantities, and lawful constraints. Chemical processes depend upon molecular structure. Biological activity depends upon cellular organization. Action depends upon bodily and social architecture. No efficacy operates as an undifferentiated power.

The second requirement is therefore formative organization. An actuality is not merely effective ; it is effective *as this actuality*. It possesses a determinate configuration through which its components, relations, boundaries, and possible effects acquire one organization rather than another. Without such determination, there would be efficacy without a pathway, occurrence without identity, and process without any distinction between what happens and what does not.

Formative organization answers a different question from energetic efficacy. Efficacy asks how an actuality becomes physically effective. Organization asks why that efficacy assumes this arrangement, follows this pathway, or sustains this function rather than another. An inventory of constituents and energetic magnitudes does not by itself explain why the same kinds of constituents form a crystal, cell, nervous system, written sentence, computer, or institution. Their arrangement alters what they can do.

Organization does not need to be imposed by an external designer. Physical symmetries and symmetry-breaks, chemical affinities, biological regulation, developmental pathways, ecological constraints, learned habits, and social rules can all contribute to form without presupposing conscious planning. Formative

determination is wider than intentional design. It concerns every case in which differentiated relations constrain a process into a relatively determinate configuration.

Nor does organization float free of physical realization. A form that is neither instantiated, represented, remembered, transmitted, nor enacted remains an abstract possibility. Concrete organization requires actual carriers and energetically effective processes. A genetic sequence depends upon molecular realization ; a neural architecture upon living tissue ; a sentence upon sounds, inscriptions, or retained mental form ; an institution upon persons, practices, records, and material conditions.

Energetic efficacy and formative organization are therefore inseparable but non-identical. Efficacy without organization would not produce a determinate actuality. Organization without efficacy would remain unrealized. Their distinction is explanatory : one concerns actual physical realization and causal transmission ; the other concerns the differentiated constraints and architecture through which realization becomes determinate.

Matter and information will articulate these two requirements. Matter names the operator of energetic efficacy and public realization. Information names the operator of formative organization, differentiated constraint, and patterned continuity. Neither term designates a substance. Matter is not formless stuff waiting to receive order, while information is not disembodied form entering matter from elsewhere. Concrete actuality involves their conjunction from the outset.

Two operators would nevertheless remain insufficient. Energetic efficacy and formative organization can account for publicly detectable processes and their determinate architecture, but they do not account for the fact that some actualities are present from a first-person vantage. Sensation, affection, attention, meaning, valuation, intention, and choice are not merely publicly described structures. They are also lived or consciously presented to a unique subject.

This is sentient presence. It does not mean that an actuality occupies a location, persists before an observer, or registers a signal. Such conditions can be described entirely from a third-person perspective. Sentient presence means that actualization includes cognizing presence : minimal clarity and awareness. At developed levels, this conscious character becomes organized as experience within one personal field of experience.

The reality of developed sentient presence is not inferred from physical theory. It is immediately available within conscious life and attributed to other persons and organisms under intersubjective and behavioral conditions. Pain is not merely neural activity described from outside ; it is also suffered. A color is not merely a wavelength distribution or neural discrimination ; it is consciously presented. A reason is not merely an informational state ; it may be understood, evaluated, and adopted by an agent.

The third-person description may identify indispensable material and informational conditions. It does not thereby eliminate the first-person object. Physical efficacy explains how neural and bodily processes affect one another.

Informational organization explains how discrimination, memory, integration, and action-guidance are structured. Neither description, solely by being complete within its own register, becomes the conscious presence of what it describes.

The inclusion of consciousness as an operator begins from this irreducibility. General metaphysics must accommodate first-person presence within the same world-system as physical efficacy and informational organization. It cannot place consciousness outside the world, reduce it to an appearance generated by matter, or reinterpret it as information processing merely because processing is one of its conditions.

A restriction is needed. The existence of individualized consciousness in persons does not deductively prove that every actual occasion possesses consciousness. One could propose that consciousness emerges only when material and informational organization reaches sufficient complexity. The present metaphysics instead adopts evolutionary panexperientialism : developed consciousness arises through organization and evolution, but its possibility is rooted in an infinitesimal sentient dimension belonging to actualization itself.

This is the strongest speculative step in the three-operator thesis. Its justification is cumulative rather than demonstrative. First, conscious presence is an actuality within the world and cannot be eliminated. Second, deriving inward presence from an antecedent reality entirely devoid of every sentient aspect introduces an ontological rupture : the conditions can be described, but the appearance of first-person presence remains unexplained. Third, the actual occasion already includes final determination, integration, and elementary self-determination rather than functioning as the passive transmission of an entirely completed past. Infinitesimal consciousness names the inward presence corresponding to this elementary self-determination.

Infinitesimal consciousness must not be confused with individualized mind. It does not imply reflective self-consciousness, conceptual thought, attention, memory, personal identity, deliberation, or ethical freedom. Nor does it imply that particles, stones, tables, organs, or institutions are conscious subjects. Compound objects may contain innumerable actual occasions without integrating their infinitesimal consciousness into one individualized point of view.

At the elementary level, sentient presence names only the minimal clarity and awareness attributed to actualization. Within the adopted Whiteheadian-process interpretation, the actual occasion also integrates inherited conditions into one determinate outcome. This integration is not an exclusive vantage and does not yet entail valuation, intent, deliberation, or choice. In more highly organized societies, cognizing presence can become coordinated, retained, and individualized as one first-person field. In persons, individualized consciousness supports attention, meaning, valuation, intent, deliberation, and freedom-in-immediacy.

The conscious operator therefore spans several degrees without dissolving their differences. Infinitesimal consciousness belongs to the elementary actual occasion. Individualized consciousness belongs to an organized society constituting one continuing first-person field. Reflective self-consciousness belongs to persons capable of making their own mental objects objects of

attention, interpretation, and judgment. The operator is continuous in its basic function while its modes of organization differ radically.

Sentient presence adds a third explanatory question. Energetic efficacy asks : How does an actuality become effective ? Formative organization asks : How does its efficacy acquire determinate structure ? Sentient presence asks : How does actualization include cognizing presence and, at developed individualized levels, become meaningfully taken up ?

The three questions cannot be answered by one another. A description of energetic interaction does not by itself disclose organization. A description of organization does not by itself produce physical realization. Neither an energetic nor an informational description becomes first-person presence merely through greater complexity. Conversely, conscious presence does not create its own material conditions or informational architecture merely by being conscious of them.

The three requirements correspond principally to the three operators :

- matter : energetic efficacy and public realization ;
- information : formative organization and differentiated constraint ;
- consciousness : sentient presence.

The correspondence is principal rather than exclusive. Informational patterns are transmitted through material processes and may become efficiently effective. Material properties constrain which organizations can arise. Conscious valuation can reorganize information and redirect material action. The operators are distinguished by their characteristic explanatory roles, not by impermeable boundaries.

They should likewise not be interpreted as three chronological stages within an actual occasion. An actuality does not first become material, then acquire information, and finally receive consciousness. Efficacy, organization, and sentient presence belong to one act of actualization. Their distinction is analytical and functional. What occurs concretely is their conjunction.

Historical development must be distinguished from this simultaneity. Material operation may dominate the earliest physical formations known to cosmology. Informational operation becomes increasingly autonomous and complex within living systems. Individualized consciousness arises only within highly developed organization. This evolutionary succession concerns changing dominance and individualization. It does not mean that the later operator is ontologically manufactured from the earlier one or was entirely absent from elementary actualization.

The same distinction applies to the virtual world-ground. Concrete actuality displays energetic efficacy, formative organization, and sentient presence. By controlled reversal, their primordial correlatives specify the virtual conditions of further actualization as primordial matter, primordial information, and primordial consciousness. The primordial set is not introduced independently and then used to deduce the operators. It is speculated from the triadic structure discerned in the actual world.

The movement from actuality to the three operators is therefore neither an empirical classification nor a deductive proof of cosmic constituents. It is an abductive and dialectical reconstruction. Efficacy must be preserved against the reduction of actuality to form or appearance. Organization must be preserved against the reduction of determinate structure to energetic quantity. Presence must be preserved against the reduction of first-person actuality to publicly described mechanism.

These distinctions propose a minimally sufficient triad. Fewer than three operators would require one of the explanatory requirements to be absorbed into another. More than three may become necessary if a further irreducible mode of operation is identified. The present claim is not that the triad has been established with absolute completeness. It is that energetic efficacy, formative organization, and sentient presence mark three differences an adequate general metaphysics cannot eliminate without loss.

Actuality is effective, determinate, and inwardly present. Matter, information, and consciousness name these three dimensions of its operation.

3. The Irreducibility of the Operators

To call matter, information, and consciousness irreducible is not to claim that they exist independently, operate in isolation, or constitute three substances. Irreducibility concerns explanatory identity. One operator is irreducible to another when its characteristic operation cannot be translated without remainder into the vocabulary, properties, and functions of the other. Dependence, correlation, embodiment, mediation, and causal interaction do not by themselves establish such an identity.

The operators are therefore distinct without being separate. Their distinction is real because each performs explanatory work the others cannot replace. Their separation is conceptual because concrete actuality never presents one operator entirely detached from the others. Material efficacy is always organized. Informational organization requires actual realization. Conscious presence depends, in its individualized forms, upon material embodiment and informational architecture. The three are conjoint in actuality, although their functions remain non-identical.

Irreducibility must first be distinguished from substantial independence. A traditional substance exists from its own side and possesses its properties independently of external conditions. No such claim is made for any operator. Matter depends upon determinate physical relations, information upon carriers and organized differences, and individualized consciousness upon corporeal and informational conditions. Each lacks inherent existence. Their irreducibility therefore does not restore three self-sufficient foundations after substance has been rejected.

Nor does irreducibility imply complete descriptive autonomy. The operators can and must be described in relation to one another. Material changes may alter informational organization and conscious states. Informational architectures may constrain material processes. Conscious valuation may select information, redirect

attention, and initiate bodily action. The operators are distinguishable precisely within these relations, not before them.

The thesis concerns three failures of reduction. Matter cannot be reduced to information or consciousness. Information cannot be reduced to matter or consciousness. Consciousness cannot be reduced to matter or information. Each reduction preserves some genuine dependencies but converts them into an identity exceeding what those dependencies establish.

Matter is irreducible because actuality requires energetic efficacy and public realization. Whatever becomes materially actual occupies a determinate spatiotemporal situation, enters physical relations, resists, interacts, and transmits effects. These features cannot be supplied by an abstract organization alone. A pattern that is neither physically realized nor mentally instantiated remains a possible pattern, not a materially effective actuality.

Information therefore cannot replace matter. A code requires a carrier. A sequence requires distinguishable states. A computational operation requires an actually functioning architecture. A biological regulation requires molecular, cellular, and energetic processes. Even when one informational pattern can be realized through several different material configurations, every realization remains material. Multiple realizability weakens the identity of information with one particular carrier ; it does not eliminate the need for carriers altogether.

The distinction becomes clear when materially similar systems perform different functions because their organization differs. Two configurations may contain the same kinds of constituents and comparable quantities of energy while producing different outcomes because their relations, sequences, or constraints differ. This shows that matter alone does not exhaust information. It does not show that information can exist without matter.

Matter is likewise irreducible to consciousness. A conscious subject does not constitute physical actuality merely by experiencing or conceptualizing it. Knowledge of matter is constructed under epistemic conditions, but the object of knowledge remains irreducible to that construction. The fact that every physical object becomes known through sensation, interpretation, language, and theory does not entail that physical existence is produced by the knower.

Mentalism converts an epistemic condition into an ontological identity. Because objects can become known only for a subject, it concludes that they exist only as contents or constructions of consciousness. This suppresses the theory-independent side of facts and closes the subject within its own presentations. Critical realism blocks the reduction : material actuality must be treated as contributing something not constituted by the conscious act through which it becomes known.

Material efficacy also displays forms of continuity and interaction that do not depend upon their being individually apprehended. Physical processes affect bodies, instruments, environments, and other processes independently of whether a person is attending to them. Their scientific articulation remains theory-dependent, but their efficacy cannot be identified with the conceptual activity through which it is represented.

The material operator is therefore irreducible in a restricted sense. It names physical realization and energetic efficacy, not a material substance underlying every actuality. This protects the reality of matter without converting matter into the measure of everything real.

Information is irreducible because determinate actuality requires organization. Material constituents and energetic magnitudes do not by themselves specify the architecture through which a process becomes this process, follows this pathway, or performs this function. Relations, sequences, boundaries, differences, constraints, and rules of transformation contribute explanatory content not supplied by an inventory of material components alone.

A living cell illustrates the point. Its constituents are material, and its activities require energy. Yet its metabolism, regulation, replication, repair, and responsiveness depend upon the organization of these constituents. The same kinds of molecules placed in another arrangement would not constitute the same living process. The organization is not an additional substance, but neither is it exhausted by listing the material parts.

Information is therefore not merely another word for matter viewed at a finer scale. A material description may identify the carrier, location, energy, and interactions involved. An informational description identifies differentiations, sequences, constraints, relations, and functional consequences. These descriptions concern one concrete process, but they answer different questions.

This difference should not be converted into a dualism of matter and form. Informational organization does not descend upon passive matter from an independent realm. Matter is never encountered as absolutely unorganized stuff, and information is never concretely effective without realization. Their irreducibility concerns explanatory role, not ontological separation.

Information is also irreducible to consciousness. Many organized processes occur without individualized awareness, understanding, or intent. Genetic transcription, cellular regulation, immune recognition, algorithmic transformation, and many neural operations can process and transmit differences without becoming conscious of what they do. Organization does not require a reflective subject.

Even where information acquires semantic significance, the distinction remains necessary. A signal may carry information for a system because differences in one process reliably constrain differences in another. Meaning in the full conscious sense requires that something be present, understood, valued, or used from a first-person vantage. Informational relation can therefore exist without individualized meaning, although individualized meaning always depends upon informational articulation.

Consciousness does not produce information simply by attending to it. It may select, interpret, combine, and evaluate informational objects, but the structures it takes up possess determinate relations that constrain the conscious act. A sentence cannot mean anything whatsoever merely because a reader wishes it to do so. A map, code, memory, or argument depends upon relations among signs and rules that are not reducible to the momentary consciousness apprehending them.

Informationalism fails when it treats matter as a replaceable carrier and consciousness as sufficiently complex information processing. The first reduction neglects physical realization ; the second neglects sentient presence. Information can mediate between matter and consciousness without becoming identical with either.

The informational operator is thus irreducible in a restricted sense. It names formative organization, differentiated constraint, and patterned continuity. It is not disembodied form, a cosmic code existing independently, or an informational substance underlying both matter and mind.

Consciousness is irreducible because first-person presence is not identical with either energetic efficacy or informational organization. A complete third-person description of a system concerns publicly accessible processes, structures, relations, and functions. Consciousness introduces the fact that something is presented, felt, intended, understood, or valued for a unique subject of experience.

Mental states are non-material, non-informational, non-reductive, and non-extended in space. They are logically primitive and ontologically distinct, although interdependent with material states and informational architecture. Each mental state is attributed to a unique individualized consciousness and is defined by an exclusive point of view or vantage point. No public description occupies this vantage merely by describing its conditions.

This does not deny embodiment. A pain depends upon bodily and neural processes. A thought depends upon informationally organized capacities. Memory depends upon retained architecture. Altering the brain can alter consciousness, and conscious intent can alter bodily action. These relations establish interdependence and causal mediation. They do not establish numerical identity between a mental state and a neural or informational state.

Dependence is not identity. A melody depends upon acoustical realization but is not identical with one particular sound wave. A computation depends upon a functioning machine but is not adequately described by the mass of its components. More decisively, a mental state depends upon bodily and informational conditions while retaining first-person properties unavailable to their third-person descriptions.

Correlation is likewise not identity. If every conscious state were correlated with a determinate neural state, this would establish a systematic relation. It would not by itself show that the correlated terms are one and the same object. Identity would require that every defining property attributable to one also be attributable to the other in the same respect. But a neural process is spatially located, publicly measurable, and described from a third-person standpoint. A mental state is non-extended and present from an exclusive first-person vantage. The difference cannot be eliminated merely by declaring the terms identical.

Causal dependence also falls short of reduction. That one process is necessary for another does not entail that both are the same process. Oxygen is necessary for ordinary human consciousness, but consciousness is not oxygen. Neural architecture is necessary for ordinary individualized mind, but necessity does not

establish ontological identity. A condition may be indispensable without exhausting what it conditions.

Functional equivalence is insufficient as well. A system may discriminate inputs, integrate signals, store information, produce reports, and regulate behavior. These functions may be necessary conditions of developed consciousness. But describing what the system does from the outside does not yet establish that anything is consciously present from within. The transition from function to presence requires argument, not definition.

The distinction between information processing and consciousness is therefore decisive. Information processing concerns organized transformations of distinguishable states. Consciousness concerns the presence of mental objects, sentience, awareness, meaning, valuation, intent, and choice. Complex processing may accompany and support consciousness, but complexity alone does not convert third-person organization into first-person presence.

Emergence does not resolve the issue merely by naming it. To say consciousness emerges from material and informational complexity may correctly identify a developmental dependence. It does not yet explain how first-person presence arises from operations defined as entirely non-conscious. If emergence means the appearance of a new irreducible mode under sufficiently complex conditions, it is compatible with the present non-reductive scheme. If it means consciousness is nothing but the complexity from which it emerges, the reduction has simply been restated.

Evolutionary panexperientialism avoids the absolute rupture by attributing infinitesimal sentient presence to elementary actualization while reserving individualized consciousness for highly organized societies. This proposal does not turn elementary particles, aggregates, or artifacts into conscious subjects. It states only that the conscious operator does not enter the world from an antecedent field wholly devoid of sentience.

The difference between infinitesimal and individualized consciousness must remain strict. Infinitesimal sentience does not include reflective awareness, personal memory, language, deliberation, or ethical agency. These arise only through complex embodiment and informational integration. Irreducibility belongs to sentient presence as such ; individualization concerns the organization through which that presence becomes one persisting mind.

Mentalism nevertheless commits the opposite reduction. It treats material and informational actualities as contents, appearances, or constructions of consciousness. The immediate presence of mental states is then converted into the ontological primacy of mind. But first-person certainty does not establish that consciousness produces what it experiences. The conscious operator is irreducible without being all-constituting.

The three principal reductions can now be stated precisely.

Materialism treats informational organization as a convenient description of physical arrangement and consciousness as a product or appearance of physical processes. It preserves energetic efficacy while suppressing the independent explanatory work of organization and first-person presence.

Informationalism treats matter as the carrier of an abstract pattern and consciousness as sufficiently integrated computation or information processing. It preserves organization while weakening the irreducibility of physical realization and sentient presence.

Mentalism treats matter and information as contents, constructions, or manifestations of consciousness. It preserves first-person presence while suppressing the extra-mental efficacy and organizational constraint to which consciousness remains answerable.

Each reduction gains apparent unity by allowing one operator to absorb the other two. The result is simple, but its simplicity is achieved by eliminating rather than explaining differences. A viable process monism must preserve one world without reducing the plurality of its operations to one privileged term.

The present position is therefore monist concerning the field of actuality and pluralist concerning its irreducible modes of operation. There is one world-system, one type of elementary actualization, and no independent material, informational, or conscious realm existing outside the others. Within this one processual field, however, energetic efficacy, formative organization, and sentient presence remain non-identical.

This position differs from Cartesian trichism. Three-substance metaphysics would require matter, information, and consciousness to exist independently and then explain how they interact. The present scheme begins from their conjunction within the actual occasion. No interaction problem arises between separately constituted substances because the operators are distinguishable functions of one actualization from the outset.

The scheme also differs from neutral monism when the alleged neutral basis is treated as more fundamental than the operators. The actual occasion is not a fourth neutral stuff from which matter, information, and consciousness are derived. It is the elementary act in which their operations are conjointly instantiated. Its unity does not erase their differences, and their differences do not divide its unity.

Irreducibility can therefore be formulated through three prohibitions. No operator may be eliminated. No operator may be translated without remainder into another. No operator may be made the self-sufficient ground of the other two.

These prohibitions remain argumentative rather than experimentally demonstrated. Science can establish dependencies, correlations, mechanisms, physical realizations, informational constraints, and behavioral effects. It cannot test the metaphysical totalization that the relevant findings instantiate exactly three irreducible operators. Nor can a present failure of reduction prove that reduction will always remain impossible.

The irreducibility thesis is defended comparatively. It is retained because attempts to reduce organization to energetic description, presence to organization, or physical actuality to conscious presentation leave identifiable explanatory remainders. A rival scheme could defeat the thesis by showing that these remainders are only verbal, that one operator can fully perform the explanatory role of another, or that the distinction rests upon an equivocation. Until such a reduction is achieved rather than asserted, the differences should be preserved.

Ultimate analysis applies to this preservation. Irreducibility does not confer inherent existence. Matter, information, and consciousness remain conventional and hyper-conceptual operators. Their identity depends upon the operations gathered under them, the contrasts through which they are distinguished, and the explanatory architecture within which they function. The absence of reduction is not the presence of substance.

The operators are therefore irreducible but empty, distinct but non-separate, and real only through their functioning. Matter cannot replace organization or presence. Information cannot replace efficacy or presence. Consciousness cannot replace efficacy or organization.

Their irreducibility establishes the differences the scheme must preserve. Their interdependence will establish why none can operate alone.

4. Their Necessary Interdependence

The irreducibility of matter, information, and consciousness does not imply their independence. On the contrary, the operators are distinguishable only within the actual processes through which they function together. Matter without organization would not constitute a determinate actuality. Information without energetic realization would remain uninstantiated. Consciousness without material and informational conditions could not become individualized, retain mental objects, or act within the world. The operators are therefore irreducible but necessarily interdependent.

The necessity involved must be precisely delimited. It is not a transcendental necessity comparable to the principles governing thought, feeling, or action. Nor is it an experimentally established law. It is a metaphysical necessity internal to the present ontological scheme. If actuality is understood as efficacious, organized, and sentiently present, then none of these modes can become concrete in complete isolation from the other two.

Interdependence also differs from identity. Two operations may depend upon one another without being numerically or conceptually identical. Informational organization depends upon material realization, but organization is not therefore identical with matter. Individualized consciousness depends upon embodiment and informational architecture, but conscious presence is not therefore identical with either. Material action can be redirected through conscious intention, but matter does not thereby become consciousness. Dependence identifies a necessary relation ; reduction asserts an identity. The former does not establish the latter.

The actual occasion supplies the elementary conjunction. It does not first arise as a neutral event and subsequently receive material, informational, and conscious additions. Its actualization is already energetically efficacious, formatively organized, and infinitesimally sentient. These operations can be analytically distinguished because they answer different explanatory questions, but they do not occur as three successive stages or separable components.

The whole occasion becomes. Its energetic efficacy is the efficacy of an organized actuality ; its organization is the organization of an energetically realized process ; its sentient presence is the inward presence of this determinate actualization.

Remove any one of these dimensions completely, and what remains no longer satisfies the present definition of an actual occasion.

This does not mean that the operators are present in equal intensity, complexity, or dominance. Their conjunction is universal within the scheme, but their proportions and modes of organization differ. Energetic efficacy may overwhelmingly dominate a physical process. Formative organization may become especially complex in living systems. Sentient presence may become individualized only in highly organized societies. Interdependence concerns co-instantiation, not equality.

The dependence between matter and information is the most immediately evident. Material operation never occurs as absolutely formless energy or undifferentiated physical stuff. Every physical actuality possesses determinate relations, quantities, symmetries, boundaries, constraints, and possible transformations. Even the most elementary physical process occurs under an organization without which it could not be identified as this process rather than another.

Matter therefore depends upon information in the broad metaphysical sense of formative organization. This does not mean that every physical event carries a message, contains a code, or has meaning for an interpreter. It means that energetic efficacy always occurs through differentiated relations and constraints. A physical process wholly without organization would have no determinate pathway, identity, or effect.

Information, conversely, depends upon matter for concrete realization. A pattern not realized through any physical or mental process remains an abstract possibility. Codes require carriers, differences require distinguishable states, memories require retention, signals require transmission, and constraints become effective only through actual processes capable of being constrained.

The carrier need not always remain the same. One informational organization may be realized in speech, writing, electronic storage, neural activity, or several other material forms. This multiple realizability shows that information cannot be identified with one particular material configuration. It does not show that information can become concretely effective without any realization whatsoever.

Matter and information therefore form a bond without forming an identity. Matter supplies energetic realization ; information supplies differentiated organization. Matter makes organization actual ; organization makes material efficacy determinate. Neither relation is temporally prior in the concrete occasion. Their priority is explanatory : each identifies what the other does not explain.

The emergence and persistence of living systems make this conjunction especially visible. Metabolism requires energetic and material exchange. Yet these exchanges sustain life only because they are organized through cellular boundaries, molecular recognition, regulatory networks, inherited structures, and recurrent feedback. Remove the material throughput, and the organism ceases. Remove the organization, and the same constituents no longer constitute the organism.

The matter-information bond nevertheless does not exhaust actuality. A physically realized and highly organized process can be described from a third-person

standpoint without thereby becoming consciously present. The conjunction of matter and information explains how a system is embodied, structured, regulated, and capable of differentiated response. It does not by itself explain why anything is experienced, felt, understood, or valued.

Consciousness therefore depends upon matter and information in its individualized forms. An individualized mind requires an embodied society capable of sustaining one relatively unified point of view. It also requires informational architecture permitting discrimination, retention, anticipation, attention, memory, and coordinated response. Without such organization, infinitesimal sentience does not become a continuing individualized consciousness.

Material embodiment situates consciousness within the public world. It supplies the corporeal conditions through which a conscious subject can receive stimulation, perform actions, communicate, and become recognizable to others. Informational architecture organizes the relations through which mental objects can be retained, compared, integrated, interpreted, and connected with action.

This dependence does not make consciousness an output added at the end of a completed material-informational process. Within the panexperiential scheme, sentient presence belongs infinitesimally to actualization itself. What complex organization produces is not sentience from an absolutely non-sentient antecedent, but the individualization, coordination, amplification, and retention of sentient presence in one conscious society.

The distinction between infinitesimal consciousness and individualized consciousness is essential here. Every actual occasion includes infinitesimal sentience, but not every aggregate or society becomes an individualized subject. A stone does not possess one unified consciousness merely because its constituent actual occasions possess infinitesimal inwardness. Individualized consciousness requires a special organization capable of integrating many occasions into one relatively continuous first-person field.

The dependence of consciousness upon matter and information is therefore developmental and organizational. It does not concern the existence of the conscious operator as such, which belongs to elementary actualization. It concerns the emergence of mind, personal consciousness, memory, deliberation, and agency. These developed forms require material and informational conditions of extraordinary complexity.

The dependence also runs in the opposite direction. In conscious actualities, matter and information can be selected, interpreted, reorganized, and directed through awareness, valuation, intent, and choice. Consciousness does not merely receive material and informational conditions. It can alter the course taken by the embodied society through which it functions.

This influence must not be represented as an immaterial force directly moving matter. Consciousness becomes effective through informational and material mediation. An intention affects action by organizing attention, selecting a goal, activating learned patterns, and redirecting bodily processes. The conscious

operation does not bypass the nervous system, body, or environment. It works through them.

Downward causation therefore does not mean causal intervention from a higher substance into a lower one. It names the capacity of an organized conscious whole to constrain and redirect the processes constituting it. The conscious subject evaluates alternatives and adopts an intention ; informational architecture translates this direction into coordinated patterns ; material processes enact the resulting action.

The sequence is analytical rather than mechanically linear. Intent, organization, and bodily realization continually affect one another. A conscious decision can alter attention, attention changes the information selected, selected information changes bodily preparation, bodily feedback modifies the conscious state, and the process continues. Reciprocal determination replaces one-way transmission.

The same reciprocity operates upward. Material conditions affect consciousness through informational mediation. Injury, illness, fatigue, hormones, neural changes, and environmental pressures can alter mood, attention, thought, and agency. But the material change does not become a conscious object merely by occurring. It must be taken up and organized within the informational architecture of the embodied mind.

Information likewise depends upon consciousness where meaning, interpretation, or deliberate use is involved. A physical difference can function informationally without being consciously interpreted. But semantic information in the developed sense requires a subject for whom signs, memories, reasons, or messages mean something. Meaning is not added to information from outside the world ; it emerges where informational organization becomes present to individualized consciousness.

Consciousness selects and weights information. Attention foregrounds some objects while leaving others unattended. Interpretation connects present material with inherited meanings. Valuation distinguishes relevance from irrelevance, attraction from aversion, and preferable from rejected alternatives. Intent organizes selected information toward an anticipated outcome.

Information therefore mediates between matter and consciousness, but it is not merely an intermediary substance placed between them. It is the organization through which material processes become available to consciousness and conscious direction becomes materially effective. Mediation is functional and dynamic. No separate informational entity travels between two autonomous substances.

The triangular relation can be clarified by considering what each pair would lack without the third. Matter and information without consciousness could explain embodied organization but not first-person presence. Matter and consciousness without information could not form a determinate embodied mind, because no architecture would coordinate energetic processes with conscious objects. Information and consciousness without matter could possess no concrete embodiment, transmission, or publicly effective action.

These counterfactual abstractions do not describe three possible worlds. They show the explanatory deficiency arising when one operator is removed from the conjunction. Within concrete actuality, the remaining pair could not function exactly as described because its operations already presuppose the excluded term.

The interdependence of the operators is therefore triangular rather than linear. Matter does not first generate information, after which information generates consciousness. Consciousness does not first create information, which then structures matter. Information does not first establish a code from which matter and consciousness are derived. Each linear hierarchy selects one operator as fundamental and treats the others as secondary products.

Cosmic and evolutionary history may nevertheless display a sequence of increasing dominance and individualization. The earliest physical structures known to science are described primarily through energetic interactions. Living systems display increasingly complex informational organization. Individualized consciousness appears only within highly developed organisms. This historical order is scientifically and metaphysically important, but it does not establish ontological derivation.

Later manifestation under more complex conditions does not mean that the later operator is nothing but those conditions. Individualized consciousness depends upon biological evolution without being reducible to biology. Biological information depends upon physical and chemical processes without being reducible to a list of their energetic interactions. Historical emergence and metaphysical identity remain distinct questions.

The relation among the operators also intersects with efficient and final determination. Matter predominantly expresses efficient determination by transmitting the achieved efficacy of antecedent actuality. Information predominantly expresses formative determination by constraining and organizing possible outcomes. Within the adopted panexperiential scheme, consciousness contributes infinitesimal cognizing presence to actualization. The Whiteheadian-process interpretation further understands the actual occasion as integrating inherited conditions into one determinate outcome. This integration may be called elementary self-determination only in a strictly non-personal sense ; it does not follow from the definition of consciousness and must not be equated with valuation, intent, deliberation, or choice. These developed operations arise only where consciousness becomes sufficiently organized and individualized.

These correspondences are not exclusive. Information is materially transmitted and therefore participates in efficient determination. Material constraints contribute to form and therefore participate in final determination. Conscious intention becomes an efficient condition when embodied action enters the public world. The two vectors and three operators cross one another because they analyze different aspects of actualization.

Necessary interdependence does not eliminate operational asymmetry. A simple physical system may display highly restricted informational organization and only infinitesimal sentence. An organism may exhibit complex information without reflective consciousness. A person may possess individualized consciousness but

remain dependent upon bodily processes largely unavailable to awareness. The operators are co-present, but they do not contribute in the same manner or degree.

Nor does interdependence imply harmony. The operators can become poorly coordinated. Material pressures may disrupt informational organization. Informational rigidity may inhibit conscious adaptation. Conscious intention may conflict with bodily limits or established patterns. A conscious society is not automatically integrated merely because all three operators are present. Their conjunction makes coordination possible ; it does not guarantee its success.

This point prevents the triad from acquiring normative significance. Greater integration among matter, information, and consciousness is not automatically true, beautiful, or good. A destructive technology may display extraordinary material efficacy, informational organization, and conscious intent. Ontological integration concerns functional conjunction, not normative excellence.

The virtual world-ground is triadically specified under the same restriction. Primordial matter, primordial information, and primordial consciousness do not form three self-sufficient sources. Energetic potential without possible organization would be indeterminate. Formative possibility without possible actualization would remain ineffective. Primordial consciousness without the other correlatives would lack any field of determinate actualization.

The primordial correlatives therefore specify one virtual world-ground conjunctively. Their distinction mirrors the operators of concrete actuality, while their interdependence prevents the virtual field from being divided into three independent reservoirs. Like the operators from which they are inferred, they are distinguishable only through their roles within one processual scheme.

Ultimate analysis applies once more. Interdependence does not produce a substantial whole over and above the operators. The triad is not a fourth entity binding matter, information, and consciousness together. Their conjunction is the actual occasion itself and, at wider scales, the organized societies formed through routes of occasions. The unity is functional and processual, not substantial.

The thesis can now be stated precisely. Matter requires information because efficacy must be determinate, and it requires consciousness because actualization includes infinitesimal sentient presence. Information requires matter because organization must be realized, and it requires consciousness wherever organization becomes meaningfully present or selected. Consciousness requires matter and information for embodiment, individualization, retention, and effective action.

None operates alone. None is identical with what it requires. Each becomes concrete only through the conjunction of all three.

Irreducibility preserves their differences. Interdependence establishes their togetherness.

5. Operational Dominance and the Three Domains

Matter, information, and consciousness are conjointly instantiated in concrete actuality, but they do not everywhere operate with the same prominence,

complexity, or explanatory importance. In some actualities, energetic efficacy determines the principal character of what occurs. In others, organization, architecture, and constraint become decisive. In still others, sentient presence becomes individualized and introduces meaning, valuation, intent, and choice. These differences establish the three domains of the present metaphysics.

A domain is not a separate realm, substance, or region of the world. It is a field of actualities identified according to the operator predominantly determining their conventional identity, characteristic activity, continuity, and explanatory profile. The material domain is characterized by the dominance of energetic efficacy. The informational domain is characterized by the dominance of formative organization. The conscious domain is characterized by the dominance of individualized sentient presence.

Operational dominance must be distinguished from exclusive operation. When matter dominates, information and consciousness do not disappear. When information dominates, matter and consciousness remain operative. When consciousness dominates, the conscious actuality remains materially embodied and informationally organized. Dominance identifies relative predominance within an interdependent conjunction.

Nor does dominance mean that one operator becomes more real than the others. Matter is not ontologically primary because physical processes appear earlier in known cosmic history. Information is not superior to matter because organized systems can regulate energetic processes. Consciousness is not metaphysically higher merely because it introduces first-person presence and choice. The operators remain equally irreducible and equally empty of inherent existence. What differs is their role within a particular actuality or organized formation.

Operational dominance is also not a numerical relation. It cannot ordinarily be determined by counting material, informational, or conscious events. A system may contain an enormous number of physical processes while its identity depends principally upon the organization coordinating them. A human organism contains innumerable molecular and cellular events, but the organism does not persist as the same living individual merely because these material constituents remain numerically present. Its continuity depends upon their regulated organization.

Dominance therefore concerns determination rather than quantity. The relevant question is : Which operator principally explains why this actuality is conventionally identified as the kind of actuality it is, why it persists or changes in the manner it does, and how its characteristic effects arise ?

This criterion remains relative to scale. The same concrete process may participate in more than one domain when considered at different levels. A neural event can be investigated materially as an electrochemical process, informationally as part of an organized pattern of discrimination or memory, and consciously insofar as it participates in a mental state present to a subject. These are not three independent events occupying three worlds. They are distinguishable operations within one embodied process.

Scale-relativity does not make the domains arbitrary. A description cannot legitimately assign dominance merely according to convenience. The

classification must answer to the actual organization and functioning of the object. A physical process cannot be moved into the conscious domain merely because a conscious observer studies it. A computational process does not become conscious merely because it manipulates symbols referring to consciousness. The object's operations, not the investigator's preferred vocabulary, determine which domain is dominant.

The material domain comprises actualities in which energetic efficacy, physical realization, interaction, resistance, and causal transmission predominate. Their principal characteristics can be investigated from a third-person standpoint through their spatiotemporal occurrence and publicly traceable effects. Fields, particles, forces, chemical reactions, bodies, and nonliving physical aggregates belong primarily to this domain.

To call such actualities material does not mean they are inert or devoid of organization. Every identifiable physical actuality possesses determinate relations, symmetries, quantities, boundaries, and possible transformations. The informational operator is therefore always present. Within the panexperiential scheme, every constituent actual occasion also possesses infinitesimal consciousness. Yet neither organization nor infinitesimal sentience becomes the dominant characteristic of the physical compound merely by being present.

A rock provides the standard example. Its constituent actual occasions are energetically efficacious, informationally determined, and infinitesimally sentient. The rock nevertheless belongs primarily to the material domain because its conventional identity and activity are governed by physical composition, spatial organization, energetic interaction, and relative stability. Its constituent occasions do not become integrated into one consciousness belonging to the rock as a whole.

This distinction prevents panexperientialism from becoming panpsychism. The conscious operator is universally instantiated at the level of actual occasions, but the conscious domain is not universal at the level of compound objects. An aggregate may contain infinitesimal consciousness without becoming one conscious subject. Consciousness in the constituents does not automatically yield consciousness of the compound.

The informational domain comprises actualities in which organized difference, architecture, constraint, regulation, patterned transmission, and functional continuity become predominant. Such actualities remain materially realized, but their identity and activity cannot be adequately explained through energetic composition alone. What matters principally is how their components are related and how these relations constrain what the system can do.

An informational actuality therefore possesses more than physical complexity. Complexity may amount only to the coexistence or interaction of many parts. Informational dominance requires differentiated organization through which some processes regulate, preserve, inhibit, reproduce, transform, or direct others. The system's organization becomes explanatory in its own right without becoming a substance separate from its realization.

Living systems make informational dominance especially evident. Their material constituents are continuously exchanged, while regulatory and reproductive

organization sustains a relative continuity of the whole. Metabolism, cellular boundaries, molecular recognition, inherited form, feedback, development, and adaptation cannot be explained merely by listing the material components involved. The organization of these components is indispensable to the continued existence of the organism as this organism.

The informational domain is nevertheless wider than biological life. Artificial systems, technical networks, languages, codes, archives, institutions, and cultural practices may display informational dominance when patterned relations and retained architectures principally determine their functioning. Their inclusion does not imply that all such systems possess one conscious subject. Informational unity is not yet conscious unity.

An organized system may integrate signals, preserve context, respond adaptively, regulate its activity, and even construct representations of itself without experiencing these operations from one first-person vantage. Such a system belongs primarily to the informational domain unless there are adequate reasons to attribute individualized sentient presence to it. Structural complexity, computation, self-reference, and behavioral coordination do not by themselves establish consciousness.

The conscious domain begins where sentient presence becomes individualized. Individualization occurs when actual occasions are integrated into one relatively continuous first-person field within which mental objects are present. The resulting actuality is not merely composed of infinitesimally conscious occasions. It constitutes one conscious subject.

In the terminology of the present ontology, such a unity is an individualized conscious society. A society as such is an ordered nexus reproducing a characteristic form through a historical route and need not be conscious. An aggregate displays comparatively weak togetherness. An organization displays patterned coordination and functional differentiation. A society adds diachronic inheritance and continuity. An individualized conscious society additionally constitutes one continuing first-person field.

Individualized consciousness does not require reflective self-consciousness. A conscious subject may feel, discriminate, remember, anticipate, and respond without conceptually representing itself as an "I." Reflective self-consciousness is a further development in which the subject makes its own states and activity objects of awareness. Conceptual consciousness adds interpretation, judgment, explicit self-designation, and reasoning.

The conscious domain accordingly contains degrees and modes of development. Sentience, awareness, attention, memory, intention, and reflective thought do not rise together along one uniform scale. One conscious subject may display intense sentience but limited conceptual organization. Another may display extensive cognitive organization but restricted attention or freedom. Operational dominance identifies the presence of one conscious unity ; it does not erase the internal diversity of conscious life.

A person belongs to all three domains, though not in the same respect. As an embodied physical object, the person participates in the material domain. As a

living and cognitively organized system, the person participates in the informational domain. As the bearer of mental states, meaning, valuation, intent, and action, the person belongs to the conscious domain.

This multidomain participation does not divide the person into three independently existing parts. The person is one embodied conscious society whose operations can be distinguished according to their characteristic functions. Material, informational, and conscious descriptions remain coordinated because they concern one processually organized individual.

The dominance of consciousness in a person does not imply continuous reflective awareness of every process occurring within the embodied society. Most bodily and informational operations remain unavailable to attention. Digestion, immune regulation, sensory processing, habitual motor coordination, and many cognitive discriminations occur without becoming conscious objects. Conscious dominance concerns the unity of the person as a subject, not the conscious supervision of every constituent activity.

The distinction between domain and operator is therefore indispensable. The conscious operator is present infinitesimally in every actual occasion. The conscious domain arises only where that presence becomes individualized at the level of an organized whole. The informational operator is present wherever differentiated relations constrain actuality. The informational domain arises where such organization becomes the principal determinant of identity and function. The material operator is present wherever actuality becomes energetically effective. The material domain arises where this efficacy remains dominant.

Operational dominance is often relational rather than absolute. A system may stand near the border between two domains because no single operator unambiguously determines its character. Biological life, for example, always involves material and informational operations, while the attribution of individualized consciousness may vary according to the organism considered and the evidence available. Metaphysics supplies the relevant distinctions, but it cannot decide every empirical case in advance.

This underdetermination is not a defect in the architecture. It follows from the continuity and interdependence of the operators. Sharp conceptual distinctions need not imply that every actual object can be assigned to one domain without remainder. Nature may display transitional forms, composite systems, unstable organizations, and processes whose dominant character changes over time.

A living conscious organism may cease to sustain individualized consciousness while retaining extensive material and informational organization. An organized system may lose the architecture maintaining its function and continue only as a material aggregate. Conversely, material processes may become incorporated into increasingly organized systems, and sufficiently integrated organization may support the individualization of consciousness. Dominance can therefore shift as the organization of the actuality changes.

These transitions must not be represented as transformations of one operator into another. Matter does not become information, and information does not become consciousness. What changes is the organization through which the operators are

conjointly instantiated and the degree to which one becomes dominant. Emergence concerns new forms of integration and dominance, not the production of an irreducible operator from something wholly lacking it.

The distinction also clarifies cosmic and evolutionary succession. In the scientifically reconstructed history of the observable universe, physical processes appear before living organization and individualized consciousness. Material dominance is therefore historically prior within that account. Informational organization later becomes increasingly autonomous and complex in living systems, while individualized consciousness becomes manifest only under highly developed material and informational conditions.

This historical sequence does not establish an ontological hierarchy of production. Material processes provide necessary conditions for developed information and consciousness, but necessity is not identity. Later manifestation does not show that the later operator is nothing but a rearrangement of the earlier one. The metaphysical triad concerns what must be distinguished within actualization ; cosmic evolution concerns the conditions under which these operations attain different forms of dominance.

Nor does historical lateness make consciousness metaphysically exceptional in the sense of entering the world from outside it. Evolutionary panexperientialism places infinitesimal sentient presence within elementary actualization from the outset. What arises later is individualized consciousness : the organization of many actual occasions into one continuing first-person field.

The three domains are nested and intersecting rather than horizontally juxtaposed. The informational domain presupposes material realization. The conscious domain presupposes material embodiment and informational architecture. Yet the broader conditions are not sufficient descriptions of the more specialized domains. A material account does not exhaust organization, and a material-informational account does not exhaust conscious presence.

This nesting is functional, not substantial. Matter does not form a lowest layer upon which information and consciousness are deposited. Information does not form a second substance inserted between matter and mind. Consciousness does not occupy a superior realm controlling the lower layers from outside. One concrete process sustains the conjunction, while different operators acquire dominance according to its organization.

The domains likewise establish no hierarchy of normative value. A conscious operation is not good because it is conscious, an informational system is not excellent because it is complex, and a material process is not deficient because it lacks individualized awareness. Ontological dominance states how something operates. It does not determine how that operation should be judged under the rules of truth, beauty, or action.

The conscious domain can indeed produce deception, cruelty, disorder, and destructive technologies. Informational organization can sustain manipulation and domination. Material efficacy can support or destroy living processes. Normative appraisal enters only when the relevant conditions of thought, feeling, or action are considered. The metaphysical triad supplies no substitute for those rules.

The domain distinction is nevertheless explanatorily indispensable. Without it, the unity of the world would be purchased by forcing every actuality into one vocabulary. Physicalism would make the material domain exhaustive. Informationalism would interpret both matter and consciousness as forms of computation or organization. Mentalism would treat the physical and informational domains as appearances or constructions of consciousness.

Operational dominance permits another form of monism. There is one world-system, but it contains actualities whose defining operations differ. The domains do not divide the world ; they articulate its *principal operational differentiations*. Unity is preserved because the operators are *necessarily interdependent*. Diversity is preserved because their *dominance* establishes genuinely *different* explanatory fields.

The classification remains corrigible. Whether a particular system is primarily material, informational, or conscious must be argued with reference to its organization, operations, continuity, and available evidence. New scientific findings may revise the criteria applied to particular cases. The domain distinction remains metaphysical, but its application is answerable to scientific and first-person knowledge.

The three domains can therefore be defined succinctly.

- The material domain comprises actualities whose identity and activity are predominantly determined by energetic efficacy and physical interaction.
- The informational domain comprises actualities whose identity and activity are predominantly determined by organization, architecture, differentiated constraint, and patterned continuity.
- The conscious domain comprises individualized societies whose identity and activity are predominantly determined by first-person presence, meaning, valuation, intent, and choice.

These definitions preserve conjunction without confusion. Every actuality is materially efficacious, informationally organized, and infinitesimally sentient. Not every actuality belongs predominantly to the informational domain, and not every compound actuality belongs to the conscious domain. Operational dominance explains how one triadic structure gives rise to three distinguishable fields without multiplying worlds or substances.

The operators are universal within the scheme. The domains arise through their different forms of dominance.

6. The Minimal Sufficiency of the Triad

The three-operator thesis is governed by the criterion of minimal sufficiency : the least extensive set of distinctions capable of preserving the principal modes of actuality without reduction. Economy alone is insufficient. A scheme may appear simple because it has eliminated or redescribed the phenomena it cannot accommodate. Conversely, explanatory breadth does not justify multiplying operators whenever a new domain, scale, or vocabulary is introduced.

The appropriate set must contain *neither fewer distinctions* than actuality requires *nor more distinctions* than explanatory work warrants.

Minimality and sufficiency express different requirements. The triad is minimal if none of its operators can be removed without explanatory loss. It is sufficient if their conjunction can accommodate the principal forms of concrete actuality without requiring an additional irreducible mode of operation. The first claim has been prepared by the argument for irreducibility. The second requires showing that apparently further candidates can be understood as configurations, developments, relations, or specifications of energetic efficacy, formative organization, and sentient presence.

The claim is not that three is a metaphysically privileged number. No significance follows from the numerical form of the triad itself. Matter, information, and consciousness are not retained because triadic structures are elegant, traditional, dialectically attractive, or symbolically complete. They are retained because three explanatory differences have become unavoidable within the present reconstruction.

The first difference concerns actuality as *effective*. Whatever becomes actual must enter the causal and relational history of the world. It must be physically realized, transmit or transform energetic conditions, and make a publicly consequential difference. Matter names this requirement of energetic efficacy.

The second concerns actuality as *determinate*. What becomes actual must possess an organization through which it is this process, structure, system, or object rather than another. It must display relations, boundaries, constraints, architecture, and possible transformations. Information names this requirement of formative organization.

The third concerns actuality as *inwardly present*. At least in conscious actualities, something is felt, presented, understood, valued, intended, or chosen from an exclusive first-person vantage. Within the panexperiential scheme, an infinitesimal form of such presence belongs to every actual occasion, while individualized consciousness arises only within sufficiently integrated societies. Consciousness names this requirement of sentient presence.

Each operator therefore answers a question the other two do not answer :

How does actuality become effective ?

How does it become determinately organized ?

How is it inwardly present and, at developed levels, meaningfully taken up ?

These questions are related, but their answers are not interchangeable. Physical realization does not by itself explain organization. Organization does not by itself explain sentient presence. Sentient presence does not by itself supply either physical efficacy or determinate architecture.

Minimality can first be tested by removing matter. A scheme containing only information and consciousness might speak of patterns, meanings, intentions, and possible structures, but it could not explain how these become *publicly effective*.

No organization could be instantiated, transmitted, maintained, or transformed. No conscious intention could alter a body or environment. The alleged world would contain form and presence without physical realization.

This deficiency cannot be repaired by redescribing matter as information. Informational organization requires distinguishable states, actual carriers, energetic transitions, and physical constraints. Multiple realizability shows that one organization need not be identical with one particular material configuration. It does not show that organization can become *concretely effective* without any material realization.

Nor can matter be absorbed into consciousness. A conscious presentation of a physical object is not the object's energetic efficacy. The epistemic dependence of object-knowledge upon a knower does not entail the ontological dependence of physical actuality upon the conscious act through which it becomes known. A two-operator scheme of information and consciousness therefore lacks the condition of *public actuality*.

Minimality can next be tested by removing information. A scheme containing only matter and consciousness might retain energetic efficacy and inward presence, but it could not explain why either assumes a *determinate form*. Material processes would possess energy but no architecture, pathways, constraints, or organized continuity. Consciousness would contain presence but no discriminated objects, retained meanings, memory, attention, or intentional direction.

Matter cannot supply this missing determination merely by being matter. The same kinds of constituents and comparable energetic conditions may participate in radically different organizations and functions. Their arrangement, sequencing, boundary relations, and constraints contribute explanatory content not given by energetic magnitude alone.

Consciousness also cannot replace organization. A subject does not create every structure through the act of experiencing it. Consciousness depends upon informational articulation to distinguish objects, retain mental form, connect present contents with memory, and direct action. A world of matter and consciousness without information would therefore contain *neither determinate physical systems nor organized conscious life*.

Minimality can finally be tested by removing consciousness. A scheme containing matter and information could explain physically realized organization, causal interaction, regulation, storage, transmission, computation, adaptation, and behavioral coordination. It could not explain *why anything is felt, experienced, understood, given meaning, valued, or intended*.

Increasing organizational complexity does not by itself supply first-person presence. A system may discriminate inputs, integrate signals, preserve information, regulate its activity, and generate reports. These functions can be described from a third-person standpoint. Their description does not establish that anything is present for the system itself.

Calling consciousness an emergent property does not remove this explanatory difference. Emergence may identify the conditions under which individualized consciousness becomes manifest. It does not establish that conscious presence is

identical with those conditions. If emergence introduces a genuinely new and irreducible mode, it confirms rather than eliminates the need for the conscious operator. If it reduces consciousness to material-informational organization, it merely restates the reduction.

The conscious operator is therefore required even though developed consciousness depends upon matter and information. Dependence does not remove irreducibility. Without consciousness, the scheme may explain behavior and organization but not experience, meaning, valuation, intent, or choice.

The removal of any operator thus produces a characteristic deficiency :

- without matter, there is no concrete efficacy ;
- without information, there is no determinate organization ;
- without consciousness, there is no sentient presence.

This establishes the minimality of the triad within the present scheme. It does not yet establish sufficiency. Three indispensable terms could still fail to exhaust the principal modes of operation if a fourth irreducible requirement remained unaccounted for.

Sufficiency must therefore be tested against the range of actualities the scheme seeks to coordinate. Physical processes require energetic realization and formative constraint. Living systems add highly developed organization, regulation, reproduction, adaptation, and environmental exchange. Conscious organisms add individualized sentience, awareness, meaning, valuation, and intentional direction. Persons add conceptual thought, self-reference, responsibility, and freedom-in-immediacy. Social and cultural formations add language, institutions, technologies, collective memory, and historically transmitted norms.

These later developments do not require a new operator merely because they introduce new properties or levels of complexity. A new operator is warranted only when the relevant actuality performs a mode of determination not explicable through the conjunction of the existing three. New organizations can generate novel capacities without introducing another co-fundamental operator.

Life is therefore not a fourth operator. Living systems exhibit distinctive processes : metabolism, autopoiesis, regulation, reproduction, adaptation, and evolution. Yet these arise through materially realized and informationally organized actual occasions. Where sentience becomes individualized, the conscious operator also becomes dominant. Life marks a complex organization and domain of operation, not an additional mode coordinate with efficacy, organization, and presence.

Complexity is not a fourth operator either. Complexity concerns the number, differentiation, connectivity, or nonlinear interaction of components within a system. It can characterize material, informational, and conscious processes. It modifies the scale and organization of their conjunction without identifying another irreducible manner of determination.

Emergence likewise names a relation between levels or stages of organization. It indicates that new properties or capacities become manifest under conditions not possessed by isolated components. Emergence may be scientifically and metaphysically important, but it does not by itself identify the operator through

which the emergent actuality functions. What emerges must still become physically efficacious, informationally organized, or consciously present.

Space, time, and spacetime are not additional operators. They concern the extensive and relational conditions under which physical actualities occur and can be ordered. They do not operate beside matter, information, and consciousness as independent agents or modes of determination. Spatiotemporal structure belongs principally to the material realization and relational organization of actual occasions.

Energy is not a fourth operator distinct from matter. In the present scheme, matter does not mean inert substance. It already names energetic efficacy, physical realization, and efficient transmission. To introduce energy separately would divide one explanatory function between two terms without establishing an irreducible difference.

Form, law, code, symmetry, order, constraint, and architecture do not require additional operators because they belong to the informational family. They are distinguishable forms of formative organization. Their differences must be preserved within the informational domain, but their plurality does not require multiplying operators at the general-metaphysical level.

Meaning, value, intent, deliberation, and choice likewise do not require separate operators. They are developed modes of conscious operation. Meaning depends upon information, and choice becomes effective through material processes, but their first-person uptake and valuation belong to consciousness. To make each a separate operator would fragment one internally differentiated mode into numerous co-fundamental terms.

Relation is not a fourth operator. Every actual occasion arises through relations, and the operators themselves are necessarily interdependent. Relation names a general condition of processual actuality rather than one distinguishable mode operating beside the others. Were relation made a separate operator, it would have to relate to the remaining operators through further relations, generating an unnecessary duplication.

Process is not an operator either. Process names the adopted metaphysical orientation according to which actuality is understood through arising, operation, transformation, and cessation. It characterizes the whole field in which the operators function. To make process another operator would reify the orientation into a universal agent operating behind concrete processes.

Creativity and novelty require the same restraint. Creativity names the advance through which inherited multiplicity becomes a new determination and contributes to what follows. Novelty names the non-identity of the achieved actuality with the conditions from which it arose. Neither is a fourth constituent inserted into the actual occasion. Both concern what occurs through the conjoint operation of efficacy, organization, and sentient self-determination.

Causality is similarly derivative. It names relations through which actual processes condition, constrain, or produce effects. Efficient causation belongs principally to material transmission. Formative determination belongs principally to informational constraint. Intentional causation involves conscious direction

mediated through information and matter. Causality coordinates these operations ; it is not an operator standing alongside them.

Identity and continuity do not require another operator. Material continuity, informational continuity, and conscious continuity are distinguishable modes through which an actuality or society can persist. Their conjunction permits conventional identification without positing an inherent bearer beneath change. Identity is the outcome of organized continuation and designation, not an additional power producing it.

Language, culture, society, and institutions likewise belong to complex conjunctions of the three operators. Their material media, informational architectures, and conscious uses can be distinguished without reducing the resulting formations to any one component. Their novelty is genuine, but the presence of novel organizations does not by itself prove the presence of novel operators.

Normativity must be excluded more decisively. Truth, beauty, and action are governed by principles, norms, and maxims uncovered through transcendental reflexivity. Their bindingness cannot be derived from matter, information, consciousness, or their conjunction. Yet normativity is not therefore a fourth metaphysical operator. It belongs to *another epistemic register*. To introduce it into the triad would confuse the rules governing thought, feeling, and action with the ontological operations about which claims are made.

Potentiality and virtuality are also not operators. They articulate the modal field of possible actualization. Possibilities do not actualize themselves and therefore do not operate as a fourth source of determination. Matter, information, and consciousness operate within actuality ; their primordial correlatives specify the virtual world-ground. The distinction between actuality and virtuality crosses the triad without adding another member to it.

The actual occasion is not a fourth operator uniting the three. It is the elementary actuality in which the operators are conjointly instantiated. Were it treated as another operator, the unit of actualization would be confused with the functions through which it becomes actual. The occasion is the act ; the operators distinguish how that act becomes efficacious, organized, and sentiently present.

The efficient and final vectors are not additional operators either. They identify two directions within actualization : the inheritance of achieved actuality and the integration of inherited conditions into a determinate outcome. Matter, information, and consciousness participate differently in these directions. The distinction between vectors and operators cuts across the actual occasion according to different explanatory concerns.

The three domains likewise add no operators. A domain is established where one operator becomes dominant within an aggregate, organization, or society. The material, informational, and conscious domains therefore arise from the triad's differentiated operation. They do not stand above it as further principles.

The same control applies to the virtual world-ground. Primordial matter, primordial information, and primordial consciousness are modal correlatives of the concrete operators, not three additional operators. The actual triad and the

primordial set are structurally corresponding but modally distinct. Counting both would duplicate the same architectonic distinctions across actuality and virtuality.

God* must not become a fourth operator. Later metaphysical theology asks whether, in addition to primordial consciousness as the non-agentive virtual correlate of mere cognizing presence, actuality warrants an actual continuing Divine subject capable of purposive valuation, responsiveness, choice, and agency. God* names that further immanent-metaphysical construction if admitted. It neither develops primordial consciousness into an agent nor converts the virtual world-ground into a subject, and it does not stand outside the triad as the entity combining the operators.

The Absolute is even less available as an operator. It remains a transcendent limit-signifier to which no positive conceptual operation may be assigned. To make the Absolute causally, formatively, or consciously operative would return it to the immanent metaphysical field and convert it into another determinate object.

These exclusions show how the triad can remain sufficient without claiming to contain every useful concept. General metaphysics requires many distinctions besides matter, information, and consciousness : process and actuality, efficient and final determination, potentiality and virtuality, aggregation and society, identity and continuity, causation and emergence, world and world-ground. The claim is only that these distinctions do not identify further co-fundamental modes of operation.

A proposed fourth operator would therefore have to satisfy stringent conditions. It would need to identify a mode of determination functionally instantiated in concrete actuality. Its explanatory role could not be reduced to energetic efficacy, formative organization, or sentient presence. It could not merely name a domain, scale, relation, vector, modal condition, normative rule, emergent product, or totalizing hyper-concept. Removing it would have to leave a determinate class of actualities unintelligible.

No presently identified candidate satisfies these conditions. This provides a comparative warrant for the sufficiency of the triad. It does not constitute a proof that no fourth operator could ever be disclosed. Absolute exhaustiveness would require knowledge of every possible actuality and every adequate conceptual scheme, which general metaphysics cannot possess.

The thesis must therefore remain corrigible. A new scientific domain, form of organization, or mode of experience might reveal an explanatory difference the present triad cannot accommodate without distortion. A rival metaphysics might show that one of the existing operators divides into two genuinely irreducible functions. Conversely, it might demonstrate that two operators can be integrated without explanatory loss.

Such possibilities do not weaken the present commitment. Corrigibility does not require withholding every determinate thesis. It requires stating precisely what has and has not been established. The triad is defended as the minimally sufficient set presently available, not as an eternally closed inventory of reality.

Its sufficiency is architectonic rather than deductive. Matter secures the actuality and efficacy of process. Information secures its determination and organization.

Consciousness secures its inward presence and, where individualized, the capacity for valuation. Their interdependence permits physical, living, conscious, personal, and social actualities to be situated within one world-system without collapsing their differences.

The triad also preserves dynamic monism. One operator would yield reductive monism. Three substances would yield pluralistic separation. Three interdependent operators permit one processual field to display irreducible operational differences without multiplying worlds or self-existing foundations.

Minimal sufficiency therefore occupies the middle between reduction and proliferation. The triad contains enough distinctions to preserve efficacy, organization, and presence, but no additional operator is introduced where a domain, relation, structure, or development can be explained through their conjunction.

Matter, information, and consciousness are not asserted as the final contents of reality-as-such. They are proposed as the least extensive operational architecture presently capable of explaining the principal modes of actuality without remainder or reduction.

The triad is sufficient because nothing essential presently falls outside it. It is minimal because nothing within it can be removed.

7. Scientific Consonance and Metaphysical Status

The three-operator thesis is *scientifically consonant* but not *scientifically established*. This distinction governs its epistemic status. Consonance means that the proposed distinctions among energetic efficacy, formative organization, and sentient presence *agree with important explanatory differences found across the sciences and do not contradict valid scientific knowledge*. It does not mean that science has experimentally discovered matter, information, and consciousness as three metaphysical operators or verified their irreducibility, universal conjunction, and minimal sufficiency.

Science investigates determinate objects and processes. Physics studies fields, interactions, particles, forces, energy, spacetime, and measurable transformations. Chemistry studies the organization and reactions of material structures. Biology studies living organization, metabolism, regulation, heredity, development, evolution, and ecological dependence. Information sciences study coding, transmission, transformation, storage, computation, and organized constraint. Neuroscience studies neural activity, connectivity, integration, behavior, reports, and the conditions associated with conscious states. None directly observes an operator as such.

An operator is a hyper-concept of immanent metaphysics. It gathers families of scientifically investigated operations under one general explanatory role. Matter coordinates physical realization and energetic efficacy. Information coordinates organization, differentiation, architecture, constraint, and patterned continuity. Consciousness coordinates sentient presence and, in its individualized forms, attention, meaning, valuation, intent, and choice. The synthesis belongs to general metaphysics because it moves beyond any one testable scientific proposition and

proposes an interpretation of how the principal dimensions of actuality belong together.

Three epistemic levels must therefore be kept distinct.

At the first level stand *scientific findings*. These concern experimentally or observationally investigated processes and remain testable, arguable, conventional, and corrigible. They include propositions concerning physical fields, energetic exchange, thermodynamic cost, cellular regulation, neural architecture, information processing, behavioral discrimination, and reported conscious experience.

At the second level stand *philosophical interpretations of these findings*. To interpret contemporary physics as favoring activity and relation over inert material substance, biological organization as irreducible to an inventory of molecular constituents, or neural dependence as insufficient to prove mind-brain identity is already to move beyond the scientific propositions themselves. Such interpretations remain disciplined by science but are settled through conceptual analysis and argument rather than through one decisive experiment.

At the third level stands the *metaphysical totalization*. The claim that matter, information, and consciousness form three irreducible but interdependent operators within one processual world is not a scientific theory. It cannot be tested as a complete proposition because no experiment can isolate the world-system as a whole, compare the proposed triad with every possible metaphysical alternative, or establish that no fourth operator could ever be required.

Confusing these levels produces opposite errors. Scientism presents the metaphysical synthesis as though it were a result of science. Speculative insulation ignores scientific findings whenever they disturb the preferred architecture. Critical metaphysics rejects both. Science constrains the scheme without uniquely determining it, while metaphysics interprets and integrates scientific knowledge without acquiring its evidential status.

The material operator displays the strongest and most immediate scientific consonance. Contemporary physics does not require matter to be conceived as inert, self-sufficient stuff composed of permanent microscopic substances. Its explanatory vocabulary concerns fields, symmetries, interactions, excitations, exchanges, transformations, and probabilities. This is consonant with matter understood as energetic efficacy rather than as a substantial bearer beneath change.

Yet physics does not thereby *establish* the metaphysical definition of matter adopted here. A physical field remains a scientific object defined within mathematical and experimental practices. It must not be generalized into a universal field of being or made into a substance replacing the particles once treated substantially. Nor does the explanatory success of physics prove that every actuality is exclusively physical.

The transition from contemporary physics to the material operator is therefore *interpretive*. Scientific findings support a dynamic and relational understanding of physical actuality. General metaphysics coordinates these findings under the hyper-concept of energetic efficacy. The operator remains broader than any

particular scientific theory and must change when the scientific understanding of physical operation changes.

The informational operator is also scientifically consonant, though its relation to scientific discourse is more semantically complex. The term *information* is used differently in thermodynamics, communication theory, computation, genetics, neuroscience, semiotics, and ordinary language. Statistical reduction of uncertainty, physical correlation, encoded transmission, functional organization, semantic meaning, and conscious understanding must not be conflated.

What these uses share at the most general level is differentiated constraint. Informational description concerns how relations among distinguishable states limit, organize, transmit, retain, or transform what can occur. This common feature warrants a metaphysical hyper-concept, but it does not erase the domain-specific differences among forms of information.

Scientific research supports two restrictions central to the present scheme. First, concrete information is embodied. Its transmission, storage, manipulation, and reproduction occur through physically instantiated processes and have energetic and thermodynamic conditions. Information is not a free-floating substance independent of material realization.

Second, informational descriptions perform explanatory work not exhausted by measurements of energy or inventories of constituents. The same types of material components can participate in different organizations, pathways, codes, regulatory structures, and functions. In biology especially, the identity and activity of a system depend upon how its constituents are organized, not merely upon which constituents are present.

These findings are consonant with the irreducibility and interdependence of matter and information. Information requires matter for realization, while material efficacy requires organization to become determinate. Science can investigate this relation in particular systems. It cannot establish by experiment that formative organization is one of exactly three universal operators.

The conscious operator presents the most difficult relation between science and metaphysics. Consciousness is scientifically investigated through reports, behavior, neural activity, perturbation, connectivity, temporal coordination, and information-bearing patterns. These investigations establish systematic dependencies and increasingly precise mechanisms. They show that individualized consciousness is embodied and depends upon complex informational organization.

Such dependence is indispensable to the present scheme. No appeal to the irreducibility of consciousness may be used to ignore anesthesia, brain injury, stimulation, pharmacology, development, sleep, attention, memory, or neural architecture. A metaphysics of consciousness incompatible with these findings would be inadmissible.

Scientific dependence nevertheless does *not* settle ontological identity. A correlation between a neural process and a conscious state establishes that the terms covary under specified conditions. An intervention showing that a neural process makes a difference to consciousness establishes causal relevance. A model

explaining discrimination, integration, memory, report, or behavioral control establishes functional organization. None of these conclusions, solely by being scientifically successful, establishes that the first-person state is numerically identical with its measured neural or informational conditions.

The distinction is not a gap introduced by scientific ignorance alone. The scientific description and the mental state possess different epistemic and ontological characteristics. Neural processes are publicly measurable, spatially extended, and described from a third-person standpoint. Mental states are non-extended and present from the exclusive vantage point of an individualized consciousness. An identity thesis must explain this difference rather than merely deny it.

Contemporary research also shows that complex information processing need not coincide with consciousness. Discrimination, prediction, semantic sensitivity, adaptive control, and integration may occur without becoming conscious objects. This blocks the simple inference from organized processing to sentient presence. Information is necessary for developed consciousness but is not thereby sufficient for it.

Conversely, the first-person actuality of consciousness cannot be converted into scientific proof of its metaphysical independence. Immediate conscious presence establishes that mental states occur. It does not establish that they can exist *without* material and informational conditions, that consciousness creates physical reality, or that the world is constituted by mind. The conscious operator is irreducible *without becoming self-sufficient*.

Science therefore supports the interdependence of consciousness with matter and information more directly than it supports its metaphysical irreducibility. The latter depends upon a philosophical argument concerning first-person presence, the difference between correlation and identity, and the explanatory remainder left by physical and functional descriptions. The argument is scientifically constrained but not experimentally decidable as a whole.

The same caution applies more strongly to evolutionary panexperientialism. Science establishes the evolution of organisms, nervous systems, behavior, cognition, and increasingly complex forms of conscious life. It does not observe infinitesimal sentience in elementary actual occasions. The proposal that sentient presence belongs minimally to actualization itself is a metaphysical response to the problem of deriving inward presence from an entirely non-sentient antecedent field.

Panexperientialism is consonant with science only in the negative sense that it need not contradict tested physical descriptions. It does not alter the equations of physics, assign reflective consciousness to particles, or replace biological and neurological explanation. Its positive warrant is metaphysical : it avoids an absolute rupture between non-sentient actuality and sentient life while distinguishing infinitesimal consciousness from individualized mind.

This is therefore one of the more speculative components of the scheme. Its status must not be elevated by association with scientific findings concerning quantum measurement, complexity, integration, or biological responsiveness. None of these findings proves elementary sentience. At most, they may show that the

proposal is not excluded by current science and that a processual, relational ontology can accommodate it without interfering with scientific explanation.

The thesis of operational dominance possesses an intermediate status. Scientific disciplines already distinguish physical interaction, biological and informational organization, and conscious cognition as *different explanatory fields*. The proposal that these fields correspond to the dominance of three interdependent operators is a metaphysical interpretation of their relation. It explains why the domains can be distinguished without being separated into autonomous worlds.

Applications of the domain distinction are partly empirical. Whether an object is an aggregate, an organized system, a living organism, or an individualized conscious society depends upon its actual structure and functioning. Scientific findings may therefore correct particular classifications. The general claim that the three domains arise through operational dominance remains metaphysical.

Minimal sufficiency is even more clearly comparative. No experiment can prove that the triad is complete. Scientific research may disclose new properties, processes, levels, and forms of organization, but the discovery of novelty does not automatically require a new operator. A fourth operator would be warranted only if it identified an irreducible mode of determination not explicable through energetic efficacy, formative organization, sentient presence, or their conjunction.

The present triad is minimally sufficient because removing any operator leaves a recognizable *explanatory deficit*, while no presently identified candidate for a fourth operator satisfies the established criteria. This conclusion remains arguable, corrigible, and open to displacement by a more adequate architecture. It is a metaphysical verdict, not an empirical generalization.

The triadic specification of the virtual world-ground occupies a still more speculative level. Science investigates particular potentials, state spaces, constraints, probabilities, and possible transitions. It does not observe the virtual world-ground as a whole. Primordial matter, primordial information, and primordial consciousness are inferred by controlled reversal from the operators distinguished in concrete actuality.

Primordial matter as energetic potential has some consonance with scientific accounts of physical possibility, fields, and energetic states. Primordial information as possible architecture has consonance with scientific accounts of constraint, order, and organization. Primordial consciousness as the virtual possibility of sentient actualization has no comparable direct scientific support. Its possible elaboration under God*, including whether valuation and choice may in any qualified sense be attributed to it, belongs to metaphysical theology and must be defended there as an immanent-metaphysical proposal.

The three primordial correlatives consequently do not possess equal proximity to science. Nor does their asymmetry invalidate the set. It requires methodological transparency concerning the degree of speculation involved in each term. The triadic correspondence is architectonic. Its empirical support is indirect and uneven.

The scientific and metaphysical statuses of the principal claims can therefore be ordered.

That physical processes are energetically efficacious, that organized differences constrain outcomes, and that conscious states depend upon embodied and informational conditions are scientifically established in many determinate forms.

That energetic, informational, and conscious descriptions perform non-identical explanatory work is a philosophical interpretation strongly consonant with scientific practice.

That matter, information, and consciousness are three irreducible and necessarily interdependent operators is an immanent-metaphysical thesis.

That infinitesimal consciousness belongs to every actual occasion is a panexperiential metaphysical proposal.

That the triad is minimally sufficient is a comparative architectonic judgment.

That primordial correlatives of the operators specify the virtual world-ground is a further speculative extrapolation.

None of these levels should borrow the authority of another. Scientific findings do not automatically prove metaphysical interpretation. Metaphysical argument does not generate scientific facts. First-person presence does not establish a cosmology. Theological development does not retrospectively validate the conscious operator.

Scientific consonance nevertheless performs real critical work. A metaphysical scheme cannot remain adequate when its factual presuppositions conflict with well-established science. If matter were defined through absolute space, immutable particles, or fixed intrinsic properties contradicted by successful physical theory, the definition would require revision. If information were treated as independent of all physical realization despite thermodynamic and biological evidence, the scheme would become defective. If consciousness were described without regard to neural and bodily dependence, the conscious operator would be insulated from correction.

Science can therefore challenge the scheme in several ways. It may expose a false factual presupposition, show that two allegedly distinct descriptions are experimentally interchangeable, reveal that a proposed domain lacks the organization attributed to it, or disclose a new explanatory difference the triad cannot accommodate. Such findings would not experimentally refute the complete metaphysical system in one act, but they could remove essential supports and force architectonic revision.

Scientific consonance is consequently asymmetric. Compatibility with science does not establish the truth of a metaphysics, whereas serious incompatibility with well-established science can render it inadmissible. Many metaphysical schemes may remain compatible with the same scientific findings. Science constrains the possible totalizations without selecting one uniquely.

The three-operator thesis is scientifically underdetermined. Physicalism, emergentism, functionalism, neutral monism, panexperientialism, dual-aspect theory, and other metaphysical positions may interpret overlapping bodies of scientific evidence differently. No experiment presently adjudicates among all these schemes as complete worldviews. Argument must determine which

interpretation preserves the greatest explanatory range with the least reduction and reification.

Underdetermination does not imply equality. A metaphysical position may be more coherent, comprehensive, semantically precise, or scientifically responsible than its rivals. The triad claims comparative superiority because it preserves the efficacy of physical actuality, the explanatory autonomy of organization, and the irreducibility of first-person presence within one world-system. It also makes their dependencies explicit rather than treating one operator as the appearance or product of another.

The scheme remains anti-substantialist throughout. Scientific consonance must not harden the operators into three natural kinds existing from their own side. Matter, information, and consciousness are not objects discovered behind the processes investigated by science. They are hyper-concepts coordinating recurrent modes of operation. Their reality lies in functional instantiation, not substantial instantiation.

Nor can the triad ground normativity. Scientific facts concerning matter, information, or consciousness do not establish the binding rules of truth, beauty, and action. Metaphysical claims concerning the operators already presuppose these rules. The triad may provide a worldview consonant with the *Regulae* trilogy, but it cannot derive the transcendental facts or legislate their principles.

Ultimate analysis imposes the final restriction. Scientific validity does not confer inherent existence upon scientific objects, and metaphysical usefulness does not confer it upon operators. Matter, information, consciousness, their domains, their conjunction, and their primordial correlatives exist conventionally and lack self-nature. The scientific-metaphysical alliance remains valid only while it resists the reification of both facts and hyper-concepts.

The epistemic verdict can now be stated precisely. The three-operator thesis is not a scientific discovery, experimental theory, or final ontology of reality-as-such. It is an immanent-metaphysical reconstruction constrained by science, supported by explanatory differences operative within scientific practice, and defended through argument. Its universal co-instantiation, irreducibility, minimal sufficiency, panexperiential interpretation, and primordial extension remain scientifically underdetermined and corrigible.

Its scientific consonance is nevertheless substantial. Contemporary inquiry treats physical actuality through activity and interaction rather than inert substance. It requires organizational descriptions not exhausted by energetic inventories. It distinguishes complex information processing from conscious presence while establishing their close dependence. These directions do not prove the triad, but they make its architecture rationally viable and heuristically fertile.

Matter, information, and consciousness are therefore retained as critically admissible operators within one processual world. Science supplies their determinate operations and constraints. Metaphysics coordinates them into an open architecture. Neither can perform the work of the other.

Chapter 2 | Matter : Energetic Efficacy

Matter is examined first because physical efficacy provides the clearest scientific point of entry into the three-operator thesis. For actuality to enter the *publicly* consequential history of the world, it must become *physically effective*. This order of exposition conveys neither substantial nor temporal priority. Matter is not the underlying stuff from which information and consciousness are produced, nor is it an independently existing realm upon which they are subsequently imposed. It names the operation through which actuality becomes physically realized, enters interaction, and contributes publicly traceable conditions to what follows.

Physics investigates fields, particles, interactions, energy, mass, spacetime, symmetries, probabilities, statistical states, and transformations. General metaphysics does not replace these concepts with one allegedly more fundamental object. It asks what mode of operation is displayed across their scientific differentiation. The proposed answer is energetic efficacy.

Energetic efficacy is a hyper-concept. It coordinates physical realization, capacity, interaction, transmission, resistance, and transformation. It does not identify matter with the scientific quantity energy, convert physical fields into substances, or present one current physical theory as the final ontology of reality-as-such. Its task is to define what material operation contributes within the triadic architecture.

1. Definition and Criterion of Operation

The concept of matter has accumulated several incompatible meanings. It has designated inert stuff, extended substance, massive body, impenetrable solidity, elementary corpuscles, physical fields, and whatever is taken to exist independently of consciousness. No single one of these meanings provides an adequate criterion for the present metaphysics. Some belong to obsolete scientific frameworks, others are too narrow to encompass contemporary physical description, and still others define matter negatively by contrasting it with mind. Matter must instead be defined positively through the characteristic operation it contributes to concrete actuality.

Matter cannot be defined as *inert* ‘substance.’ Inertness signifies the absence of a specified macroscopic change under specified conditions, not the absence of physical activity. A body macroscopically at rest remains involved in gravitational, electromagnetic, molecular, thermal, and other physical relations. Its apparent stability depends upon active equilibria, recurrent organization, constraints, exchanges, and resistance to alteration. To conceive matter as passive stuff awaiting motion from elsewhere therefore abstracts from the interactions through which material stability is achieved and maintained.

Nor can matter be defined simply through *extension*. Physical actuality is spatiotemporally articulated, but the relation between matter and spacetime is not adequately represented as that of a substance placed inside an independently existing receptacle. General relativity represents gravitation through spacetime geometry and relates this geometry *dynamically to physical distributions*. It thereby replaces Newtonian absolute space and universal time as unaffected

backgrounds with one *interdependent* physical account of geometry and material conditions (Einstein, 1916). Whatever interpretation of spacetime is finally adopted, material actuality cannot be identified merely with solid extension occupying a pre-given container.

Matter cannot be defined by *mass*. Photons and other *massless* excitations remain physically *efficacious*. They transmit energy and momentum, enter interactions, and produce measurable effects. Massive bodies, conversely, cannot be reduced to the possession of one quantity. Their physical actuality also involves field relations, interactions, organization, spacetime conditions, and possible transformations.

Matter cannot be identified with *particles alone*. Particle descriptions remain scientifically indispensable within appropriate domains, but quantum field theory does not generally represent physical actuality as a determinate collection of localized *corpuscles* possessing complete identities independently of fields and interactions. Fields, excitations, symmetries, probabilities, couplings, boundary conditions, and interaction structures also belong to physical description. Matter must therefore be defined widely enough to include the physical efficacy investigated through these different but interconnected scientific concepts.

Nor can matter be identified with *energy*. Energy is not a universal material fluid flowing beneath physical appearances. It is a quantitatively defined feature of physical theories whose meaning and conservation conditions depend upon specified dynamical structures. Noether's theorem establishes a precise relation between continuous symmetries and corresponding conservation laws. Where temporal-translation symmetry obtains, a corresponding conservation of energy follows. The theorem articulates a formal and physical relation ; it does not disclose a permanent energetic substance existing beneath every transformation (Noether, 1918).

The adjective 'energetic' must consequently be understood *functionally*. It points toward *capacity* for physical interaction, transmission, work, exchange, resistance, and transformation. It does not convert the scientific quantity energy into the 'essence' of matter. Energetic efficacy is broader than energy because physical outcomes also depend upon geometry, field structure, symmetries, probabilities, couplings, constraints, and boundary conditions. It is narrower than actuality as a whole because it does not, merely by naming physical efficacy, explain formative organization or consciousness.

Matter may therefore be defined as follows :

Matter is the operator of physically realized efficacy through which actual processes enter spatiotemporal relations, interact, transmit or transform physical conditions, and produce publicly traceable effects.

Each element of this definition imposes a restriction.

First, material operation is *physically realized*. A merely conceivable pattern, mathematical structure, uninstantiated law, possible computation, or imagined interaction does not become materially actual by being logically describable. Physical realization requires determinate states, fields, carriers, relations, structures, or processes capable of participating in physical interaction.

This criterion does not decide whether the scientific ontology of matter should privilege particles, fields, events, structures, dispositions, or some combination of these. General metaphysics cannot settle by definition questions that remain internal to physical theory and its philosophical interpretation. The criterion identifies what any adequate physical ontology must preserve : concrete efficacy capable of entering the interactional history of the world.

Physical realization also distinguishes matter from *abstract organization*. An informational pattern may be specified independently of one particular carrier, but each of its concrete instantiations requires physically distinguishable states and actual transitions. A computation not performed, a signal not transmitted, a code not instantiated, and an architecture not realized remain possibilities of organization rather than materially effective processes. Matter contributes the physical actuality through which *organization becomes capable* of producing consequences.

Second, material operation is *efficacious*. A physically realized state makes a difference to the possible course of physical process. It may transmit momentum, alter a field, affect a trajectory, generate heat, sustain a configuration, resist deformation, enter a reaction, modify an environment, or change the physical conditions inherited by a later process. The relevant difference need not be macroscopic, immediate, or presently observable. Efficacy may be minute, indirect, distributed, probabilistic, or detectable only through elaborate instrumentation and inference.

The criterion is therefore counterfactual as well as observational. A state or process materially operates when a variation in its physically realized condition would, under the relevant physical circumstances, permit or produce a variation in possible interactions or outcomes. If an alleged physical difference could make no possible difference whatsoever to any physical relation, transition, constraint, or result, it would perform no material operation within the present definition.

This counterfactual criterion does not reduce existence to actual measurement. A process may be materially efficacious *without* having been observed, recorded, or known. Critical realism excludes the identification of physical existence with its current presentation to a scientific community. Observation and experiment provide regulated access to physical processes ; they do not bring those processes into existence merely by detecting them.

Third, material operation is *spatiotemporally articulated*. This does not require every physical object to possess the determinate localization, trajectory, and boundaries of a classical body. Fields may extend across regions. Quantum states may resist classical localization. Spacetime geometry itself participates in physical determination. Material operation must nevertheless belong to the physical order within which relations of extension, duration, succession, causal accessibility, transformation, and interaction are scientifically articulated.

Spatiotemporal articulation must not be reified into one immutable geometry or tied to one final scientific ontology. Physical theories organize the relevant relations differently, and scientifically adequate descriptions may vary across energy and length scales. Effective field theory shows how a theory can identify the relevant degrees of freedom and yield accurate predictions within a delimited scale without claiming to disclose the final high-energy constitution of physical actuality (Weinberg, 1979 ; Donoghue, 1994). Matter as energetic efficacy therefore remains compatible with scientific revision. It is not committed to one completed inventory of fundamental objects.

Fourth, material effects are *publicly traceable*. Physical actuality enters a causal and interactional field that is, in principle, accessible from more than one first-person vantage through bodies, instruments, records, environmental changes, and intersubjectively controlled inquiry. A physical effect may leave a trace in another system even when no person was present when it occurred. Public traceability concerns its participation in this shared field, not its actual observation at a particular time.

Publicity distinguishes material efficacy from the exclusive presence of a mental state without separating matter and consciousness into autonomous worlds. A pain is conscious only for the subject suffering it. Its embodied conditions, expressions, and consequences nevertheless enter public physical processes. Neural activity, physiological changes, withdrawal, vocalization, and bodily action can become objects of scientific investigation. The conscious state is *not* reducible to these material operations, but its *capacity to affect* the *public* world depends upon material mediation.

Publicity must not be confused with direct or uninterpreted access. Energy, quantum fields, spacetime curvature, and subatomic interactions are known through measurement, modeling, conceptual determination, and theoretical interpretation. What becomes scientifically established is a sensate and conceptual object constructed under critical conditions. Material operation concerns the extra-mental efficacy that scientific inquiry must normatively suppose its objects track, not matter as allegedly presented without interpretation or known as it exists from its own side.

The criterion of material operation may consequently be stated more exactly :

A process functionally instantiates the material operator insofar as it is physically realized and its determinate condition contributes, under physical circumstances, to the interactional possibilities and publicly traceable consequences of the world-process.

The criterion is intentionally broader than ordinary object-language. It applies not only to macroscopic bodies but also to radiation, fields, interactions, physical structures, and physically consequential geometric relations. It is nevertheless restrictive. A merely formal relation is not material unless physically instantiated. A meaning is not material merely because it concerns a physical object. A conscious state is not material merely because it depends upon embodied

processes. Materiality belongs to *physical realization and efficacy*, not to everything *connected* with a physical system.

The distinction from information is especially important. Matter answers the question of how an organization becomes *physically actual and effective*. Information answers the question of how physical possibilities are differentiated, constrained, related, arranged, and maintained. An electrical circuit requires material carriers, voltages, currents, and interactions. Its *architecture* determines which pathways are available and which functions can be performed. One concrete circuit therefore instantiates *both* material and informational operations without making them identical.

Material efficacy is never formless. Fields possess structure ; interactions occur under symmetry conditions ; physical objects have boundaries ; particles display determinate properties ; and physical processes follow constrained pathways. Formative organization is therefore always conjointly involved in material operation. Yet organization cannot replace the physical efficacy through which it becomes instantiated and capable of producing effects. A circuit diagram does *not* conduct electricity, and an uninstantiated architecture does *not* enter physical interaction. Hardware without software does *not* solve problems.

The material operator is principally associated with *efficient determination*. An actual occasion inherits achieved physical conditions and transmits physically realized consequences into what follows. This association is not an identity. Material processes are already organized, while geometric, structural, statistical, and boundary conditions participate in determining physical outcomes. Matter names the physically effective realization and transmission of the process, not the complete explanation of its determinate form.

This restriction prevents energetic efficacy from becoming causal monism. Not *every* explanatory difference is an energetic difference. Two systems may possess comparable constituents and available energy while behaving differently because their *organization* differs. Matter specifies the physically realized capacity for transition. Information specifies the *differentiation* and *constraint* through which one transition rather than another becomes available, probable, sustained, or inhibited.

The positive definition also prevents matter from being identified merely through opposition to consciousness. Matter is not whatever remains when experience has been removed from an account. *It is physically realized efficacy*. Consciousness may depend upon material processes and influence embodied action through them *without* becoming material in the sense established here. The distinction concerns characteristic operation, not separation into two substances.

Matter must likewise be distinguished from the material domain. The material operator is functionally instantiated wherever physical realization and efficacy occur. The material domain comprises actualities whose conventional identity and characteristic activity are predominantly explained through this operation. An organism and a person instantiate the material operator, but their adequate explanation also requires formative organization and, in the person, individualized consciousness. Material operation is therefore proposed as universal within the present scheme, whereas material dominance is not.

This universalization must be assigned its proper epistemic status. Science establishes physical realization and efficacy in innumerable determinate processes. It does not experimentally establish that every actuality instantiates matter as one of exactly three metaphysical operators. The movement from scientifically investigated physical operations to the universal material operator is an immanent-metaphysical totalization.

The totalization is nevertheless scientifically constrained. It cannot define matter in a way that contradicts valid physics, identify one current scientific theory with reality-as-such, or convert energy, particles, fields, spacetime, or the physical vacuum into a self-sufficient foundation. Scientific descriptions may change, but any adequate successor must still explain how physical processes become realized, enter interaction, and produce effects. Energetic efficacy names this continuing metaphysical requirement.

The matter-operator is therefore not a hidden bearer placed behind physical processes, nor an additional object discovered beside fields, particles, and interactions. It is functionally instantiated in the operations themselves. A physical interaction does not occur because matter stands behind it and exercises an independent power. The interaction is one concrete manner in which energetic efficacy becomes actual.

Ultimate analysis applies without exception. *Matter lacks inherent existence.* It does not exist *independently* of physical processes, formative organization, sentient actualization, scientific identification, or metaphysical construction. Its emptiness does *not* make it unreal. Physical processes resist, interact, transform, affect bodies, constrain possibilities, and transmit consequences.

Matter is empty of self-nature and full of efficacy.

The definition and criterion can therefore be condensed :

Matter names physically realized efficacy. Its criterion is the capacity of a determinate physical state or process to enter spatiotemporal relations and make a publicly traceable difference to the possible course of physical actuality.

Matter is not what remains unchanged beneath operation. It is the efficacy through which operation becomes physically actual.

2. Matter as Energetic and Efficient Determination

Matter has been defined as the operator of physically realized efficacy. The next question concerns its *characteristic mode* of determination. Within the present scheme, matter corresponds principally to energetic and efficient determination. The correspondence is principal rather than exclusive. Matter supplies the *physical efficacy* through which actual processes interact, resist, transform, and transmit consequences. Efficient determination names the *direction* in which achieved actuality becomes a condition of further actualization. The two concepts converge where a completed physical process makes a difference to what may happen next.

Energetic and efficient determination must nevertheless be distinguished. Energetic determination concerns the *physical capacity* for interaction, transmission, resistance, work, and transformation. Efficient determination concerns the *relation* from antecedent actuality toward subsequent actuality. The first identifies a *mode* of operation ; the second identifies a *direction* of dependence within process. Matter joins them because physical realization is the indispensable medium through which achieved physical conditions become operative within what follows.

This formulation reverses the inherited image of matter as passive stuff. Classical substance metaphysics treated matter as a persistent bearer possessing properties while remaining numerically identical beneath alteration. Motion, interaction, and change then *occurred to matter*, as though materiality itself were *inactive*. Process metaphysics begins from the opposite direction. Matter does not first subsist and subsequently become effective. It is functionally instantiated through organized physical activity, interaction, resistance, and transmission.

So material persistence is an *achievement* rather than the endurance of an immutable core. In composite systems such as molecules, rocks, instruments, organisms, and bodies, persistence depends upon the continued reproduction of sufficiently stable physical and informational relations, even while constituents interact, exchange energy, transform, or are gradually replaced. Elementary excitations require different scientific criteria of persistence, but here too stable identification does not entail an immutable bearer beneath interaction. Stability is not the suspension of process. It is one conditionally maintained form of process.

Dissipative structures illustrate this point with particular clarity. A macroscopic organization may arise and remain relatively stable far from thermodynamic equilibrium only while the relevant exchanges, gradients, environmental relations, and boundary conditions continue. When the sustaining processes cease, the organization disappears. Its identity belonged to an *organized recurrence of activity* rather than to an *invariant* material substance *concealed beneath* that activity (Prigogine, 1977).

The term ‘energetic efficacy’ emphasizes this active character, but it must not convert energy into a replacement substance. Energy is a technically defined physical quantity, not a universal material fluid. Its meaning, measurement, transformation, and conservation belong to determinate physical theories. Noether’s theorem relates continuous symmetries to corresponding conservation laws ; where temporal-translation symmetry obtains, a corresponding conservation of energy follows. Nothing in this relation establishes energy as *permanent stuff* persisting beneath every physical transformation (Noether, 1918).

Energetic efficacy is therefore *not* identical with energy. It is a hyper-concept coordinating physical realization, capacity for interaction, transmission of physical conditions, resistance, performance of work, maintenance of structures, and transformation. The adjective energetic directs attention toward effective physical activity. It does not name a hidden entity or substrate operating behind physical events.

The same restriction applies to mass-energy equivalence. The precise relation between mass and energy does not show that matter is composed of energy

understood as a substance. Nor does it permit mass, energy, fields, particles, and spacetime to be compressed into one imagined cosmic ingredient. These concepts perform determinate functions within physical theories. General metaphysics may coordinate their dynamic implications without converting any one of them into the ultimate bearer of physical actuality.

Efficient determination concerns *inheritance*. Every actual occasion arises within a world *already actualized in innumerable respects*. It does not begin from absolute nothingness, establish its own antecedent conditions, or decide which past processes have occurred. Fields, temperatures, pressures, trajectories, chemical compositions, bodily states, spatial relations, and environmental circumstances have already become determinate and enter the conditions under which the new occasion arises.

Whitehead's account of causal objectification articulates the same central insight : completed actualities become effective conditions for *subsequent becoming* rather than enduring as unchanged substances moving through time (Whitehead, 1978, pp. 150, 222). Their completed determinations become data for what follows. The present scheme retains this processual inheritance while reconstructing it through the material operator.

Efficient determination may therefore be defined as the inherited efficacy through which achieved actuality conditions further actualization. In *material* operation, this inheritance includes transmitted momentum, field conditions, thermodynamic states, physical configurations, chemical compositions, geometrical relations, boundary conditions, and the effects of prior interactions. These are not external influences imposed upon an occasion already constituted independently of them. They *participate in the conditions* through which the occasion becomes the actuality it is.

Inheritance does not mean that a self-identical material core *migrates* from one occasion to another. No permanent particle-substance, body-substance, or energetic substance *passes unchanged* through the succession while acquiring accidental modifications. What persists is the *efficacy of achieved determination*. An antecedent actuality has altered the world and thereby changed the conditions under which later actuality can arise.

The past therefore persists through consequences rather than through substantial identity. A completed occasion no longer undergoes its own becoming, but its outcome does not disappear. Its physical determination enters the settled world inherited by subsequent occasions. What was attained as the outcome of one actualization becomes an efficient condition of another.

This conversion of completed outcome into inherited condition establishes the *material rhythm of process*. An occasion inherits physical conditions, integrates them into one determinate actuality, and transmits the physical consequences of that actuality into what follows. Continuity does not consist in one thing remaining numerically identical while moving through successive states. It consists in the ordered transmission and transformation of achieved conditions.

The distinction between the occasion as becoming and the occasion as achieved outcome is therefore functional rather than substantial. During actualization,

inherited conditions contribute to the constitution of one determinate process. Once this determination is complete, the occasion becomes available as an effective condition for later actualities. The outcome is not detached from the becoming as another entity. It is the completed determination of that becoming considered according to its subsequent efficacy.

Along a selected route of actualization, this succession may be represented schematically as :

$$(x - dt) \rightarrow x \rightarrow (x + dt)$$

The occasion x inherits conditions from $x - dt$ and contributes conditions to $x + dt$. The representation is local and simplified. An actual occasion may inherit from several converging routes and contribute to several diverging routes. Its antecedent field is seldom reducible to one predecessor, and its efficacy need not be confined to one successor. Efficient determination is directional without being merely linear.

The efficient vector represents this direction from achieved actuality toward further actuality. It is not an independent force, a material current flowing between occasions, or a universal timeline containing every process. It is an *architectonic representation of inherited efficacy*. The physical conditions achieved within one actualization become constitutive conditions for other actualizations capable of receiving their effects.

The earlier expression material momentum identified an important feature of this transmission but was too narrow to characterize material operation as a whole. Momentum is one precisely defined physical quantity. Physical inheritance also occurs through fields, radiation, temperature, pressure, spacetime geometry, chemical composition, statistical relations, boundary conditions, and other determinate physical structures. Energetic efficacy therefore provides the more comprehensive term.

Efficient determination must also be distinguished from *sufficient* determination. To state that antecedent actuality conditions what follows is not to state that it *completely fixes one unique outcome*. Some physical theories are deterministic within their domains. Others assign probabilities to possible outcomes. Complex processes may depend upon initial conditions, boundary conditions, fluctuations, environmental exchanges, nonlinear interactions, and descriptions operating at several scales.

The metaphysical claim remains neutral among these scientific possibilities. Efficient determination means that further actuality does not arise independently of the achieved world. It does not mean that the achieved world contains one exhaustively predetermined future. Inheritance constrains becoming without necessarily completing its determination.

This distinction is essential for the possibility of novelty. Were efficient determination invariably sufficient, every subsequent actuality would already be fully contained in its antecedent conditions. Novelty would then be only epistemic : an appearance produced by incomplete knowledge of an already determined sequence. The present metaphysics does *not* claim that science has established

universal indeterminism. It refuses only to define physical inheritance as metaphysical *closure*.

Material efficacy is consequently real without being sufficient by definition for the complete metaphysical explanation of actualization. It supplies inherited capacities, resistances, exclusions, tendencies, and limits, making some physical continuations available and others unavailable. Where antecedent physical conditions permit more than one continuation, energetic inheritance does not by itself specify why this determinate organization becomes actual. Where a physical theory determines one continuation within its domain, the further metaphysical question concerns what that determination presupposes concerning organization rather than whether physics has failed to determine an outcome.

Were efficient determination the *sole* dimension of actualization, the world-process would consist *entirely* in the transmission, recombination, and continuation of what had *already* become. The antecedent field might contain many conditions, and their conjunction might be highly complex, but the new occasion would add *no determination not already fixed by its inheritance*.

The present ontology rejects the stronger metaphysical thesis that efficient inheritance exhausts the determination of actualization. What has been inherited must still acquire one concrete organization within the occasion. Efficient determination explains *why* an actuality cannot arise without the achieved past. It does not by itself explain *how* the inherited plurality becomes this *particular* unity.

Final determination names this second direction. The adjective 'final' does not refer to an external purpose imposed from the future, a predetermined destination toward which every process is compelled, or an intelligent designer arranging events from outside the world. It concerns the final determination achieved by the actual occasion itself : the *particular organization* through which inherited conditions *become one completed actuality*.

Efficient and final determination are therefore distinguishable but co-constitutive. Efficient determination concerns *what* enters the occasion as inherited actuality. Final determination concerns *how* this inheritance is integrated, constrained, weighted, and completed. They are not two chronological stages in which matter first arrives and form is later added. The inherited conditions become effective only *within the determinate actualization* through which they are taken up.

The material operator corresponds principally to efficient determination because physical realization transmits the efficacy of achieved actuality. This correspondence is not an identity. Material processes are always organized, and their physically possible outcomes depend upon symmetries, structures, constraints, probabilities, and boundary conditions. Matter names the physically effective inheritance and realization of process, not the complete explanation of its form.

Conversely, efficient determination is not exclusively material in its adequate explanation. Informational organizations and conscious acts can become efficient conditions once they are physically realized. A genetic sequence, neural disposition, technical architecture, social institution, linguistic convention, scientific theory, remembered commitment, or deliberate decision can *affect*

subsequent events. Each requires material instantiation to enter the public world, but its efficacy may not be adequately explained by citing only the physical energy or constituents involved.

A spoken command illustrates the distinction. Its sound waves are materially realized and physically effective. Yet why they produce one response rather than another depends upon linguistic organization, learned meaning, social relations, and the hearer's conscious understanding and choice. These determinations do not contribute an additional quantity of physical energy. They organize and redirect physically available processes.

Matter and efficient determination therefore cannot be identified without remainder. Matter is an operator ; efficient determination is a *direction* of actualization. Matter supplies the physical efficacy through which inherited conditions become *transmissible*. Information and consciousness may also contribute to what becomes efficiently consequential, but they do so *through material realization*.

This crossing of operators and directions prevents a rigid mapping in which matter belongs *only* to efficiency, information *only* to form, and consciousness *only* to finality. Material properties constrain possible organizations. Informational structures are physically transmitted and can become efficient conditions. Conscious intentions become effective through organized bodily action. The vectors and operators distinguish different features of one actualization and therefore intersect.

Nevertheless, matter carries the principal burden of public transmission. A possible organization cannot alter the actual world unless it is instantiated. A symbol cannot affect another subject unless it is expressed, retained, transmitted, or enacted. An intention cannot change a body or environment unless it becomes effective through neural, bodily, technical, linguistic, and environmental processes.

Matter may consequently be related to efficient determination as follows :

Matter is the operator through which efficient determination becomes physically realized and transmissible.

This formulation is stronger than the claim that matter merely accompanies causation. Physical realization is indispensable to the entry of an achieved determination into the public conditions of further actuality. A wholly uninstantiated possibility produces no physical consequence. A relation that makes no physically realizable difference performs no material operation.

The formulation is weaker than physicalism. The fact that every publicly effective action requires physical implementation does not establish that the physical description exhausts the organization, meaning, valuation, intent, or choice involved. Material operation secures worldly consequence. It does not by itself explain why the process possesses this architecture, performs this function, or enacts this consciously adopted direction.

Efficient determination must likewise not be reduced to *mechanical impact*. Physical efficacy may operate through contact, fields, radiation, distributed interactions, thermodynamic gradients, chemical relations, or changes in spacetime conditions. The classical image of one solid body pushing another captures only one limited mode of physical transmission.

Nor should efficient determination be represented as a *substantial power* residing inside an actuality. An occasion does not possess efficacy as a separable entity or force stored behind its physical properties. Its efficacy consists in the differences its determinate condition makes to the possibilities and outcomes of subsequent process.

The same anti-reifying control applies to causal laws. A law does not stand outside actual processes and compel them as an independently existing agent. Scientific laws formulate stable relations, transformations, constraints, and regularities discovered through inquiry. Their physical efficacy lies in the processes and relations they describe, not in a separate law-substance governing the world from elsewhere.

Efficient determination is therefore *conditional*. The effect of an achieved actuality depends upon the later processes capable of receiving, transmitting, resisting, amplifying, or transforming it. One physical condition may produce different consequences in different organizations. Causation is not the projection of an isolated power from a self-sufficient cause into a passive effect. It is a conditioned relation among actual processes.

This conditionality also explains why transmitted determination is accompanied by *transformation*. The past is not reproduced unchanged in the present. Its efficacy is received within a new conjunction of conditions. What is inherited acquires a *new function* according to the actuality in which it participates. Continuity and novelty therefore belong together : the new occasion depends upon achieved determinations while reorganizing them into a non-identical outcome.

Material transmission may preserve, amplify, inhibit, redirect, or dissipate antecedent effects. A signal can weaken, a force can be counteracted, heat can disperse, a chemical pathway can be blocked, and a bodily movement can be redirected. Efficient determination supplies real conditions without guaranteeing that every antecedent contribution remains equally effective.

The material history of the world is consequently neither the persistence of substances nor the execution of a completed program. It is the transmission and transformation of achieved physical conditions through successive and interacting actualizations. Every physically achieved result alters, however minutely, the situation inherited by what follows.

This transmission also changes virtuality. When a material possibility becomes actual, it closes some continuations, preserves others, and may open new physical possibilities. The construction of an instrument, formation of a molecule, development of an organism, alteration of an environment, or performance of an action changes the conditions under which later processes can occur. Matter therefore contributes not only consequences but also revisions of the available field of further formation.

Ultimate analysis remains applicable throughout. Neither energetic efficacy, efficient determination, causal inheritance, nor the material route possesses inherent existence. Each depends upon actual processes, relations, conditions, organization, and conceptual determination. Their emptiness does not abolish their functioning. Antecedent processes really constrain what follows, bodies resist, fields interact, structures persist conditionally, and achieved outcomes enter subsequent actuality.

The relation can now be stated precisely. Energetic determination concerns the capacity of physical actuality to interact and produce effects. Efficient determination concerns the inheritance of those effects by further actuality. Matter is principally associated with both because it supplies the physical realization through which achieved conditions become publicly consequential and transmissible.

Matter is therefore active without becoming an agent, inherited without becoming an enduring substance, and efficient without becoming sufficient. It carries the achieved world into what follows while leaving the determinate organization of what follows dependent upon the conjunction of all three operators.

3. Fields, Particles, Forces, and Physical Interaction

Energetic efficacy becomes scientifically determinate through fields, particles, forces, and interactions. These terms do not name *independent* ingredients from which a metaphysical material substance is composed. They belong to interconnected theoretical descriptions of how physical states are realized, differentiated, related, and transformed. General metaphysics may interpret the implications of these descriptions, but it may neither replace their scientific meanings nor convert one preferred vocabulary into the final inventory of reality-as-such.

Classical atomism gave explanatory priority to independently existing particles. The particles were conceived as elementary entities possessing determinate identities and properties, while forces and relations were added as external influences acting upon them. Interaction could change their position or motion without participating in the constitution of what they were. The fundamental order therefore ran from self-contained terms toward subsequently established relations.

This model remains useful within restricted scientific domains. Classical particles, trajectories, and forces provide highly accurate descriptions where quantum and relativistic effects can be neglected. Their success within those domains must not be denied merely because contemporary physics employs more comprehensive formalisms. Scientific advancement usually restricts and situates earlier theories rather than rendering every object described by them unreal.

The classical model nevertheless becomes insufficient when generalized into a complete metaphysics of physical actuality. Contemporary field theory does not require every physical state to consist of a determinate collection of localized particles possessing complete identities independently of the relations in which they occur. Particle descriptions remain indispensable, but quantum field theory permits particles to be understood, under suitable conditions, as quanta or

excitations associated with fields. Interactions may create and annihilate particle excitations, transform particle types, produce bound states, and generate physical conditions for which no determinate number of localized particle individuals can be assigned (Weinberg, 1995).

The familiar image of an elementary particle as a microscopic pellet is therefore inadequate. A particle is not a miniature macroscopic body whose identity remains complete before its field-theoretic context is considered. Its scientifically relevant properties, including mass, spin, charge, stability, permitted transformations, and interaction strengths, are articulated within a wider architecture of fields, symmetries, couplings, and dynamical relations.

This does not make particles unreal. Detectors register localized events, particle beams can be prepared, scattering processes can be measured, and particle descriptions yield exceptionally precise predictions. Particles exist conventionally as identifiable and physically efficacious physical objects within the regimes in which the relevant descriptions apply. Their conventional reality does not require that they possess immutable identities from their own side.

The metaphysical interpretation must consequently preserve two truths. Particle descriptions track real physical efficacy, but the efficacy need not belong to an *independently existing corpuscular substance*. A particle may be interpreted as a conventionally identifiable mode of physical actualization whose sufficiently stable characteristics are maintained or reproduced across specified interactions. This processual interpretation retains particle reality while abandoning the assumption that one permanent bearer persists unchanged beneath every physical transformation.

Relative stability should not be confused with absolute identity. An electron displays stable values for properties such as charge and spin within the applicable theory, and these regularities permit its scientific identification. Yet the metaphysical inference from stable characteristics to a *self-grounding* particle-substance does *not* follow. Stability establishes dependable physical organization and reproducible behavior under specified conditions. It does not disclose an inherent essence *independent* of fields, relations, theoretical determination, and the physical processes through which the particle becomes detectable.

Fields require equal restraint. In classical physics, a field assigns physical quantities to locations or regions and describes distributed physical conditions. Gravitational, electric, and magnetic fields permit physical influence to be represented without reducing every interaction to direct contact between solid bodies. The field thereby shifts attention from isolated objects toward distributed relations and local physical conditions.

A quantum field is not simply a continuous material medium filling a pre-given spatial container. It belongs to the mathematical and physical architecture through which possible states, observables, excitations, symmetries, couplings, and interactions are represented. The field is not scientifically known *apart* from these determinate functions, structures, and experimentally accessible consequences.

The statement that particles are excitations of fields is scientifically powerful but metaphysically underdetermined. It does not demonstrate that fields constitute the

sole substance of the physical world. Replacing particle-substance with field-substance would reproduce the same ontological error under another description. Instead of a multitude of self-sufficient corpuscles, one would posit self-sufficient fields existing beneath every manifestation. The vocabulary would change while the substantialist grammar remained intact.

A field is scientifically identified through its states, transformations, symmetries, couplings, observables, and measurable effects. Its physical reality lies in the operations and relations expressed through these determinations, not in an inaccessible self-grounded being concealed behind them. A field acts *nowhere* as a *metaphysical agent* separate from its physical states and interactions.

This does not imply that the field is merely a calculation or subjective representation. The distinction is not between a real particle and an unreal field. Fields contribute indispensably to successful predictions and explanations and have experimentally traceable consequences. Critical realism therefore permits their conventional physical reality while withholding the claim that scientific representation discloses *how they exist from their own side*.

Particle and field ontologies need not be treated as exhaustive alternatives. The same theoretical framework may support particle language under one set of conditions and distributed field language under another. Localized detector events may be described as particles, while propagation and interaction may require field descriptions. Bound systems, coherent states, thermal states, and other physical configurations may resist reduction to one simple particle inventory.

The relevant descriptions answer different scientific questions and operate at different scales. General metaphysics should not decide in advance that one vocabulary must eliminate the other. Their coexistence suggests that physical actuality can sustain several valid modes of scientific objectification without being exhausted by any one of them.

Effective field theory reinforces this conclusion. Physical theories are commonly organized according to energy or length scale. A theory may accurately identify the relevant degrees of freedom and predict their behavior within one regime without supplying a completed description of unknown processes at higher energies or shorter distances. Low-energy validity does not require complete knowledge of the ultimate high-energy constitution of the physical world (Weinberg, 1979 ; Donoghue, 1994).

This scale dependence has two metaphysical consequences. First, the success of a scientific object within a restricted domain does not make that object merely fictitious. Molecules, phonons, quasiparticles, fluids, and other scale-relative objects can be conventionally real and physically efficacious within the organizations in which they arise. Their reality lies in their functioning and explanatory indispensability under determinate conditions.

Second, such success does not confer final metaphysical status. An entity appearing fundamental within one effective theory may be explained through different degrees of freedom at another scale. The categories appropriate to one regime need not provide the immutable furniture of reality-as-such. Scientific

realism can therefore remain scale-sensitive without collapsing into instrumentalism or substantialism.

Scale sensitivity is not arbitrariness. Experimental findings, mathematical transformations, constants, boundary conditions, and domains of applicability impose objective constraints. An effective theory cannot simply describe anything whatsoever. Its concepts are valid because they organize and predict determinate physical results within a demonstrable range. The critical conclusion is only that validity within a range must not be converted into an absolute ontology extending beyond that range.

The language of *force* requires corresponding qualification. In classical mechanics, force denotes what changes the motion of a body and remains indispensable within its domain. The concept permits the accelerations and trajectories of bodies to be explained and predicted. Nothing in the process orientation requires abandoning a valid classical concept where it continues to perform this work.

At more fundamental levels, *interaction* is the more comprehensive term. It includes binding, scattering, decay, exchange, transformation, coupling, and the dependence of one physical state upon another. A physical interaction need not resemble the mechanical impact of one solid object upon another. It may be distributed through a field, involve exchanges of conserved quantities, change the kinds or numbers of particle excitations present, or alter the physical state of a compound system.

The shift from force to interaction has metaphysical importance. Force readily suggests an *independently existing thing* exercising an intrinsic power upon another independently existing thing. Interaction places the relation *within* the *constitution* of the event being described. The participating physical states do not necessarily possess every relevant determination independently before their interaction. Their possible transformations and observable properties may depend upon the interactional architecture in which they occur.

This does not mean that relation replaces the related physical processes as a new substance. An interaction is *not* an entity hovering between two terms. It is the physically realized way in which their states become mutually consequential under determinate conditions. The terms and the relation are distinguishable within the description, but neither need possess complete metaphysical independence from the other.

The Standard Model describes electromagnetic, weak, and strong interactions through quantum field theories organized by gauge symmetries. Electromagnetic and weak interactions are unified within electroweak theory, while the strong interaction is described through quantum chromodynamics. Gravitation is described by general relativity and has not been incorporated into a complete, experimentally established quantum unification with the other interactions.

It is therefore incorrect to present the four commonly distinguished fundamental interactions as scientifically demonstrated differentiations of one primordial super-force. Electroweak unification is experimentally supported within its tested domain. Proposed grand unified theories and theories of quantum gravity remain

active *research programs* rather than established scientific accounts of one completely unified interaction.

General metaphysics must remain neutral concerning their eventual outcome. The three-operator thesis does not depend upon the present number of scientifically distinguished interactions. Future physics may unify existing interactions, identify additional ones, revise field theory, or reconceive what counts as fundamental. Whatever the eventual scientific architecture, material operation will still require physically realized relations through which states can affect, transform, and constrain one another.

The distinction between scientific unification and metaphysical unity is decisive. A successful physical unification would establish that phenomena previously described through different theories can be represented within one more comprehensive formalism. It would not establish that the world-system is one inherent substance, one undifferentiated field, or one cosmic object. Formal and explanatory unity does not entail substantial unity.

Gauge symmetries illustrate the conjunction of energetic efficacy and formative organization. Physical interaction does not arise from an unstructured supply of energy. The possible states and transformations of a theory are articulated through formal symmetries, field contents, couplings, conservation relations, and patterns of symmetry breaking (Yang & Mills, 1954).

Symmetry must not be reified as an independently acting cause. A symmetry identifies an invariance under specified transformations. It constrains the architecture of the physical description and thereby contributes to what states, interactions, and transitions are admissible. The actual process remains physically realized through fields, states, couplings, and interactions. Symmetry does not act upon these processes from outside them.

The relation displays the conjunction of two operators. Material operation supplies the *physically realized efficacy* through which the interaction occurs. Informational operation supplies the *differentiated architecture* and *constraint* through which some interactions become permitted, prohibited, conserved, or transformed. Neither operator acts separately. The physical interaction is simultaneously efficacious and determinate.

This interpretation must remain distinct from the scientific theory itself. Physics formulates gauge symmetries mathematically and tests the consequences of theories organized through them. The classification of symmetry as an informational contribution and physical interaction as material efficacy belongs to the metaphysical totalization. It is consonant with the scientific distinction, but it is not itself a finding of physics.

The language of exchange particles also requires caution. Photons, gluons, and the W and Z bosons are associated with the interactions described by the Standard Model. In perturbative calculations, Feynman diagrams may represent contributions through lines interpreted heuristically as exchanged quanta. This view is scientifically useful, but is not to be routinely converted into a microscopic account of little objects traveling secretly between observed particles.

Internal lines in Feynman diagrams represent terms within a calculation. So-called virtual particles do not constitute a separately observed class of short-lived substances possessing every property of asymptotic particle states. Their role is theory-dependent and calculational. To literalize them indiscriminately is to transform a *formal* representation into a concealed *physical mythology*.

This caution does not make the interactions unreal. The experimentally confirmed outcomes, scattering amplitudes, energy and momentum transfers, decays, and correlations are physically real. What remains restricted is the ontological interpretation of one representational device used to calculate them. Scientific efficacy must not be confused with the literal truth of every image attached to the formalism.

A physical interaction may now be defined as follows :

A physical interaction is a materially realized relation through which physical states modify, constrain, transform, or become correlated with one another under determinate conditions.

The definition includes classical forces, field-mediated effects, binding, scattering, decay, exchange of conserved quantities, and other physically realized dependencies. It does not require classical contact between solid bodies, nor does it presuppose that the participating terms were metaphysically complete before entering the relation.

Modification and constraint must both be retained. Some interactions visibly change motion, energy, composition, or field state. Others sustain a structure, exclude a transition, preserve a conserved relation, or maintain a bound condition. Physical efficacy does not consist only in producing overt change. Resistance, stabilization, and exclusion can also make physically consequential differences.

Correlation requires additional care. Two physical states may display statistically structured relations without the correlation itself identifying a signal or efficient influence traveling between them. The scientific and metaphysical treatment of non-local quantum correlations belongs to a later subsection. Here it is sufficient to state that interactional and relational structure need not be reducible to the separately assigned classical properties of isolated terms.

Physical interaction is also not identical with *communication*. A physical process can affect another *without* encoding a message, representing a content, or being interpreted by a system or subject. Gravitational attraction, thermal exchange, molecular collision, and radioactive decay are physically consequential without necessarily constituting communication.

Every concrete communication nevertheless requires physical interaction. A message must be embodied in distinguishable states, transmitted through a medium, and capable of affecting a receiver. Material interaction provides the physical efficacy of communication, while information concerns the organization through which the physical differences function as signals, codes, or messages. Consciousness becomes relevant where the message is apprehended, understood, valued, or used by an individualized subject.

The distinction prevents physical interaction from being expanded into an unrestricted concept of information. If every physical difference were called a message merely because it produced an effect, the distinction between causation and communication would disappear. The broader metaphysical use of information as formative organization must remain controlled.

The quantum vacuum belongs within the same field-theoretic order. It is not absolute nothingness. A vacuum state possesses determinate physical structure and can vary according to the fields, interactions, geometry, and boundary conditions involved. Casimir-type effects concern measurable differences associated with such physical configurations, not the production of actuality from metaphysical non-existence (Casimir & Polder, 1948).

The vacuum must likewise not be identified with the virtual world-ground. A quantum vacuum is a scientifically specified state within a *physical* theory. The virtual world-ground is an *immanent-metaphysical articulation* of the possibilities of further formation within the world-system. The two concepts differ in scope, epistemic status, and function.

To identify them would commit two errors. It would inflate a determinate object of physics into the total modal ground of actuality, and it would present a metaphysical hyper-concept as though it had been experimentally encountered. Scientific vacuum states may contribute to the physical possibilities of a cosmic situation. They do not constitute the possibility-aspect of the world-system as a whole.

The vacuum is also not a self-sufficient physical foundation. Its properties depend upon the field-theoretic framework, physical conditions, symmetries, geometry, and boundary arrangements through which it is defined. Calling it a lowest-energy state does not turn it into the ultimate ontological ground *beneath* every actuality.

Fields themselves must not be identified with the virtual world-ground for the same reason. A physical field is actual insofar as it is physically instantiated, possesses determinate states, and enters measurable relations. Primordial matter, by contrast, names the speculative possibility of further energetic actualization. The former belongs to determinate physical actuality ; the latter belongs to the modal specification of virtuality.

The actual occasion must also remain distinct from fields, particles, forces, and interactions. It is not simply a particle, field excitation, interaction vertex, detector event, or spacetime point. These scientific objects may be interpreted as manifestations, organizations, or representations of physical actualization, but no physical theory has experimentally identified one of them with the metaphysical unit proposed in Chapter 4 of Volume I.

The actual occasion belongs to immanent metaphysics. It gathers efficient inheritance, determinate integration, differential extension, energetic efficacy, formative organization, and infinitesimal consciousness within one elementary actualization. The objects of physics are constructed and tested within scientific theories. Similarities between them and the actual occasion can support interpretation, but not identity.

An interaction vertex, for example, may suggest a localized physical event in which antecedent conditions yield a determinate transformation. This structural resemblance does not establish the vertex as a complete representation of concrescence. A diagrammatic vertex belongs to a calculation and lacks the full metaphysical articulation assigned to the actual occasion.

Likewise, a quantum-field excitation may display relative stability across interactions, but it is not thereby one enduring route of actual occasions in the complete metaphysical sense. Physics identifies experimentally tractable states and transitions. Metaphysics reconstructs their possible place within a wider processual ontology.

The restriction protects both disciplines. Physics need not adopt the categories of the metaphysical scheme to retain its validity. General metaphysics need not force every scientific object into a direct one-to-one correspondence with its own concepts. Scientific findings constrain the metaphysical interpretation without uniquely determining it.

The legitimate scientific conclusion is therefore substantial but limited. Contemporary physics strongly supports dynamic, field-theoretic, interactional, relational, and scale-sensitive descriptions of material processes. It undermines the unrestricted classical image of the world as a collection of inert, self-contained corpuscles moving through an unaffected container.

It does not uniquely establish particle ontology, field ontology, structural realism, dispositionalism, event ontology, or process metaphysics. Each interpretation draws different metaphysical conclusions from overlapping scientific formalisms. Physics can exclude interpretations incompatible with its results, but it does not presently select one complete metaphysical totalization.

The present scheme makes an argued choice.

It interprets particles, fields, forces, and interactions as scientifically differentiated forms of energetic efficacy. The matter-operator is not another object added to their inventory. It coordinates what they share : physical realization, capacity for interaction, resistance, transformation, and publicly traceable consequence.

This choice preserves physical plurality without substantialism. Particles are real without being immutable corpuscles. Fields are real without becoming universal substrates. Forces remain valid within their domains without becoming occult powers. Interactions are constitutive physical relations without becoming independent entities. Vacuum states are physically structured without becoming nothingness or world-ground.

Ultimate analysis applies to all of them.

Particles, fields, forces, interactions, symmetries, vacuum states, and the matter-operator lack inherent existence. Their conventional physical identities depend upon relations, physical conditions, scales, and the operations through which they become determinate ; their scientific identification additionally depends upon theoretical frameworks and experimental practices. Their lack of self-power does not abolish their efficacy. Fields interact, particles are detected, forces alter trajectories, and physical relations transform what may happen next.

The metaphysical verdict is neither particle substantialism nor field substantialism. Physical actuality consists in relationally organized energetic efficacy, scientifically articulated through several complementary and scale-sensitive descriptions. Matter is not the object behind fields, particles, and interactions. It is the operator functionally instantiated through their physically consequential activity.

Such physical activity is always spatiotemporally articulated. The next question therefore concerns the relations of location, duration, extension, succession, and causal accessibility through which energetic efficacy becomes physical actuality.

4. Spacetime, Extension, and Physical Actuality

Physical interaction is always spatiotemporally articulated. Fields, particles, bodies, and other physical processes enter relations of location, duration, succession, trajectory, extension, causal accessibility, and mutual influence. These relations are not external additions to an otherwise complete physical actuality. They belong to the conditions under which energetic efficacy becomes determinate and physically consequential.

Classical mechanics distinguished material bodies from the spatial and temporal framework within which they moved. Bodies were treated as enduring substances occupying positions in absolute space, while absolute time passed uniformly and independently of every physical process. Space and time formed an *unaffected receptacle*. Material objects entered, crossed, and persisted within this receptacle while retaining their identities beneath changes of location and motion.

This architecture suited substance metaphysics. Self-identical actors moved upon a fixed stage, and the stage remained unaffected by the events occurring upon it. Relations of position and succession could therefore be added to material objects without participating in their basic constitution.

Einstein's theory of relativity removes this framework from fundamental physics. Spatial distance, temporal duration, and simultaneity *depend upon frames of reference* and upon *physically defined relations among events*. There is no universally privileged decomposition of spacetime into one absolute space and one universal time as Newton proposed. Events that are simultaneous relative to one inertial frame need not be simultaneous relative to another.

The relativity of such assignments does not abolish objectivity. Observers may assign different spatial distances and temporal durations while agreeing upon invariant relations and upon the transformations connecting their descriptions. Objectivity is therefore secured through *lawful relations* among perspectives rather than through one privileged physical standpoint.

General relativity makes the dependence between physical processes and spacetime geometry more explicit. Gravitation is represented through spacetime geometry, while the geometry is dynamically related to material and energetic distributions. Matter does not simply *move through* an unaffected spatial and temporal background. Physical distributions, trajectories, causal structure, and geometry *belong to one interconnected account* (Einstein, 1916).

These scientific results are consonant with a relational process metaphysics, but they do not uniquely establish it. Substantial, relational, structural, and processual interpretations of spacetime remain philosophically contested. Relativity excludes Newtonian absolute space and universal time from fundamental physical description. It does not experimentally prove that spacetime possesses no form of physical reality, that relations alone are fundamental, or that physical actuality consists of actual occasions.

The present metaphysics adopts a processual-relational interpretation. Spacetime names the organized extensive relations through which physical actualities become located, ordered, causally accessible, and mutually determinate. It is neither an independently existing receptacle nor a substance extending beneath physical processes. Nor is it a fourth operator added to matter, information, and consciousness.

This interpretation does not reduce spacetime to a subjective construction. Spacetime geometry has physical significance. Trajectories, clock rates, gravitational relations, causal accessibility, and the propagation of physical effects depend upon geometrical conditions. These dependencies are experimentally investigated and publicly consequential. What is rejected is not physical significance but self-sufficient existence.

Spacetime geometry can therefore contribute to material determination *without* becoming an independent agent. Geometry does not act upon matter from outside the physical world. Nor does it function as an invisible substance directing trajectories. It articulates the organized relations within which physical states and interactions become determinate.

Spacetime consequently displays the conjunction of matter and information. Its geometry is *materially consequential* and *formally organized*. It differentiates positions, intervals, trajectories, horizons, and causal relations. The material operator secures the physical realization and efficacy of these relations. The informational operator concerns their differentiation, structure, and constraint.

This conjunction must not convert spacetime into information alone. A geometrical structure represented mathematically does not become physically actual merely by being coherent. Physical spacetime is not identical with the formal system used to describe it. The mathematical structure becomes a *scientific representation* of physical spacetime insofar as it *successfully articulates measurable physical relations and effects*.

Nor can spacetime be reduced to matter understood as an independently existing material substance. Physical processes do not occupy spacetime as objects placed inside an external container, but neither does matter simply manufacture geometry from an isolated material core. The scientific account concerns a *structured relation between physical distributions and geometrical determination*.

Extension must be distinguished from the complete spacetime geometry through which extension is represented. A physical actuality is extensive insofar as it occupies, constitutes, or enters determinate spatial and temporal relations. Extension indicates that physical actuality is not a dimensionless and durationless abstraction.

This does not mean that every physical actuality must possess the sharply bounded extension of a classical body. A field may be distributed across a region. A quantum state may resist classical localization. An interaction may involve a relational structure that cannot be assigned to one isolated point-like bearer. Extension concerns determinate physical articulation, not necessarily rigid boundaries or classical trajectories.

Mathematical points possess no extension. Coordinates identify positions within a formal representation. A physical event may be modeled as occurring at a point when its relevant extension can be neglected for a particular calculation. This methodological idealization does not establish that the event is metaphysically point-like.

The distinction is important because a mathematical representation may suppress features irrelevant to its immediate scientific purpose. A point particle, instantaneous collision, or sharply localized event can be an indispensable idealization without providing a complete metaphysical description of the process represented. The map does not determine the ontological constitution of what it maps.

The actual occasion is therefore conceived within the present scheme as a differential-extensive interval, designated 'dt,' where t denotes time and d marks the differential character of the interval. The notation refers to the occasion's *non-zero temporal extension* along a selected route of actualization ; it does not reduce its extension to the temporal dimension alone, since an actual occasion also enters determinate spatial relations. The notation excludes two contrary models. An actual occasion is not an enduring substance remaining numerically identical through an extended temporal passage. It is also not a dimensionless instant from which concrete duration and physical extension must somehow be constructed.

The adjective differential indicates a finite but elementary difference within a selected route of actualization. It does not assert that the occasion is a mathematical infinitesimal in the strict formal sense. Nor does it establish a universal minimum duration. The notation dt is an architectonic device used to mark the nonzero extension of one elementary actualization relative to antecedent and consequent occasions.

The adjective extensive indicates that an occasion enters determinate spatial and temporal relations. Its atomicity does not consist in geometrical indivisibility. The interval may be mathematically divided, spatially partitioned, and conceptually analyzed. Its indivisibility concerns its status as one completed act of actualization rather than as a series of independently completed smaller occasions.

The distinction between mathematical divisibility and ontological atomicity is decisive. Every extended interval can be represented through smaller intervals. It does not follow that the actuality represented consists of a chronological succession of completed sub-actualities. Coordinate division may identify regions and relations within the achieved occasion. It does not necessarily disclose a sequence of internally arising occasions.

The internal differentiation of an actual occasion is therefore structural, functional, or genetic rather than a temporal succession of smaller acts. Efficient inheritance,

formative integration, and sentient determination can be distinguished within its constitution. These distinctions do not imply that one operation is completed, followed chronologically by another, while the occasion itself waits to become actual.

The actual occasion becomes as one act. Its differentiated conditions and operations are co-constitutive of that actualization. The genetic order through which they are analyzed expresses relations of dependence and integration, not necessarily a succession measured by an internal clock.

This position preserves Whitehead's distinction between the *becoming of continuity* and a *continuous succession within becoming*. Continuity becomes actual through completed occasions and their relations, but one occasion need not consist of an internal continuum of smaller completed acts (Whitehead, 1978, pp. 35-36). The present model nevertheless constitutes a reconstruction rather than a simple repetition of Whitehead. It assigns the actual occasion a non-zero temporal differential extension and formalizes this extension through 'dt.'

The notation must therefore remain under strict controls. The symbol 'dt' does not designate Planck time, one experimentally discovered quantum of duration, the differential coordinate time of a privileged reference frame, or a universal temporal unit shared by all physical processes. No such identity has been established.

Nor does the ontology require all occasions to possess equal duration or extension. The value represented by 'dt' is local, variable, and route-dependent. No universal duration is assigned to every elementary actualization. Its temporal extension may vary with the physical route and conditions through which it becomes actual, without making occasionhood itself a merely conventional function of observational scale. The notation expresses a metaphysical structure, not a universal numerical measurement.

An occasion belongs to one or more routes of actualization. As said, along a selected route, its relation to antecedent and consequent occasions may be represented schematically as : $x - dt \rightarrow x \rightarrow x + dt$. The representation expresses *succession* among occasions. The occasion x inherits achieved conditions from antecedent actuality and contributes a completed determination to what follows. It does not imply that every occasion has exactly one predecessor and one successor.

Actual processes commonly involve *convergence* and *divergence*. An actual occasion may inherit conditions from several interacting routes and contribute effects to several subsequent processes. Fields overlap, interactions combine, and organized systems integrate numerous physical contributions. The linear notation isolates one relation for analysis without reducing the physical world to a single chain.

Nor does the succession establish one globally ordered cosmic series. Different routes may intersect, diverge, overlap, or remain spacelike separated. Events may be causally connected, mutually inaccessible, or assigned different temporal relations according to the relevant frame. No universal present is required to gather every actual occasion into one simultaneously existing cosmic state.

The present is therefore local at the physical level. An occasion inherits the actual world relative to the physical conditions capable of entering its constitution. What can become an efficient condition depends upon causal accessibility. A physically distant event cannot simply enter the present occasion independently of the relations governing physical transmission.

The expression ‘actual world’ relative to the occasion does not imply that each occasion creates its own universe. It indicates that the physically inherited world differs according to location, causal history, and route. The one world-system contains *many locally situated processes* whose accessible antecedent conditions are not identical.

Metaphysics must therefore not restore absolute simultaneity after physics has removed its scientific warrant. The speculative desire to totalize the world does not provide an *external* standpoint from which *every* event can be placed within *one* privileged now. General metaphysics considers the world-system as a whole without converting totalization into global temporal observation.

The differential-extensive model also clarifies motion. One actual occasion does not travel from place to place. It achieves *one determinate spatiotemporal actuality*. What is conventionally called ‘the motion of a body’ belongs to an *ordered route* in which defining physical and informational relations are reproduced across successive actual occasions.

The route is continuous enough to sustain measurable displacement, velocity, acceleration, and trajectory. Yet the continuity need not belong to one numerically identical material substance occupying every point along the path. It can belong to the ordered inheritance and reproduction of physical organization across non-identical actualizations.

A worldline may accordingly be interpreted as representing the organized continuity of a physical route rather than the history of one self-grounding bearer. This is a metaphysical interpretation of the scientific representation, not a result contained in the geometrical formalism itself. Physics can represent the worldline without deciding whether substantial or processual identity underlies it.

The processual account preserves real motion. Rejecting an enduring substance does not make displacement an illusion. Successive physical actualities possess different spatiotemporal relations, and the organized route displays an objectively measurable trajectory. What is rejected is only the inference from continuity of trajectory to inherent identity.

Persistence receives the same interpretation. A body persists insofar as its physical and informational organization is sufficiently reproduced through successive occasions. Its conventional identity depends upon causal history, recurrent structure, functional continuity, and intersubjectively valid criteria of identification. No unchanging material core is required.

Spatiotemporal continuity therefore belongs principally to routes, fields, aggregates, organizations, and societies of occasions. Atomicity belongs to the individual occasions through which these continuities become actual. The continuous route and the atomic occasion are not contradictory because they concern different levels of organization.

The continuity is also not metaphysically explained merely by representing it as a set of extensionless points. Mathematics can construct extended intervals from point-sets, but this formal result does not establish that concrete physical duration is ontologically composed of independently actual, durationless instants. The differential-extensive occasion already possesses non-zero extension, while routes arise through organized relations among such occasions.

The relation between occasion and route thereby avoids two extremes. Pure continuity would make it difficult to identify a completed act of actualization or a determinate outcome entering subsequent process. Pure point-atomicity would make extension, duration, and physical transmission difficult to reconstruct. Differential extension preserves atomic completion without reducing actuality to dimensionless instants.

Physical actuality may now be defined in relation to spacetime and extension :

Physical actuality is actuality considered under the material operator insofar as it becomes differentially extensive, enters determinate spatiotemporal relations, and contributes physically efficacious conditions to further actualization.

The phrase considered under the material operator is essential. Physical actuality is not a *separate realm* alongside informational and conscious actuality. *Every* actual occasion is proposed as conjointly instantiating energetic efficacy, formative organization, and infinitesimal consciousness. The expression identifies the aspect under which extension, interaction, and public physical consequence carry the principal explanatory burden.

An organism is physically actual because it occupies an extensive bodily organization, exchanges matter and energy, enters environmental relations, and produces material effects. It is *not exhausted* by this physical description because its living continuity also depends upon complex formative organization.

A person is physically actual because the embodied person occupies spacetime, receives physical influences, and produces physical consequences. The person is *not exhausted* by this actuality because informational architecture and individualized consciousness perform further explanatory work.

A sign is physically actual insofar as it is spoken, written, stored, or otherwise instantiated. Its meaning is not identical with its physical extension, but it cannot enter public communication without a physically realized carrier. A conscious intention is physically consequential only insofar as it becomes enacted through embodied and environmentally situated processes.

Spacetime consequently does not belong exclusively to objects classified as merely material. Organisms, persons, artifacts, signs, institutions, and conscious actions possess material conditions and spatiotemporal realization. What differs is the operational dominance required for their adequate explanation.

This point prevents the three domains from becoming *three locations*. The material, informational, and conscious domains do not occupy different regions of

spacetime. They identify differences of operational dominance within one embodied world. A person does not leave the material domain when thinking, nor enter the conscious domain by moving elsewhere.

A distinction must nevertheless be drawn between physical extension and phenomenal spatiality. A consciously presented visual field may possess apparent depth, direction, distance, position, and form. These phenomenal determinations occur within conscious life. They are not simply identical with the measured spatial extension of the neural processes upon which they depend.

The distinction does not establish that phenomenal space is an independently existing immaterial region. Nor does it deny that changes in neural organization affect spatial experience. It states only that the spatial character of a presented object and the public physical geometry of its embodied conditions belong to different explanatory descriptions.

A neuroscientific account may localize enabling processes, map representational organization, and identify causal dependencies. It does not thereby measure conscious presence as another extended physical object situated beside the neural processes. Physical localization of conditions is not identity with the conditioned conscious state.

The present subsection therefore advances a restricted conclusion. Spatiotemporal extension is a criterion of material operation. It is not a complete definition of consciousness, and it does not justify the reduction of phenomenal spatiality to public physical geometry.

The relation between spacetime and the virtual world-ground must be controlled equally carefully. Spacetime belongs to *determinate physical actuality*. The world-ground concerns the *virtual possibilities* of further actualization. The latter is not an empty spatial container extending beyond the actual universe, nor a timeless region holding every possible spacetime.

Primordial matter consequently does not designate a primordial spacetime substance. It names the speculative potential for energetic actualization. Whether familiar spacetime is fundamental to every possible physical actualization or arises only within determinate physical regimes remains a scientific and cosmological question.

The question of the beginning of spacetime must therefore be restricted. A cosmological model may describe a finite past boundary, an initial singularity within a classical extrapolation, or an early physical regime in which conventional spacetime differs radically from its later form. Such results concern the history and structure of the observable universe under a determinate scientific model. They do not establish a transition from absolute nothingness to actuality.

‘Before’ and ‘after’ already presuppose temporal relations. Absolute nothingness cannot precede spacetime because it contains *no temporal field* in which precedence could obtain. To represent nothingness as lasting before spacetime begins would transform it into a temporally extended state and therefore into something determinate.

Nor would the beginning of one physical spacetime establish the beginning of every possible actuality or of the virtual world-ground. The world-ground is not a

physical region existing before conventional spacetime. It is the modal aspect of the world-system considered according to available possibilities of further formation.

Questions concerning a finite cosmic past, a pre-geometrical physical regime, cyclic cosmology, or the emergence of conventional spacetime belong to metaphysical cosmology. General metaphysics should provide the conceptual distinctions required for these inquiries without deciding them in advance.

The same caution applies to claims that spacetime emerges from a more fundamental physical structure. Such proposals may become scientifically fruitful. Emergence, however, does not mean appearance from absolute nothingness. Whatever physically conditions the emergence must possess determinate relations, structures, or possibilities, even when these are not adequately described through familiar spacetime concepts.

The phrase emergence of spacetime therefore cannot by itself explain the origin of actuality. It identifies a possible relation between physical regimes. It does not explain *why* there is a world-system or establish an independently existing pre-spatiotemporal ground.

Effective field theory reinforces this epistemic restraint. General relativity can be treated successfully as an effective field theory within accessible regimes without thereby providing a complete theory of every scale or physical condition (Donoghue, 1994). Scientific adequacy within a domain does not convert one geometrical model into the final ontology of reality-as-such.

The matter-operator must therefore always remain *open to scientific revision*. Its criterion does not depend upon one immutable geometry, one fixed inventory of spacetime entities, or one completed theory of quantum gravity. It requires only that material operation become *physically* realized through determinate extensive and interactional *relations*.

This requirement does not dictate what future physics must call 'spacetime.' Familiar geometrical concepts may remain fundamental, become approximate, or be reconstructed through another physical architecture. General metaphysics must follow valid science in determining which relations count as physically basic while retaining the distinction between scientific description and metaphysical interpretation.

Spacetime, extension, and physical actuality are thus inseparable but non-identical. Spacetime names the organized extensive relations of physical processes. Extension names their non-point-like spatial and temporal articulation. Physical actuality names the realized efficacy operating through these relations.

None is self-sufficient. Spacetime without physical actuality would be an uninstantiated abstraction. Physical actuality without determinate extensive relations would lack physical location, duration, causal accessibility, and interactional structure. Extension without organization would identify no definite interval, region, trajectory, or physical process.

Nor does their conjunction form a substance. Spacetime is not an entity containing extension and physical actuality as properties. The three terms distinguish related

aspects of one physical process. Their conceptual separation serves explanation without establishing independent existence.

Ultimate analysis applies to each. Spacetime cannot be found as a self-existing container. Extension cannot be isolated as an inherent essence possessed by physical objects from their own side. The actual occasion cannot be established as a self-grounding metaphysical atom existing independently of its conditions, relations, operations, and designation.

Their lack of inherent existence does not eliminate their conventional and functional reality. Physical systems possess measurable distances and durations. Events display causal relations. Bodies follow trajectories. Clocks register differential temporal intervals. Spacetime geometry enters successful physical explanations. Actual occasions are proposed as differentially extensive units through which such determinations become concrete within the metaphysical scheme.

The scientific verdict is therefore strong but restricted. Relativity rejects absolute space, universal time, and one privileged simultaneity while treating spacetime geometry as physically consequential. It does not uniquely establish relationalism, process metaphysics, or the differential-extensive actual occasion.

The immanent-metaphysical verdict is correspondingly qualified. Spacetime may be critically understood as the *organized extensive relation of physical actualities* rather than as an *absolute receptacle* or independent substance. The differential-extensive actual occasion provides a coherent unit of physical actualization, provided 'dt' remains local, non-zero, variable, scientifically undetermined, and free from any claim to represent an experimentally discovered quantum of time.

Physical actuality does not occur *inside* spacetime as an actor upon an empty stage. Physical processes constitute the activity, while spacetime articulates the *extensive relations* through which that activity becomes determinate. These constrain but need not *completely* determine what becomes actual.

The next subsection therefore examines probability and the qualified relation between quantum determination and actualization.

5. Probabilistic Determination and Quantum Actualization

Classical determinism holds that a complete specification of a physical system at one time, together with the laws governing it, determines its later physical states. The future may remain practically unpredictable because the initial conditions cannot be measured with *unlimited precision* or because the system is highly complex. Such ignorance does not alter the deterministic structure attributed to the process. One physically possible future follows from the *fully specified* antecedent state.

Quantum theory does not preserve this universal classical picture. Its formalism represents physical states, observables, dynamical transformations, and probabilities associated with possible measurement outcomes. In the standard mathematical treatment, the quantum state may evolve continuously and deterministically according to its dynamical equation, while the outcomes

registered in measurement are governed *probabilistically* (square of the modulus of the quantum state's amplitude or $|\psi|^2$ – the Born rule). Quantum theory therefore does not simply replace every form of determination with *unrestricted* chance. It joins tightly constrained state-evolution with a probabilistic relation between the *quantum state* and *possible results* (von Neumann, 1955).

The quantum state does not assign equal probability to everything conceivable. The range of admissible outcomes and their relative weights depend upon the prepared state, the observable involved, the dynamics, the experimental arrangement, and the physical interactions through which a result can be produced. Quantum probability is therefore *structured determination* rather than the absence of determination.

Probabilistic determination may be defined as follows :

Probabilistic determination occurs when antecedent physical conditions specify a structured range of possible outcomes and their probabilities without, within the relevant theoretical description, specifying one unique later outcome.

The definition concerns the relation between antecedent conditions and possible results. It does not imply that the process is uncaused, lawless, or independent of physical conditions. The probability distribution is itself determined by the relevant state and theoretical structure. An outcome falling outside the permitted range would not represent freedom from determination but a failure of the theory or of its application.

The distinction between *deterministic* and *probabilistic* determination must also be separated from the distinction between predictability and unpredictability. A deterministic system may be practically unpredictable because of sensitivity to initial conditions, computational limitations, incomplete measurement, or complex interactions. Conversely, a probabilistic theory may make exceptionally accurate predictions concerning statistical distributions across repeated trials.

Predictive precision at the statistical level does not establish that each *individual* result was predetermined by local or non-contextual *hidden variables* representing pre-existing classical properties. Nor does uncertainty concerning one result establish the *complete absence* of physical determination. The scientific question concerns which structures, states, and variables the theory requires. The metaphysical question concerns *what kind of actuality* these structures represent.

Classical probability is often *epistemic*. A tossed coin is represented probabilistically because the relevant initial conditions and forces are not fully known or calculated. The probability expresses *limited knowledge* of a process presumed to possess one determinate trajectory. Quantum probability cannot be reduced to this classical model without introducing an interpretation or additional variables not contained in the minimal predictive formalism.

It does not follow that quantum probability has been scientifically established as a self-existing objective ingredient of the world. The mathematical probabilities are indispensable to the theory's predictions. Their ontological meaning remains

contested. They may be interpreted as objective chances, dispositions, relational features, branching weights, expressions of incomplete information, or consequences of a more comprehensive underlying structure.

No consensus interpretation converts the successful quantum formalism into one uncontested account of what exists and how determinate outcomes occur. The present scheme therefore *avoids* the unqualified expression ‘objective probabilism.’ Quantum theory establishes the objective validity of probabilistic predictions under *specified conditions*. It does not by itself establish probability as an independently existing constituent *acting upon* physical actuality.

Probability is not a force. It does not push a system toward one result, choose among alternatives, or supply an additional quantity of energy. A numerical probability characterizes the *structured relation* between a state, an experimental context, and possible outcomes. Treating probability as an agent would reify a theoretical relation into a cause.

Chance requires the same restriction. To call an event ‘a chance event’ may mean that the theory assigns several possible outcomes and does not determine which one will occur in a particular trial. Chance does not thereby become an *operator* producing the result. The physically achieved outcome still arises through determinate states, interactions, couplings, and conditions.

Something may be logically conceivable without being physically permitted by a quantum state. An outcome represented within the wider formal space may receive zero probability under a particular preparation, while another may become unavailable under a different experimental arrangement. Logical conceivability, formal representability, and physical admissibility must therefore be distinguished.

Quantum possibility is therefore *theory-relative* and *condition-dependent*.

A quantum superposition must not be represented as a collection of classical alternatives all existing simultaneously in the same manner. Superposition belongs to the *mathematical structure* of the quantum state and permits interference among components of that state. The manner in which these components correspond to physical actuality depends upon the *interpretation* adopted.

The claim that a particle is literally in every classically imaginable state at once is consequently too crude. So is the contrary claim that the quantum state merely records ignorance concerning one fully determinate but concealed classical state. Both formulations add an ontology to the formalism. Quantum theory constrains possible interpretations without eliminating their plurality.

The Kochen-Specker theorem strengthens this caution. It shows that quantum observables cannot, under the relevant assumptions, all be assigned determinate pre-existing values independently of the measurement context while preserving the functional relations required by the theory. The theorem restricts non-contextual hidden-value models. It does not establish that consciousness creates physical properties or that nothing exists before observation (Kochen & Specker, 1967).

Contextuality means that the value attributed to an observable cannot always be understood as one intrinsic classical property possessed independently of the

compatible measurements and physical arrangement through which it becomes determinate. This weakens the unrestricted classical picture of a physical object carrying a complete inventory of context-independent properties.

It does not abolish physical actuality. A quantum system possesses a determinate state, enters interactions, produces correlations, and contributes to experimental effects even when the theory does not assign one classical value to every possible observable. The absence of a complete classical property catalogue is not the absence of material operation.

Probability must be distinguished even more sharply from virtuality. A quantum probability distribution is formulated within a determinate physical theory. It concerns a specified state, a defined range of observables or outcomes, and a physical or experimental context. Its mathematical structure permits quantitative prediction and empirical testing.

The virtual world-ground has another scope and epistemic status. It is an immanent-metaphysical articulation of the formative possibilities of the world-system. It is not a quantum state, wave function, probability distribution, Hilbert space, or physical vacuum. No experiment measures the virtual world-ground or assigns numerical probabilities to its possibilities.

Quantum probability is therefore one scientifically defined mode in which *physical alternatives are represented*. Virtuality concerns the more comprehensive metaphysical possibility of further actualization. The former may contribute to reflection upon the latter, but it cannot be identified with it.

Not every metaphysical possibility has a quantum probability. Nor does every component of a quantum state correspond to a distinct possibility already contained in the virtual world-ground as a separately existing object. The world-ground is *not a warehouse* of preformed outcomes awaiting physical selection.

The same restriction applies to potentiality. Potentiality must not be reified as a half-actual substance occupying a region between non-existence and actuality. A possible outcome functions as possible *relative to determinate conditions*. Once one outcome is achieved, the alternatives remain relevant as excluded possibilities of that situation, not as hidden actualities continuing beside it.

Whitehead's treatment of potentiality and determination supplies a metaphysical comparison. He understands the individuality of an actual entity through limitation : the attainment of one determinate unity excludes other possible determinations. Concrescence eliminates indetermination and reaches satisfaction through a decision by which one concrete actuality is achieved (Whitehead, 1978, pp. 44-48, 149-150).

This offers a structural analogy with quantum outcomes. In both schemes, a *plurality* of *possible* determinations is related to *one achieved result*. Yet the analogy must be controlled. Whitehead's potentialities are not quantum probabilities. His actual occasions are not wave functions, and his account of decision is not the physical theory of measurement.

The phrase 'quantum actualization' may nevertheless be retained within the present metaphysical vocabulary, provided it is explicitly restricted :

Quantum actualization denotes the production of a determinate physical outcome represented within quantum theory in relation to a structured range of permitted or weighted alternatives.

The phrase does not name an additional quantum force or a technical process accepted under that name by every interpretation. It coordinates the contrast between a theoretically represented range of possible outcomes and the occurrence of a determinate physical result.

Actualization must first be understood materially. An outcome becomes physically actual by entering determinate interactional relations and producing physical consequences. In an experimental context, these consequences may become stabilized as a detector event, mark, pointer position, electronic signal, image, numerical record, or another publicly accessible result.

The physical outcome should not be confused with the later *human recognition of the outcome*. A detector may register an event *before* any person examines the record. The production of a physical result belongs to material operation. The organization and retention of *distinguishable records involve information*. Their conscious apprehension and interpretation belong to individualized consciousness.

The word ‘registered’ must therefore *not* imply that physical actuality begins only when a human observer becomes aware of it. Registration means that the interaction has *produced a sufficiently determinate physical difference* capable of *entering further physical and informational processes*. The relation between observation, measurement, and conscious awareness will be examined in the next subsection.

Quantum actualization must also remain neutral concerning the collapse of the wave function. In interpretations employing physical or formal state reduction, a determinate result is associated with collapse of the quantum state. In no-collapse interpretations, all components may remain within the more comprehensive state while determinate outcomes are understood *relative to branches, relations, or observers*. Hidden-variable approaches supplement the quantum state with further variables, while other reconstructions alter the dynamics or the interpretation of physical states.

These approaches do not agree on whether a literal collapse occurs, whether the evolution is fundamentally deterministic, whether probabilities describe objective chances, or how the definiteness of outcomes should be understood. The term ‘quantum actualization’ must therefore refer to the *production of determinate physical results* without deciding these controversies by definition.

The distinction is especially important because the standard formalism combines two apparently different kinds of description. The quantum state undergoes continuous dynamical evolution, while measurement is associated with determinate outcomes and probabilistic weights. The problem is not merely that the result was unknown. It concerns how the *theoretical* representation of *alternatives* relates to the *definite* physical result.

The measurement problem cannot be solved merely by renaming the transition actualization. The new term identifies the philosophical issue but does not provide

a physical mechanism. A metaphysical vocabulary becomes inadmissible if it presents itself as a scientific solution while adding no testable difference to the theory.

Quantum actualization is therefore an interpretive coordination, not a completed theory of measurement. It identifies a feature the metaphysics must accommodate : physical inquiry produces determinate records even though the quantum formalism represents structured *alternatives* and does not receive *one* universally accepted ontology.

The achieved outcome is not the creation of physical actuality from nothing. Before the outcome, a physically realized state and experimental arrangement *already exist*. Fields, systems, apparatus, interactions, and boundary conditions are actual and efficacious. What becomes determinate is a *particular* outcome within this organized physical situation.

Nor does the result transform a mathematical abstraction into matter. The mathematical state is a scientific representation of the physical system. Its relation to physical actuality remains theory-dependent. A detector event does not cause a previously unreal mathematical object to become material. It produces a new physical determination represented through the theory.

This distinction corrects the older claim that ‘measurement makes particles real.’ A measurement can produce or register particle-like events under a particular arrangement. It does not follow that *nothing* physical existed *before* measurement or that human consciousness *summoned* a particle into existence.

Quantum actualization is consequently conditioned on both matter and information. Material operation provides the physical state, interactions, apparatus, energetic exchanges, and realized effect. Informational operation contributes the differentiated structure of the state, observable, constraints, possible outcomes, and record. The outcome is neither formless physical efficacy nor disembodied information.

This conjunction must not be overstated. The scientific formalism does not classify its components as *manifestations* of two metaphysical operators. Physics investigates states, observables, probabilities, interactions, and records. Their interpretation through energetic efficacy and formative organization belongs to the present metaphysical synthesis.

The probabilistic character of quantum prediction also does not establish final determination. The fact that antecedent physical conditions do not, within a given formulation, select *one* classically *unique result* does not show that another metaphysical operator chooses the result. A gap in efficient specification is not evidence for a hidden act of final causation.

The present metaphysics proposes independently that actualization involves efficient inheritance and final determination. Efficient determination supplies the achieved conditions received from the antecedent world. Final determination concerns the particular integration through which one new actuality becomes complete.

Quantum probability may be consonant with this distinction because it permits antecedent physical conditions to structure several possible outcomes *without*

representing *one unique result* as classically fixed. It does not prove that the resulting determination occurs through a Whiteheadian decision, subjective aim, valuation, or sentient selection.

Consonance concerns compatibility of structures. Both accounts reject the unrestricted thesis that every actual outcome must be completely represented as the mechanical continuation of independently possessed classical properties. This shared rejection does not establish identity between their concepts.

The metaphysical scheme may state that probabilistic determination is compatible with its independent distinction between efficient and final determination. It may not infer final determination from quantum indeterminacy or claim that quantum probability scientifically detects final causation. The former is an immanent-metaphysical interpretation. The latter would be an illicit conversion of interpretive compatibility into scientific confirmation.

Novelty must likewise be distinguished from randomness. A random result is not novel merely because it was unpredictable. It may be a routine member of a familiar statistical distribution. Conversely, a highly organized and historically unprecedented structure may arise through processes whose local dynamics are largely deterministic.

Novelty concerns the achievement of a *non-identical actuality* whose determinations were *not* previously actual *in that conjunction*. Randomness concerns the probabilistic relation between antecedent conditions and outcomes. The concepts may intersect, but neither defines the other.

A stochastic event is also not a choice. Choice requires a subject capable of apprehending alternatives, valuing them, forming intent, and assuming a direction. These are developed operations of individualized consciousness. A quantum event displaying several possible outcomes is *not* thereby an agent deliberating among them.

The term ‘decision’ requires similar discipline. Whitehead uses decision in a broad metaphysical sense of limitation and achieved definiteness. In ordinary psychological and ethical discourse, decision implies conscious consideration and choice. The two meanings must not be silently exchanged.

An elementary actual occasion may, within the present metaphysical scheme, possess final determination without engaging in individualized deliberation. Its finality concerns the attainment of *one determinate actuality*. It does not entail representation of alternatives, reflective judgment, intention, or freedom-in-immediacy in the personal sense.

Quantum indeterminacy therefore supplies no scientific evidence that electrons, fields, particles, detector events, or elementary actual occasions *understand* alternatives or *select* among them *consciously*. The panexperiential hypothesis must stand on its own metaphysical argument and remains untestable as a metaphysical totalization. Quantum probability, indeterminacy, measurement, Bell correlations, complexity, and information do not confirm infinitesimal consciousness. The distinction protects both consciousness and physics. It prevents the complex operations of individualized consciousness from being

projected onto elementary processes. It also prevents unresolved quantum questions from being prematurely answered through mentalistic vocabulary.

Freedom cannot be derived from indeterminacy. If an action were produced merely by an undirected random fluctuation, this would not make it more attributable to the person. Personal freedom requires that an act express intent, valuation, ownership, and the subject's relation to the immediate situation. Randomness can interrupt determination *without* supplying agency.

The metaphysical interpretation of elementary finality is therefore *weaker* than the attribution of choice. It states that every actualization reaches a determinate outcome not exhausted by abstract description of its antecedent multiplicity. Whether this finality has a sentient aspect belongs to the panexperiential thesis, not to quantum physics.

The relation between quantum actualization and the actual occasion must consequently be stated with precision. The two concepts are not numerically identical. A quantum outcome is a scientific object represented through a physical theory and established through determinate experimental procedures. The actual occasion is an immanent-metaphysical unit proposed to interpret concrete actualization generally.

One detector event need not correspond to exactly one actual occasion. It may involve a highly organized sequence or society of physical processes. Conversely, an actual occasion need not correspond to an experimentally isolated quantum transition. The metaphysical and scientific units possess different criteria of individualization.

The wave function ψ is not the subjective pole of an occasion. The possible measurement outcomes are not eternal objects. Probability weights are not valuations. Collapse is not concrescence, and the measuring apparatus is not the occasion's subjective aim.

Such identifications would confuse formal, experimental, and metaphysical categories. They would also make the ontology depend upon one disputed interpretation of quantum mechanics. The actual occasion must remain intelligible whether future physics retains, revises, or replaces the present formalism.

The legitimate analogy is more restricted. Quantum *theory* represents a physical situation through a *structured multiplicity* of permitted or weighted outcomes, while *experiment* yields *determinate physical results*. Process metaphysics understands actuality as the integration of inherited conditions and possibilities into one achieved determination. Both concern a relation between multiplicity and definiteness.

Whitehead characterizes decision as the limitation through which potential indetermination becomes the definiteness of one actual entity. He also distinguishes the efficacy of the achieved past from the final determination internal to the new concrescence (Whitehead, 1978, pp. 44-48, 86-88). This structure informs the present metaphysics. Quantum theory does not contain that complete structure. It supplies no scientific concept equivalent to subjective aim, satisfaction, final causation, or infinitesimal consciousness. The analogy therefore supports philosophical construction without supplying empirical proof.

The differential-extensive occasion must be protected by the same qualification. Quantum theory does not identify an experimentally discovered interval 'dt' corresponding to one actual occasion. A state transition, interaction vertex, detector event, or collapse cannot simply be assigned this metaphysical status.

The scheme proposes that every physically determinate outcome becomes actual through differential-extensive actualization. This proposition belongs to immanent metaphysics. Its admissibility depends upon coherence, consistency with science, explanatory value, and freedom from reification. It is *not* directly tested by quantum experiments.

Quantum theory is therefore consonant with the rejection of *classical substantialism*. It does not require physical systems to possess complete, context-independent inventories of classical properties. It represents physical relations, superpositions, probabilities, transformations, and outcomes whose meanings depend upon a broader theoretical and experimental structure.

It is also consonant with resistance to *universal deterministic closure*. The standard predictive structure does not determine one unique result in the classical manner. Yet quantum theory as such does not prove universal ontological indeterminism, because interpretations differ concerning the underlying dynamics and the status of outcomes.

The critically admissible conclusion lies between two exaggerations. Quantum theory does not restore the classical world as a set of self-contained substances possessing every property independently. It also does not establish a universe in which consciousness, free choice, or metaphysical creativity produces physical outcomes.

Its strongest implication is more restrained. Material determination can be exact, law-governed, and empirically successful *without* taking the form of one completely specified classical trajectory. Energetic efficacy can be probabilistically structured without becoming arbitrary or uncaused. Probabilistic determination modifies but does not abolish efficient determination. The antecedent state, dynamics, interaction, and experimental arrangement continue to constrain what can occur and with what probabilities. The achieved result enters the settled physical world and becomes an efficient condition for later processes.

Once actualized, the outcome is no longer one merely weighted alternative relative to that event. It has produced *determinate consequences*. A detector has fired, a trace has formed, a state has changed, or another physical difference has entered the history of the system. The result thereby *acquires material efficacy*.

The alternatives not actualized in that result must *not* be treated as physical substances surrounding it. Their status depends upon the interpretation of the quantum state. For the present metaphysics, it is sufficient that one achieved actuality excludes other determinations from being this actuality. This exclusion is not annihilation of entities that previously existed from their own side. It is determination. The actuality *becomes what it is* through the non-identity between its achieved constitution and the alternatives not instantiated in it.

Ultimate analysis applies to the quantum state, probability, outcome, measurement arrangement, and actual occasion alike. None possesses inherent existence. The

quantum state is defined through a formalism, preparation, relations, and interpretive use. An outcome depends upon physical interactions and conditions. Its identification depends upon measurement, theory, and publicly regulated judgment.

Their lack of inherent existence does not abolish their functioning. Quantum states support exact predictions. Probabilities constrain expectations. Interactions produce determinate records. Physical outcomes enter later processes. Scientific inquiry tests and revises its models through their agreement or conflict with these results.

The final metaphysical verdict is qualified. Quantum theory permits a conception of matter in which antecedent conditions probabilistically structure physical outcomes without always specifying one unique classical continuation. This is compatible with process, relation, non-substantiality, and the distinction between efficient inheritance and final determination.

It does not prove the actual occasion, concrescence, final causation, panexperientialism, freedom, or conscious selection. Quantum actualization remains a critically regulated interpretive term for the *attainment of determinate physical outcomes within a probabilistically structured field*.

Matter is not rendered unreal by probability. Its efficacy is displayed precisely when one physically realized outcome *enters* the world and *changes* what can follow.

6. Observation and Physical Reality

A measurement event is an *organized physical interaction* through which a process becomes correlated with an apparatus and produces a sufficiently stable and discriminable record. It requires material coupling and informational differentiation. A scientific measurement procedure includes more : a normative and conceptual framework specifying what is being measured, which physical distinctions count as possible results, how the apparatus is calibrated, and under which conditions the resulting record may function as evidence.

Observation is therefore not passive inspection. The scientific observer does not occupy a standpoint *outside* the physical world from which nature can be surveyed *without* interaction. The preparation of the system, construction and calibration of the apparatus, selection of the observable, mode of intervention, conditions of registration, and criteria used to distinguish signal from noise *all participate in determining which scientific object can become manifest*.

This dependence upon experimental conditions is not peculiar to quantum theory. A telescope, microscope, spectrometer, thermometer, particle detector, or imaging system makes selected physical differences accessible while remaining insensitive to others. Every instrument possesses a *determinate response range*, resolution, sensitivity, threshold, and error structure. Measurement always occurs through an apparatus whose physical and informational organization selects and transforms what can become a record.

Quantum measurement gives this general condition exceptional formal and philosophical importance. The observable being measured cannot always be treated as a *pre-existing* classical property *simply revealed* by an otherwise ‘neutral’ apparatus. The preparation and measuring arrangement *help define which physical distinction can become determinate in the experiment*. The observable, apparatus, and interaction cannot therefore be separated without remainder.

The term ‘observer’ has several meanings that must be distinguished. It may refer to an individualized conscious subject conducting or interpreting an experiment. It may refer to a detector or recording system that interacts with the process. It may identify an idealized frame of reference within a physical model. It may also indicate the position from which a particular set of variables is mathematically represented.

These meanings are *not* interchangeable. A detector is not a conscious subject merely because a scientific description calls it an observer. A reference frame does not possess awareness. An automated system can register, store, and transmit a result without understanding it. Conversely, a conscious scientist does more than function as *another physical detector*. The scientist formulates the question, selects the experimental arrangement, interprets the record, evaluates its evidential force, and incorporates it into an arguable account.

The ‘technical’ observer therefore need not be conscious. A detector, photographic plate, computer-controlled apparatus, environmental interaction, or another physical recording system can perform the operative role assigned to observation within a physical theory. A conscious subject becomes indispensable where a scientific question is posed, an apparatus is intentionally constructed or selected, a result is read as evidence, and a judgment concerning its meaning and validity is made.

These roles occur in different registers. The conscious subject is normatively indispensable to science but need not be introduced as an *additional* physical cause within the measured process. Subjectivity establishes the question, purpose, conceptual articulation, and evidential interpretation of the experiment. The apparatus realizes this organization physically. The interaction between system and apparatus produces the record.

The relation can be expressed through three moments. *Before* the experimental run, the scientist determines what is to be investigated and which arrangement will make the relevant physical differences measurable. *During the run*, the system, apparatus, and environment interact according to their physically realized conditions. *After the run*, the resulting records are classified, interpreted, compared with theoretical expectations, and evaluated by one or more conscious subjects.

These moments are analytically distinguishable without always being chronologically isolated. Contemporary experiments may involve continuous monitoring, adaptive control, automated analysis, and feedback. The crucial distinction nevertheless remains. The subject’s intention becomes scientifically consequential only when it is embodied in a materially realized and informationally organized experimental arrangement.

A thought that remains unexpressed and unimplemented makes no difference to a quantum system. Deciding to measure which path a particle takes acquires physical efficacy only when detectors, fields, shutters, beam splitters, polarizers, or other components are arranged so that the path alternatives become differently correlated with physically distinguishable states. The subject's conscious choice determines the *experimental question*. The apparatus-system interaction determines how that question becomes *physically instantiated*.

This distinction prevents two opposed errors. The first reduces observation to a wholly observer-independent physical process and overlooks the transcendental and normative conditions through which anything becomes an object of scientific inquiry. The second converts the subject's indispensable epistemic role into an additional physical force and makes consciousness responsible for producing the experimental result.

The double-slit experiment illustrates the distinction. When particles are sent through an arrangement containing two open slits and no physically effective path marking, the accumulated records may display an interference pattern. The resulting pattern cannot be reconstructed by treating each particle as following an independently specified classical path through one slit while the alternative slit and wider experimental arrangement are physically irrelevant. Interpretations retaining determinate trajectories require additional, non-classical relational or dynamical structure. When the apparatus is altered so that path information becomes physically distinguishable, the interference pattern disappears. The crucial change does not consist in a human subject looking at the apparatus. It consists in the physical interaction through which the path alternatives become correlated with distinguishable detector or environmental states.

The *arrangement* capable of registering path information differs physically from the *arrangement* preserving interference. The alternatives are no longer combined in the same manner because the system has become entangled with states carrying path-related distinctions. As path-related states become physically distinct, their coherent contribution to the same interference pattern is reduced and, in the ideal limit of complete distinguishability, eliminated.

No person needs to inspect the stored path information *while the experiment is occurring*. The record may be produced, retained, and erased without being consciously read. Whether interference is preserved depends upon the physical organization of the experiment and the distinguishability of the relevant alternatives, not upon the later occurrence of human awareness.

This point corrects the popular statement that a particle behaves as a wave when nobody watches and becomes a particle when observed. The decisive contrast is not between conscious looking and the absence of conscious looking. It is between physical arrangements *preserving* coherence and arrangements *establishing path distinguishability*.

The conscious observer remains relevant. A subject or research community *decides* which question to pose, *which* apparatus to realize, *what* counts as path information, and *which* pattern will be treated as evidence. Yet this relevance is intentional and normative. It must not be redescribed as a mental force *causing* the disappearance of interference.

Bohr's principle of complementarity emphasizes that different experimental arrangements permit the manifestation of different, mutually exclusive aspects of quantum phenomena. An arrangement disclosing interference is not simultaneously an arrangement supplying determinate path information under the same conditions. The phenomenon includes the conditions under which it is observed rather than consisting of a self-contained classical object whose complete properties are merely exposed by the apparatus (Bohr, 1928).

Complementarity must not be inflated into ontological idealism. The dependence of the scientific phenomenon upon the measuring arrangement does *not* entail that consciousness *creates* physical reality. It establishes that the scientific object cannot always be detached from the material interaction and conceptual organization through which it becomes experimentally determinate.

The apparatus does *not* freely construct any result whatsoever. Once the arrangement has been realized, the physical state, interactions, geometry, couplings, boundary conditions, and statistical structure *constrain* the possible records. The scientist can choose *which* experiment to perform but cannot choose which individual result will occur *merely by preferring it*.

The experimental choice *opens a restricted field of possible results*. It does not *command* nature to produce one selected member of that field. The apparatus defines which distinctions can become measurable ; the physical interaction supplies the determinate event and the outcome statistics.

The older statement that 'the observer makes particles real' is therefore too strong. Measurement does not create physical actuality from absolute nothingness. Before measurement, a physically realized system, apparatus, environment, and field of interaction *already exist*. What measurement produces is a new determinate physical relation and, under appropriate conditions, a stable record of that relation.

Before measurement, quantum theory may not assign the measured observable one determinate classical value. It does not follow that nothing physically exists. The absence of one pre-existing classical property is not the absence of physical actuality. Fields, states, probabilities, correlations, and interactional capacities remain physically consequential even where the formalism does not permit every possible observable to possess one context-independent classical value.

What physically exists before measurement and how the state should be interpreted depend upon the interpretation of quantum theory. Collapse theories, no-collapse theories, hidden-variable approaches, relational interpretations, and other reconstructions differ concerning the ontology of the state and the production of determinate outcomes. Measurement cannot be used to establish one of these interpretations merely by restating the formalism in metaphysical language.

Von Neumann's formal treatment sharpened the measurement problem by distinguishing the continuous evolution of the quantum state from the projection associated with a determinate result. If the apparatus is included within the quantum description, the interaction correlates possible system states with different apparatus states. The boundary between system and apparatus can then be moved along a measurement chain without the formalism itself identifying one

uncontested physical location at which a unique outcome becomes actual (von Neumann, 1955). However, the measurement chain does not automatically end in consciousness. One may extend the physical description from the system to the detector, from the detector to the recording device, and from the recording device to the environment. The fact that a conscious subject eventually experiences or interprets one result does *not* establish that consciousness *supplied* the *physical transition* producing it.

The consciousness-causes-collapse hypothesis turns the conscious subject into the dynamical terminus of the measurement chain. According to this proposal, the quantum state remains in superposition *until* awareness of the result occurs. The conscious act would then *produce* or *complete* the reduction to one outcome.

This hypothesis has no established experimental necessity. Physical records can be produced, amplified, stored, and distributed *before* any person becomes aware of them. Experiments yield the same statistical results when the apparatus operates automatically and its records are examined only later. Conscious observation is therefore *not* required as an *empirically detected trigger* of the physical interaction.

The hypothesis also conflates two distinct necessities. A scientific result must eventually enter consciousness if it is to become understood, judged, argued, or incorporated into knowledge. It does not follow that conscious understanding must *physically generate* the result understood. The first claim is transcendental and epistemic. The second is causal and belongs to physics. The former does not establish the latter.

Decoherence clarifies this distinction. A measuring apparatus is not isolated from its environment. Its possible states interact with innumerable environmental degrees of freedom. Through these interactions, different components of the quantum state *become correlated* with effectively distinguishable environmental states. Interference among the macroscopically relevant alternatives then becomes rapidly inaccessible in the reduced description of the apparatus.

Mathematically, the reduced density matrix becomes approximately diagonal in a dynamically selected basis. Stable or robust pointer states emerge because some apparatus states *retain* their correlations under environmental interaction *more successfully than others*. Decoherence thereby explains why macroscopic records behave *as though* they belonged to a restricted set of *classical* alternatives rather than continuing to display observable interference among every component of the quantum state (Zurek, 2003).

Decoherence is a physical process. It depends upon system-apparatus-environment interaction, *not* upon the occurrence of conscious awareness. It can take place *before* anyone *inspects* the record, and its rate depends upon physical parameters such as coupling strength, temperature, environmental complexity, and the distinguishability of the relevant states.

Decoherence therefore explains why interference becomes effectively suppressed and why stable classical-looking records emerge. It also explains why macroscopic superpositions are extremely difficult to observe under ordinary environmental conditions. These achievements are substantial.

It does not by itself resolve every form of the measurement problem. The reduced density matrix may become indistinguishable for practical purposes from a statistical mixture, but the global quantum state may still contain the correlated alternatives. Decoherence explains the loss of observable coherence relative to a subsystem. Whether it also explains why *one determinate outcome* occurs depends upon the interpretation adopted (Schlosshauer, 2007).

The distinction may be expressed by saying that decoherence explains why the alternatives cease to interfere in ordinary observation without necessarily explaining why this particular alternative becomes the sole achieved result. Collapse, branching, hidden variables, relational definiteness, or another interpretive account may still be invoked to address the relation between the global state and the definite record.

Metaphysics should not declare solved what physics continues to dispute. It may use decoherence to reject the claim that conscious looking is needed to suppress interference. It may not present decoherence as an uncontested account of the occurrence of one unique outcome.

The same restraint applies in the opposite direction. The persistence of interpretive disagreement does not provide evidence that consciousness must complete the physical process. A gap between decoherence and one interpretation of definite outcomes cannot be filled merely by inserting awareness as a causal agent. The present scheme therefore assigns consciousness *no special physical role in quantum measurement*. Consciousness does not supply energy, alter the wave function through awareness, or intervene as a force outside the organization of the apparatus. Where a scientist's intention changes the physical experiment, it does so through *embodied action and materially realized informational organization*.

The scientist *selects* an arrangement, *adjusts* instruments, *sets* thresholds, activates detectors, and *initiates* procedures. These actions *alter* the physical conditions under which the process occurs. Conscious intent is causally relevant through its embodiment in organized material operations, not through an unmediated *mental influence upon the quantum state*.

The distinction exemplifies the conjunction of the three operators. Material operation supplies the coupling among system, apparatus, recording medium, and environment. Informational operation supplies the differentiated architecture through which alternative physical states become correlated with distinguishable records. Individualized consciousness supplies the intentional question and the later *understanding, evaluation, and use* of the result.

The conjunction is not a *chronology* in which consciousness first chooses, information next organizes, and matter finally acts as three independent agents. The subject's choice is already embodied and informationally articulated. The apparatus is materially realized and formally organized. The result becomes scientific knowledge only when the record enters a conscious and norm-governed practice of interpretation. Measurement may consequently be analyzed under two inseparable but non-identical aspects. It is a *physical event* producing a record, and it is an *epistemic procedure* through which that record becomes *evidence*.

As a physical event, measurement involves interaction, amplification, stabilization, retention, and possible transmission. The result must make a material difference. A detector changes state, a mark appears, a current flows, a pixel is activated, a pointer shifts, or another physically distinguishable condition is produced.

As an informational event, measurement establishes a correlation among states and differentiates one record from other possible records. The apparatus must possess an organization capable of mapping relevant variations in the measured process onto distinguishable physical states. A device producing the same output under every condition would not measure the selected variable.

As an epistemic procedure, measurement belongs to a normative practice. The apparatus must be calibrated, the variable operationally defined, errors estimated, controls established, records classified, and results subjected to intersubjective criticism. A physical mark becomes scientific data only through its place within this regulated organization.

Data do not interpret themselves. A sequence of detector outputs becomes evidence only relative to a hypothesis, model, background theory, experimental design, and inferential rule. The same physical record may bear upon different questions when embedded in different theoretical and experimental contexts.

This contextual dependence does not make evidence arbitrary. The record resists expectations, and its relations to other records can confirm, disconfirm, or force revision of a theory. Scientific construction is constrained by the physically effective process investigated.

The distinction between *data* and *fact* is therefore important. Data consist of recorded differences selected and organized under experimental conditions. A scientific fact is a critically established judgment concerning what those data warrant within a normative and theoretical framework. Neither data nor fact exists as an uninterpreted copy of reality-as-such.

The fact nevertheless concerns *more* than the conceptual framework. Testing would lose its force if the result were *only* the projection of the scientist's expectations. An experiment can fail, produce an anomaly, resist replication, reveal systematic error, or contradict the prediction. This *resistance* indicates the contribution of an *extra*-mental physical process not determined merely by the concepts brought to it.

Critical realism organizes these two sides. A scientific fact is theory-dependent in its formulation because concepts, instruments, models, classifications, and inferential norms participate in its constitution. At the same time, scientific inquiry must normatively assume that the fact concerns an *extra*-mental process whose efficacy is not created by the theory ; otherwise, facts would be merely mental constructions.

The scientific object is therefore neither a transparent reproduction of reality-as-such nor a free construction. It is a conventionally valid sensate and conceptual object arising through the regulated conjunction of physical resistance, apparatus, formal expectation, interpretation, and intersubjective judgment. This position differs from naive realism. Naive realism assumes that the scientific object

corresponds directly and completely to the physical process as it exists independently of every condition of knowledge. It overlooks the roles of apparatus, theory, sensation, interpretation, and norm-governed judgment.

It also differs from ontological idealism. Ontological idealism converts the dependence of scientific objects upon cognitive and experimental conditions into the dependence of physical actuality upon consciousness. From the fact that no known object is independent of the conditions of knowledge, it infers that no extra-mental actuality exists independently of being known.

That inference does *not* follow. The epistemic dependence of a scientific fact upon the subject and its methods does not establish the *production* of the physical process by consciousness. It converts an epistemic condition into an ontological identity.

The transcendental subject should therefore not be inserted into physical theory as one further causal variable. It establishes the necessary and binding rules under which observation, inference, argument, and judgment count as knowledge. These rules cannot be discovered as one more measured object because they already govern the activity of measurement and scientific justification.

Nor does this transcendental function make the subject a world-producing substance. The subject does not create the extra-mental efficacy encountered through experimentation. It supplies the *conditions* under which that efficacy can become a scientifically known object.

Observation thus has a double dependency. It depends upon the physical process and apparatus that produce a sensible difference, and it depends upon the subject and conceptual organization through which that difference becomes identified and judged. Eliminating either side destroys scientific observation. Without physical resistance, the result becomes an unconstrained construction. Without conceptual and normative organization, the physical trace does not become knowledge.

Intersubjectivity extends rather than eliminates this structure. Scientific publicity does not mean access to objects free from every standpoint. It means that methods, instruments, records, calculations, and judgments can be communicated, criticized, repeated, and assessed by several subjects and research cells under shared rules.

A result is public when it is not confined to the exclusive conscious state of one observer. Its material and informational record can be approached by other investigators. Yet each encounters it through sensation, conceptual interpretation, and judgment. Publicity consists in regulated comparability among situated subjects, not in the occupation of a view from nowhere.

Stable records are crucial to this publicity. A fleeting microscopic interaction becomes scientifically accessible when its effect is amplified, retained, copied, or otherwise incorporated into a persistent physical organization. The detector event may be minute, but the record must enter a route of material and informational inheritance through which later investigators can examine it. Amplification does not make the underlying event more real. It makes its consequences more accessible and robust. A microscopic process may be physically efficacious before

amplification. The apparatus transforms this efficacy into a record capable of entering macroscopic practices of observation.

Objectivity likewise does not require the complete elimination of subjects. It requires that the validity of the result not depend upon the private preference or arbitrary decision of one subject. Instruments are calibrated, procedures standardized, data preserved, and analyses opened to criticism so that the judgment can be warranted *beyond one individual conscious field*.

The observer's freedom is therefore limited but indispensable. The investigator may choose which question to ask, which variables to measure, and which arrangement to realize. That freedom does not extend to *choosing the result*. The physical world answers *within the constraints* of the realized situation.

Different questions can produce different legitimate scientific objects. Measuring path information and measuring interference are not two arbitrary descriptions of an identical classical property inventory. They establish different physical arrangements and make different relations manifest. The plurality of valid objects does not entail that every description is equally valid.

The objectivity of the result lies in the *reproducible relation* among preparation, apparatus, interaction, and record. Under comparable conditions, the relevant statistical structure can be tested by other investigators. Objectivity is relational and normative without becoming merely subjective.

Quantum measurement thereby undermines the ideal of an observation *wholly external* to what is observed. The apparatus participates physically in the process through which the result becomes determinate. This participation does not mean the boundary between system and apparatus is purely imaginary. It means the boundary is *selected* and *justified* relative to the explanatory and experimental purpose. The placement of the boundary may vary. One analysis treats the detector as external to the measured system. Another includes detector and system within a larger quantum description. Both may be scientifically legitimate if their domains, assumptions, and purposes are specified.

No selected boundary can be converted without argument into an absolute division within reality-as-such. The system, apparatus, environment, scientist, and research community belong to one world-system. Their functional differentiation is real and necessary for explanation without implying substantial separation.

The measurement event should also not be identified directly with one actual occasion. An experimental outcome commonly involves a complex sequence of interactions, amplifications, registrations, and retentions. The visible record may belong to an organized society or route of actual occasions rather than to one metaphysically elementary act.

Conversely, an actual occasion need not be an observed detector event. Most physical actualizations are neither isolated nor recorded by scientific apparatus. The actual occasion is an immanent-metaphysical proposal concerning elementary actualization, while measurement events are scientifically constructed objects individuated according to experimental criteria. The structural comparison remains legitimate. Both involve the attainment and transmission of determinate physical conditions. An outcome becomes settled relative to the experiment and

enters subsequent interaction through its record. Yet this resemblance does not establish measurement as a direct experimental observation of concrescence.

Nor does quantum observation prove panexperientialism. The physical interaction of system, apparatus, and environment does not reveal infinitesimal consciousness. The fact that an outcome is called 'observed' does not mean the measured process possesses awareness or that the detector is a subject.

Consciousness enters the scientific situation in its individualized form through the scientist and the community of inquiry. The proposed infinitesimal consciousness of actual occasions belongs to a separate immanent-metaphysical argument. Quantum measurement provides neither a detector nor a criterion for it.

Ultimate analysis applies to the complete experimental situation. The measured system, apparatus, observer, observable, record, scientific fact, and interpretation possess no inherent existence. Each depends upon relations, conditions, practices, conceptual determination, and the processes through which it becomes functionally identifiable.

Their emptiness does not destroy their differences. A detector is not therefore identical with a scientist. A physical record is not identical with its conscious interpretation. A scientific fact is not identical with reality-as-such. Dependence and conventional construction permit valid distinctions without establishing self-grounding substances.

The material conclusion is secure. Measurement is physically efficacious, organized, record-producing, and condition-dependent. It shows that observation is an interaction rather than a passive view from nowhere.

The epistemic conclusion is equally exact. A scientific observation becomes knowledge only through conceptual articulation and norm-governed judgment. Consciousness is indispensable to this knowledge without becoming the physical force that produces the measured outcome.

Physical reality is neither created by the observer nor known independently of every condition of observation. Its extra-mental efficacy constrains inquiry, while its scientific articulation arises through the conjoint operation of matter, information, and consciousness.

Measurement therefore does not make the physical world real. It makes a determinate physical relation accessible as an arguable scientific fact.

7. Locality, Non-Local Correlation, and Physical Relation

Physical interactions, registrations, and records are locally realized even where the physical state relating separated systems is non-separable.

Fields, bodies, detectors, signals, and interactions occupy or constitute *determinate* spacetime relations. Their effects propagate under physical conditions, and their causal accessibility is constrained by the structure of spacetime. Quantum entanglement does not abolish these conditions. It does,

however, *challenge* the classical assumption that spatially separated systems must possess *complete* physical states *independently* of the *relations joining them*.

Several concepts must be distinguished at the outset : spatial separation, separability, locality, local causality, correlation, causation, and signaling. Their conflation turns a precise scientific result into an indefinite claim that everything instantaneously affects everything else.

Spatial separation means that two physical systems occupy distinguishable spacetime regions. It does not by itself establish that their complete physical states are independent. Two systems may remain spatially separated while participating in one quantum state whose correlations cannot be reconstructed from separately assigned classical properties.

Separability is the stronger thesis that the physical state of a compound system is completely determined by the states intrinsically possessed by its spatially separated parts, together with their ordinary spatiotemporal relations. On this view, the whole contains no physically relevant determination beyond what is already given in the independently specified components and their external arrangement.

Classical atomism naturally favors separability. Elementary objects possess their properties from their own side. Relations connect objects whose physical identities are already complete. A composite system can consequently be understood by inventorying the intrinsic states of its constituents and adding the relations among them.

Locality concerns the permissible relation between events occurring in different spacetime regions. In its broad relativistic form, it denies that a controllable physical signal, energy transfer, or causal influence propagates *faster* than light. Bell's more technical concept of 'local causality' concerns the probabilistic independence expected when the relevant physical conditions in the common past of two spacelike separated regions have been completely specified.

Correlation is not causation. Two outcomes are correlated when their joint statistical distribution differs from what would be expected if they were probabilistically independent. The correlation may arise through direct interaction, a common antecedent condition, coordinated preparation, structural constraint, or another relation. The presence of correlation alone does not identify which causal account is correct.

Signaling is narrower still. Signaling requires that an agent can control a physical variation in one region so as to transmit a distinguishable message to another region. A correlation may be non-local in the technical quantum sense without permitting such controllable transmission. The inability to signal faster than light is therefore compatible with correlations that violate Bell inequalities.

These distinctions determine what may responsibly be inferred from quantum theory. Quantum entanglement establishes relations among systems that cannot always be represented as correlations among independently possessed classical properties. It does not establish an unrestricted instantaneous efficient interaction among every part of the universe.

The problem arose sharply in the Einstein-Podolsky-Rosen argument. Einstein, Podolsky, and Rosen considered quantum systems prepared in an entangled state and then spatially separated. Quantum theory permitted measurements performed upon the systems to display precisely coordinated results even though the theory did not assign each measured quantity one independently possessed classical value *before* measurement.

The argument sought to show that the quantum-mechanical description was incomplete. If a measurement performed upon one system permitted the corresponding value for the distant system to be predicted with certainty without physically disturbing it, then that value appeared to belong to the distant system independently of the measurement. If quantum mechanics did not represent that value, its representation seemed incomplete (Einstein, Podolsky & Rosen, 1935).

The argument relied upon a *locality condition*. A freely selected measurement performed in one spacetime region could not immediately alter the physical reality of a spacelike separated system. The distant system should possess its own real condition independently of which measurement was selected elsewhere.

Quantum mechanics challenged this conclusion because different possible measurements could be chosen. The value inferred for the distant system *depended* upon which observable was measured locally. Treating all such values as simultaneously possessed classical properties generated a tension between the quantum predictions, completeness, and locality.

The EPR argument did not experimentally refute quantum theory. It formulated a *dilemma* concerning the *adequacy* of its *description*. One could regard the quantum state as incomplete, revise locality, reject the unrestricted assignment of pre-existing classical values, or reconstruct the relation among these assumptions in another way.

Bell transformed the ‘philosophical’ dilemma into a *testable mathematical result*. He considered theories in which measurement outcomes were determined, or probabilistically conditioned, by further variables supplementing the quantum state. Under local-causality assumptions, correlations among sufficiently separated measurement outcomes must satisfy determinate *inequalities*. Quantum mechanics predicts *violations* of these inequalities for appropriate entangled states and measurement settings (Bell, 1964).

Let us put this in a lay analogy. Imagine two particles are made together and then sent far apart. At each end, a scientist can turn a detector one way or another *before* looking at the particle. If each particle already carried fixed instructions telling it what result to give for every detector position, the two results could only match *each other so often*. Bell showed that, under the relevant locality assumptions, no such locally pre-arranged account can reproduce all the correlations predicted by quantum mechanics. Experiments confirm this. So the particles cannot simply be carrying fixed local answers with them from the start. This shows that the classical picture of independently existing particles with *fully predetermined local properties* cannot account for the observed quantum correlations.

Bell’s theorem does not state simply that hidden variables are impossible. It excludes broad classes of local hidden-variable theories capable of reproducing all

the relevant quantum predictions. A hidden-variable theory may remain possible by abandoning Bell locality, revising another assumption entering the derivation, or altering the explanatory architecture in a more fundamental manner.

Nor does Bell's theorem establish that realism as such is false. The word 'realism' has several meanings. It may refer to the existence of an extra-mental physical world, to the possession of determinate values before measurement, to the completeness of a physical state independently of observation, or to a specific hidden-variable construction. A theorem restricting one conjunction of assumptions cannot be converted into a disproof of realism as such.

The restricted conclusion is more exact. Quantum predictions cannot be reproduced by theories in which the outcome at each detector depends *only* on *local* conditions and not on the setting or outcome of the distant detector, given the other assumptions of Bell's theorem. The classical conjunction of independently possessed local properties and local causal explanation cannot therefore be treated as the compulsory underlying account of quantum phenomena.

Experimental tests have repeatedly supported the quantum violations. Aspect, Dalibard, and Roger employed time-varying analyzers to test correlations between spatially separated entangled photons and obtained results *violating* the relevant Bell inequalities (showing correlations stronger than any local hidden-variable explanation allows), in agreement with quantum mechanics (Aspect, Dalibard & Roger, 1982). Subsequent experiments have refined the methods, increased the distances, improved the control of experimental conditions, and addressed major experimental loopholes.

The experiments establish the failure of Bell inequalities under the tested conditions. They do not directly display a *superluminal signal* traveling between the measuring devices. Each local observer obtains outcomes whose individual sequence appears probabilistic. The distinctive correlation becomes evident only when the two sets of results are *later compared*. That comparison requires ordinary physical transmission. Records from the separated measurement stations must be brought together through signals propagating within the causal structure permitted by relativity. The distant measurement choice cannot be used to alter the local distribution of outcomes in a controllable manner. Quantum correlations therefore do not provide an operational channel for faster-than-light communication.

The term 'non-local' must consequently be used with discipline. Bell non-locality means that the observed correlations cannot be explained by the relevant class of *locally causal models*. It does not by itself specify an instantaneous efficient cause, a hidden signal, or an energetic transfer crossing the spatial interval. What is thereby undermined is not realism as such, but the *classical identification* of physical reality with strictly local, independently possessed properties. Whatever account of quantum reality is adopted, the observed correlations cannot be accommodated within that classical local-causal picture. Bell-type results show that the classical local-causal picture cannot be *universally* true : it remains valid as an effective description of many physical processes, but it cannot provide the *complete underlying structure of physical reality*.

The observed correlation is real. It is reproducible, quantitatively structured, and experimentally testable. What remains underdetermined is the ontology through which it should be explained. The mathematics and experiments constrain the range of admissible interpretations without selecting one uncontested metaphysical account.

One interpretation introduces explicitly non-local hidden dynamics. The Bohmian approach, for example, retains determinate particle configurations but coordinates their evolution through a non-local guiding structure. It sacrifices Bell locality rather than abandoning determinate physical variables.

No-collapse interpretations retain continuous quantum evolution and interpret determinate outcomes relative to branches or other internal structures of the total state. The correlations then arise from the organization of the entangled state rather than from a later signal passing between already separated systems.

Relational interpretations deny that every quantum state or property must be assigned absolutely and independently of physical relations. A state may be determinate relative to one interaction without functioning as an observer-independent inventory possessed from its own side.

Retrocausal proposals reconsider the temporal direction of the explanatory relation. Other approaches revise the independence assumed between measurement settings and underlying variables. Each strategy carries substantial theoretical and philosophical costs. Their existence shows that Bell-type results underdetermine the complete ontology.

The scientific result should therefore not be expressed as the direct observation of universal instantaneous causation. What has been demonstrated is a *correlation structure* incompatible with broad classes of Bell-local explanation. Calling this structure ‘instantaneous’ may suggest a measurable temporal transmission for which the experiments provide no evidence.

The entangled state is also not adequately represented as two independently completed objects exchanging information after separation. The preparation establishes *one compound quantum state*. Measurement correlations belong to the structure of *that state*. The systems are spatially distinguishable and locally measurable, but their joint physical description is not reducible to a pair of independently assigned classical states.

This is the principal challenge to separability. The state of the whole contains relational determination *not recoverable* from an inventory of intrinsic classical properties assigned separately to the parts. The whole is not merely the numerical sum of independently constituted constituents.

The conclusion must not be converted into the opposite substantialism. The entangled whole is not one indivisible cosmic substance erasing every distinction among its components. The systems remain distinguishable. They occupy *different* regions, enter *different* local interactions, and yield separately registered outcomes. Nonseparability concerns the structure of their joint state, not their fusion into numerical identity.

The non-identity of the parts is therefore preserved. Their states are relationally coordinated without becoming one object in every respect. Dependence does not

abolish distinction. The failure of classical separability does not entail that no individual physical systems can ever be identified or that all individualization is arbitrary.

Entanglement is determinate and selective. Particular systems become entangled through particular preparations and interactions. The correlations concern specified observables, states, and measurement arrangements. They are not an undifferentiated bond connecting every property of every object with every property of every other object.

Nor should entanglement be treated as an *unalterable relation* persisting forever in an experimentally accessible form. Further interaction with environments and other systems *changes* the relevant quantum state. Correlations may be redistributed, obscured, or rendered practically inaccessible. The history of interaction matters, but it does not establish one eternally preserved pairwise bond operating independently of every later condition.

The material world is therefore relational without becoming a homogeneous totality. Relations are specific, conditioned, and structured. A relation does not abolish the related terms, and a whole does not acquire inherent existence merely because its state cannot be reduced to independently specified parts.

The physical significance of non-separability belongs first to material operation. Entangled systems, measuring devices, fields, and records are physically realized. The correlations become experimentally accessible only through material preparation, interaction, detection, and comparison. No disembodied relation appears independently of the physical systems instantiating it.

The correlation also displays formative organization. It specifies a structured relation among possible measurement settings and outcomes. The organization is mathematically articulated and empirically constrained. Different preparations yield different correlations, and the relation can be preserved, modified, or destroyed according to the physical architecture of the process.

Within the three-operator thesis, quantum correlation consequently displays the conjunction of energetic efficacy and formative organization. The systems and measurements are materially realized. The pattern of joint probabilities constitutes a determinate relational organization.

This interpretation does not establish that the correlation is information in every sense of that term. It may be represented through statistical information and used in quantum-information protocols. It is not therefore a semantic message transmitted from one particle to another. No particle understands the correlation, encodes an intention, or reads a distant result.

The metaphor of one particle *informing* another is especially misleading. Information in the communicative sense requires a controllable physical distinction functioning as a signal within an organized relation between sender and receiver. Bell correlations do *not* provide such a controllable superluminal message. The correlation structure may nevertheless be informational in the restricted scientific sense that it *defines statistical dependencies* among possible results. This form of information belongs to the organization of the compound state. It does not exist as a substance passing between the systems.

Consciousness adds no explanatory necessity to the physical phenomenon. The *choice* of measurement settings may be made by conscious experimenters, automated devices, or other physical procedures. Once embodied in the apparatus, the setting determines the local experimental arrangement. The resulting correlations do *not* depend upon human awareness of the outcomes.

Bell correlations therefore provide no scientific evidence for consciousness acting at a distance. They do not demonstrate telepathy, psychokinesis, collective consciousness, or a mental field connecting separated subjects. A correlation established between physical measurement outcomes cannot be transferred without argument into a claim concerning conscious communication.

They also do not establish infinitesimal consciousness. Physics detects prepared states, settings, probabilities, detector events, and correlations. It does not detect mere clarity and awareness in the systems involved. The panexperiential thesis requires an independent immanent-metaphysical argument and may not cite non-locality as empirical confirmation.

The same restriction excludes theological inflation. Quantum non-separability does not establish a Divine agency coordinating physical events, a transcendent unity beyond spacetime, or the world-ground as an experimentally discovered field. These concepts belong to different epistemic registers.

The virtual world-ground cannot be identified with quantum entanglement. An entangled state is a *determinate physical state* represented within quantum theory. The world-ground is an immanent-metaphysical account of possibilities of further formation. The former is scientifically modeled and experimentally constrained ; the latter totalizes the modal dimension of the world-system.

Non-local correlation also fails to establish the world-system as one actual occasion. The existence of compound quantum states does not imply that the physical universe constitutes one numerically unified act of actualization or one conscious subject. The passage from relational physical states to a cosmic actual occasion would require independent metaphysical argument.

The legitimate relation to process metaphysics is one of consonance. Process metaphysics denies that relations are merely external additions to self-enclosed substances. It permits the determinations and behavior of an actuality to depend upon the wider organization in which it occurs. Quantum nonseparability is compatible with this priority of conditioned relation.

Consonance is not proof. Ontic structural realism can interpret relations or structures as ontologically primary. Dispositionalism may locate the relevant correlations in relational powers. Bohmian mechanics may retain particle configurations within a non-local dynamics. Everettian, relational, retrocausal, and information-theoretic approaches may interpret the same experimental constraints differently.

Physics does not uniquely select process metaphysics from among these alternatives. The present scheme makes a comparative philosophical judgment : interpreting quantum systems *as relational physical processes* accords better with its anti-substantialist architecture than treating them as collections of independently complete local substances.

The result also possesses a restricted consonance with ultimate analysis. Quantum theory does not establish emptiness. Bell's theorem concerns formal probabilities, correlations, and specified assumptions within physical theory. Ultimate analysis concerns the absence of inherent existence in every object and determination.

Nevertheless, the quantum result blocks one scientifically naive image to which substantialization readily appeals : spatially separated objects cannot always be interpreted as bearers of complete, independently possessed classical properties whose relations are merely added afterward. Their physical determination may depend upon the wider state and experimental organization.

This dependence is not identical with $\neg SV(x)$. A Bell violation does not logically derive the absence of inherent existence. It supplies a scientific finding consonant with the philosophical rejection of isolated self-grounding objects. The movement from nonseparability to emptiness remains an argument of ultimate analysis, not an experimental inference.

Locality must also retain its positive validity. Quantum non-separability does not make local physical explanation *obsolete*. Measurements occur through local interactions among systems and apparatuses. Detectors respond at determinate locations. Records are locally produced. Signals and energy transfers remain constrained by spacetime relations.

The physical preparation of an entangled state itself requires *determinate* interactions and a *shared* causal history. The systems do not become correlated *without* conditions. Their later measurements are performed locally, and the comparison of records requires ordinary communication.

The quantum result therefore *modifies locality* without simply abolishing it. Bell-local causal explanation fails for the relevant correlations, while operational no-signaling and local physical interaction remain *indispensable*. A defensible metaphysics must preserve both findings.

Physical relation is consequently more comprehensive than classical local interaction. It includes local energetic transmission, shared antecedent preparation, compound-state organization, and nonseparable statistical correlation. These modes must be distinguished rather than gathered under one vague causal vocabulary.

A physical relation may now be defined more exactly :

A physical relation is a materially realized and formally determinate dependence through which the states, possibilities, or outcomes of physical processes are connected under specified conditions.

Some physical relations are efficiently causal. A field alters a trajectory, a collision transfers momentum, or a signal changes a detector state. Other relations concern common preparation, constraint, symmetry, or correlation without identifying one directed efficient influence between the relata.

The definition prevents relation from becoming a fourth operator. Relation names the conditioned connection within which the operators function. Material

operation supplies the physical realization and efficacy of the related processes. Informational operation supplies the differentiated organization of their possible states and correlations.

Relation is therefore neither an independent substance nor an additional force. It is instantiated through actual processes. An entanglement relation does not exist from its own side apart from the prepared systems, state, interactions, and conditions through which it is defined.

Nor should relation become the single metaphysical essence replacing matter. To state that physical actuality is relational does not explain what is related, how the relation becomes physically effective, or how its structure becomes determinate. Relationality characterizes the architecture of process ; energetic efficacy identifies its material realization.

The three-operator thesis accordingly draws a limited but important conclusion. Quantum theory supports the need to distinguish physically realized systems from the relational organization of their joint state. It thereby supplies a particularly strong case in which energetic efficacy and formative organization cannot be adequately described as *isolated operations*.

The conclusion does not establish the irreducibility of the operators as a scientific theorem. A physicalist, structural realist, or another interpreter may regard the relational organization as wholly physical. The present metaphysics argues that material realization and formal organization answer distinguishable explanatory questions even when they are instantiated together.

The scientific finding is that Bell inequalities are violated under the relevant experimental conditions. The scientific interpretation is that classical separability and Bell-local hidden-variable explanation cannot be *universally* retained. The philosophical argument is that *relational organization* belongs to the physical constitution of quantum systems rather than functioning merely as an external addition.

The immanent-metaphysical proposal is stronger : the finding is interpreted within one processual world-system in which energetic efficacy and formative organization are necessarily *interdependent*. Science constrains this proposal but does not test it as a total architecture.

Ultimate analysis applies to locality and non-locality alike. Neither term identifies an inherent feature possessed independently of theoretical definition, state preparation, spacetime structure, experimental arrangement, and the relations being considered. A process may be local in one sense and non-local in another.

A detector event is local in its physical realization. The joint probability distribution may violate a Bell inequality. The comparison of records requires *subluminal* signaling. The compound quantum state may be non-separable. No single word captures all these relations without qualification.

The final verdict must avoid both classical isolation and mystical holism. Physical systems cannot always be treated as self-enclosed substances possessing complete local identities before relation. They also cannot be dissolved into one undifferentiated universal object.

Quantum non-separability establishes conditioned relational structure. It does not establish a cosmic substance, universal instantaneous causation, or consciousness at a distance.

Matter remains locally realized and publicly efficacious. Its physical determinations may nevertheless belong to organizations extending *beyond* the intrinsic classical properties assignable to localized, *isolated parts*.

The material world is relational because physical actuality arises and functions through conditioned relations. It is not relationless substance, and it is not a relation without differentiated actualities.

8. Mass, Energy, and the Higgs Field

Mass and energy are central quantities in physical science, but neither supplies an adequate definition of matter. Massless radiation remains physically efficacious, while massive bodies cannot be reduced to the possession of one quantitative property. Mass-energy equivalence establishes precise relations among physical quantities and transformations. It does not identify matter with a substance called energy.

The association of matter with mass arose naturally from ordinary bodies but cannot be generalized to physical actuality as a whole. Photons possess no invariant rest mass yet transmit energy and momentum, enter interactions, and produce measurable effects ; massive particles, conversely, are characterized not by mass alone but also by charge, spin, field relations, interactional capacities, stability, and permitted transformations. Mass is therefore one important determination of material operation, not its criterion or universal essence.

Energy is equally indispensable and equally insufficient. It is a quantitatively defined determination of physical states and processes, not a material ingredient added to them. The statement that ‘everything is energy’ therefore converts the generality of an important physical quantity into the metaphysical claim that energy is the substance from which everything else is made. Kinetic energy depends upon motion relative to a frame ; potential energy upon an interacting configuration ; field, thermal, and rest energies receive their meanings within their respective theoretical contexts. The word coordinates these determinate uses without naming an undifferentiated cosmic fluid. Noether’s theorem sharpens the restriction. Under specified theoretical conditions, continuous symmetries correspond to conservation laws ; where temporal-translation symmetry applies, energy is conserved (Noether, 1918). What is conserved is a quantitatively determined physical relation across permitted transformations, not an invisible material stuff enduring unchanged beneath them.

The conservation of energy must consequently not be expressed as though an invisible material stuff moved unchanged from object to object. What remains invariant is a *quantitatively defined relation* across the transformations permitted by the theory. The physical processes themselves may change radically. Radiation can be absorbed, particles can be created or annihilated, chemical structures can be transformed, and kinetic motion can become thermal agitation while the relevant conservation relation remains satisfied.

Mass-energy equivalence must be interpreted with the same care. It does not state that matter is made of energy or that mass and energy are two substances capable of being exchanged. It expresses a determinate relation within relativistic physics. A system at rest possesses an energy corresponding to its invariant mass, while the total energy of a moving system also depends upon momentum.

The relation is frequently summarized through the equation $E = m.c^2$. This abbreviated form concerns *rest* energy. It is not a universal equation for every physical state without further qualification. Its significance lies in showing that *mass contributes to the energy of a system* and that physical processes may transform configurations in ways that alter the rest masses of the resulting systems while preserving the relevant total relations.

Mass should therefore not be imagined as solid material quantity on one side and energy as immaterial activity on the other. Both are scientific determinations within one physical architecture. Mass characterizes features such as resistance to acceleration and the rest-energy of a system. Energy characterizes capacity for physical transformation relative to the relevant theoretical conditions. This relation has processual significance. A physical system cannot be divided into an inert bearer called matter and an active addition called energy. What is conventionally identified as a material object already consists in physically organized fields, interactions, motions, constraints, and relatively stable relations. Its mass expresses features of this organized physical actuality rather than the quantity of an underlying substance.

The distinction becomes especially clear in compound systems. The mass of a composite is not generally obtained by simply adding the invariant masses of independently existing constituents imagined as unchanged within the whole. Internal motion, field configurations, interaction energies, binding relations, and the organization of the compound *contribute* to its total mass.

Binding may reduce the mass of a stable compound relative to the summed masses of separated constituents because energy has been released in the formation of the bound state. Conversely, an excited state may possess greater mass than the lower-energy state of the same system. The mass of the compound therefore expresses the achieved physical organization and energetic condition of the whole.

This does not mean that mass is merely subjective, conventional in the sense of arbitrary, or reducible to the observer's description. Differences in mass have measurable physical consequences. They affect acceleration, trajectories, stability, decay possibilities, gravitational relations, and the energy required for transformations. The point is that mass functions through determinate physical relations rather than inhering as an independent essence.

The dependence of mass upon organization becomes particularly important in ordinary matter. Protons and neutrons form almost all the mass of familiar atomic nuclei. Their constituent quarks possess elementary masses associated with coupling to the Higgs field, but these bare quark masses account for only a comparatively small part of the total nucleon mass. Most of the mass of protons and neutrons arises from the *dynamics of the strong interaction*, including the energy of quark motion, gluon fields, confinement, and binding.

Ordinary material mass is therefore *not* supplied wholly by the Higgs mechanism. The Higgs field is indispensable to the *elementary* masses of quarks and charged leptons and to the masses of the weak gauge bosons. It does *not* function as one universal reservoir from which every macroscopic mass is drawn.

The statement that ‘the Higgs boson gives matter its mass’ is consequently misleading. It compresses several different physical processes into one popular formula. The Higgs mechanism explains why certain *elementary* particles possess specified mass terms within the Standard Model. It does not explain the *full* mass of compound systems, and it does not create the energetic efficacy through which every physical process operates.

The Higgs mechanism belongs to the electroweak theory. Before symmetry breaking is taken into account, the theory is organized through a gauge symmetry that does not permit explicit mass terms for the electroweak gauge bosons in the required manner. A scalar field is introduced whose lowest-energy configuration possesses a non-zero value. The equations retain their gauge-theoretic architecture, but the realized vacuum state does not display the complete symmetry in the same manifest form. The expression ‘spontaneous symmetry breaking’ must not suggest that a law of nature is violated. The underlying theoretical relations remain symmetrical. What changes is the state in which the system is realized. The state selects one among a range of symmetry-related possibilities and thereby displays less manifest symmetry than the equations describing the range.

The distinction is familiar in other physical contexts. A perfectly balanced system may permit several equivalent orientations, while its realized state possesses one determinate orientation. The laws do not prescribe that one direction is intrinsically privileged. Once one state is realized, however, the physical organization is no longer indifferent among the alternatives.

The analogy must not replace the field theory, but it clarifies the relation between symmetry and realized determination. Symmetry concerns the structured range of transformations under which the theoretical relations remain invariant. Symmetry breaking concerns the determinate physical state through which one organization of that range becomes actual.

Goldstone, Salam, and Weinberg analyzed the consequences of broken continuous symmetries, while Englert and Brout and Higgs showed how gauge-field theories could acquire massive gauge bosons without abandoning the gauge architecture required by the theory (Goldstone, Salam & Weinberg, 1962 ; Englert & Brout, 1964 ; Higgs, 1964).

Within the electroweak theory, coupling to the non-zero Higgs field distinguishes the massive W and Z bosons from the massless photon. The electroweak gauge fields are reorganized after symmetry breaking so that one combination corresponds to the electromagnetic field and remains massless, while other combinations correspond to the massive weak-interaction bosons.

The photon does not remain massless because it somehow avoids moving through the Higgs field. Nor do the W and Z bosons become massive because the field

mechanically obstructs their motion. Their different mass properties arise from the structure of the couplings and the unbroken electromagnetic gauge symmetry.

The familiar molasses analogy is therefore inadequate when taken literally. According to this image, particles move through an all-pervading medium and encounter different degrees of drag. Greater resistance is then equated with greater mass. This picture may convey that particles differ according to their relations with the Higgs field, but it misrepresents the mechanism as mechanical friction.

Friction dissipates kinetic energy, produces heat, and depends upon motion through a resisting medium. The Higgs mechanism does not make particles lose energy merely by traveling through space. A freely moving massive particle does not continually slow because the Higgs field impedes it. *Mass is not drag.*

The Higgs field is also not a classical material medium filling an independently existing container. It is a quantum field belonging to the Standard Model. Its non-zero vacuum value participates in the physical architecture through which the electroweak theory acquires its realized particle spectrum.

Elementary fermions acquire masses through couplings between their fields and the Higgs field. These are commonly described as ‘Yukawa couplings.’ Different coupling strengths correspond to different elementary masses. The Standard Model represents these couplings with great predictive success, but it does not presently derive all their numerical values from a deeper established principle.

The Higgs mechanism therefore explains how elementary fermion masses can occur consistently within the theory, but it does not fully explain why each fermion possesses precisely its observed mass. The existence of a field-theoretic mechanism and the determination of all coupling values are different explanatory achievements.

This limitation should not diminish the importance of the mechanism. It identifies a coherent physical architecture through which particles that would otherwise be represented as massless acquire determinate mass terms while the required gauge structure is preserved. It replaces the unexplained insertion of particle masses with a relational field-theoretic account.

The distinction between field and excitation must also remain explicit. The Higgs field is the physical field whose non-zero vacuum value participates in the mass-generating mechanism. The Higgs boson is a quantized excitation of that field. The two terms are related but not interchangeable.

The discovery of the Higgs boson did not bring the Higgs field into existence. Nor did it create particle masses. It supplied experimental evidence for the field-theoretic mechanism already incorporated into the Standard Model. The observed particle was a new physical excitation whose properties were consistent with those predicted for the Higgs boson.

In 2012, the ATLAS and CMS collaborations independently reported the observation of a new boson in the mass region near 125 GeV whose measured characteristics were consistent with the Standard Model Higgs boson (ATLAS Collaboration, 2012 ; CMS Collaboration, 2012). Subsequent investigation strengthened this identification through measurements of its production and decay properties. The experimental achievement is scientifically decisive within its

domain. A particle predicted by the Standard Model's symmetry-breaking architecture was detected through independently analyzed collision data. The result strongly supports the Higgs sector of the theory.

The experiment establishes the boson's measured properties and strongly supports the Higgs sector of the Standard Model. It does not establish the Higgs field as a metaphysical ground of matter, prove process metaphysics, or demonstrate energetic efficacy as one of exactly three universal operators. Dependence, interaction, symmetry, and field-theoretic organization may be integrated into a processual interpretation, but that interpretation remains philosophical and immanent-metaphysical rather than experimental.

The strongest metaphysical significance of the Higgs mechanism concerns *dependence*. Mass need not be treated as an unexplained property simply *inhering* in an elementary corpuscle from its own side. The masses of the relevant particles are articulated through field content, symmetry, vacuum organization, and coupling. This does not mean that particle mass is unreal or only relational in a loose sense. Within the Standard Model, elementary particle masses are stable, measurable parameters. They support precise predictions and have determinate physical consequences. Their dependence upon field-theoretic architecture does not abolish their conventional identity.

Stable physical properties can be real without being self-grounding. A particle may possess a determinate and measurable mass within a physical regime even though that mass depends upon field organization, couplings, symmetries, and interactions. Dependence and determinacy are compatible : conventional reality does not require inherent existence.

The same applies to the Higgs field. It is one determinate field within the highly successful but incomplete Standard Model, warranted within that domain by the predictive and experimental success of the theory, but neither a replacement substance nor the final ontology of physical actuality. Domain-relative realism concerning a field does not require treating it as an independent bearer existing behind its states, couplings, excitations, and effects.

The Higgs mechanism also demonstrates the conjunction of material efficacy and formative organization. Fields and interactions supply physical efficacy ; symmetries, couplings, permitted transformations, and symmetry breaking articulate its differentiated organization. These are not two substances or forces : the organization is physically instantiated in the same field-theoretic processes.

The case therefore illustrates why an energetic inventory alone does not specify a physical process. Comparable energy scales can occur within systems differing in fields, symmetries, couplings, and boundary conditions. The determinate course of physical efficacy depends upon the organization through which it is distributed, constrained, exchanged, and converted.

Energetic efficacy is always *formed efficacy*.

This conclusion does not establish the information-operator as a separate scientific discovery. Physics describes symmetries, couplings, fields, and transformations in its own formal vocabulary. Their coordination under formative organization

belongs to the metaphysical scheme. The scientific findings support the explanatory distinction without proving its universal ontological status.

Mass also illustrates the scale-sensitivity emphasized earlier. At the elementary-particle level, specified masses are related to Higgs couplings. At the hadronic level, most mass arises through the dynamics of the strong interaction. At atomic and molecular levels, binding and excitation contribute small but physically real mass differences. At macroscopic levels, total mass reflects the organized energetic state of complex systems.

There is no contradiction among these accounts. They concern different levels and organizations of physical description. The mass of a human body need not be explained solely by listing elementary Higgs couplings. Such couplings belong to the physical conditions of the constituents, while most of the mass of ordinary material constituents arises through *strong-interaction dynamics* and the *organized energetic constitution of nucleons*.

Scale-sensitive explanation prevents two reductions. The first would treat the Higgs mechanism as the complete explanation of all mass. The second would dismiss higher-level mass relations as unreal because they depend upon more fundamental processes. A complete physical account must relate scales without assuming that the vocabulary of one scale exhausts every explanatory question posed at another.

The same point applies to the relation between matter and energy. A chemical reaction, nuclear transformation, biological metabolism, and particle collision all involve energy relations. The word ‘energy’ does not thereby erase the differences among their mechanisms, structures, and outcomes. The physical quantity remains indispensable while the explanation also requires the specific organization of the process.

Energetic efficacy is intended to coordinate this plurality without replacing it. It names the physically realized capacity for interaction, resistance, transmission, and transformation. It does not claim that all the structures investigated by physics can be reduced to energy as one quantity.

Mass contributes to energetic efficacy by characterizing determinate capacities and constraints of physical states. It affects which transformations are kinematically available, how systems respond to forces, and how much energy is associated with their rest condition. The Higgs mechanism contributes by explaining part of the field-theoretic architecture through which elementary masses arise.

Neither mass nor the Higgs field *exhausts* material operation. Massless fields remain efficacious. Spacetime geometry contributes to physical determination. Quantum probabilities structure possible outcomes. Boundary conditions alter what physical states and transformations are available. Thermodynamic processes involve statistical organization and gradients. Matter as energetic efficacy coordinates the total physical mode of realization rather than identifying one privileged quantity as its essence.

The metaphysical interpretation must also avoid turning symmetry breaking into a universal doctrine of creativity. The Higgs mechanism shows that a theory with

a symmetrical architecture can possess realized states displaying a more differentiated organization. This is scientifically established within the relevant field-theoretic context. It may provide an illuminating analogy for the transition from a structured range of possibilities to one determinate physical regime. It does not establish that every actual occasion arises through spontaneous symmetry breaking, that metaphysical novelty is physically identical with broken gauge symmetry, or that the virtual world-ground is a Higgs-like field.

The Higgs field must particularly not be identified with primordial matter. Primordial matter concerns the *virtual* possibility of energetic actualization within the immanent-metaphysical reconstruction of the world-ground. The Higgs field is an *actual*, determinate physical field belonging to the Standard Model.

The non-zero vacuum value of the Higgs field also does not transform the physical vacuum into metaphysical world-ground. The vacuum state remains a *physically* specified state with *determinate* field structure. It is not absolute nothingness, unlimited possibility, or the source of every possible physical organization.

The word ‘primordial’ would be especially misleading if transferred directly from the metaphysical account to the Higgs field. The field occupies a basic place in the present electroweak theory, but theoretical fundamentality within one scientific framework is *not* equivalent to metaphysical primordality.

The Higgs boson should likewise not be called ‘the God particle.’ The expression encourages several confusions at once. It suggests that the boson creates matter, grounds existence, or possesses theological significance. None follows from the scientific theory or the experiments.

The boson is a physical excitation associated with a field participating in electroweak symmetry breaking. Its detection was an extraordinary confirmation of the Standard Model, not an experimental disclosure of the Divine, the ultimate ground of actuality, or the reason why there is something rather than nothing.

The anti-reifying restriction does not diminish the scientific achievement. It protects it from conceptual inflation. The more exact the physical result, the less need there is to enlarge it through metaphysical mythology.

The Higgs mechanism therefore supplies a particularly instructive example of *physical dependence without substantial identity*. The particle is not reducible to a classical corpuscle bearing mass independently of all relations. Its mass is articulated within a field-theoretic organization. Yet the particle remains conventionally real, experimentally detectable, and physically efficacious.

The field is not reducible to an imagined medium composed of smaller material elements. It functions through states, couplings, excitations, and measurable consequences. Yet it must not become a universal substance replacing the corpuscles of classical atomism.

Symmetry is not an independently acting cause. It articulates invariances and permitted transformations. Yet the organization represented through symmetry is indispensable to the scientific explanation.

Energy is not a substance. It is a quantitatively determined feature of physical systems and transformations. Yet its conservation and exchange remain fundamental to physical explanation.

Mass is not the essence of matter. It is a real and consequential physical determination. Its scientific interpretation reveals both stability and dependence.

Ultimate analysis prevents these physical determinations from becoming substances. Mass, energy, and the Higgs field are conventionally real because they make determinate physical differences, yet none can be isolated as an inherently existing property, substance, or ground apart from the relations and conditions through which it functions. Their emptiness concerns their mode of existence, not the denial of their operation.

The scientific verdict is exact. The Standard Model's Higgs mechanism explains how the W and Z bosons and elementary fermions acquire specified mass terms within electroweak theory. The observation of a Higgs boson supports this mechanism. Most of the mass of ordinary matter nevertheless arises through strong-interaction dynamics rather than directly from elementary Higgs couplings.

The philosophical verdict is equally restricted. These results undermine the image of mass as an unexplained property inhering in an independently existing particle-substance. They support a field-theoretic and relational understanding in which physical properties depend upon symmetries, couplings, interactions, and realized states.

The immanent-metaphysical verdict goes further but remains arguable rather than testable. Mass, energy, and the Higgs field may be interpreted as differentiated manifestations of energetic efficacy within one processual world-system. This synthesis is consonant with physics but is not experimentally established by it.

Mass and energy therefore support the material operator only when energetic efficacy remains functional. Matter is not mass, energy, or the Higgs field. It is the *physically realized efficacy* instantiated through their *determinate operations and relations*.

Mass does not disclose a permanent bearer beneath change. Energy does not disclose a universal substance undergoing change. The Higgs field does not disclose the ground from which change arises.

Together, they display a physical world in which stable properties emerge through organized fields, couplings, interactions, and transformations. Their reality lies in this efficacy, not in independence from it.

The success of their physical explanation consequently strengthens neither material substance nor ontological materialism. It prepares the distinction required in the next subsection : matter is irreducible as physically realized efficacy without thereby being the exclusive measure of *everything actual*.

9. Matter without Materialism

From about the middle of the nineteenth century onward, the successes of physics, chemistry, physiology, and evolutionary biology encouraged an increasingly

materialist interpretation of natural explanation. Büchner's *Kraft und Stoff*, Tyndall's scientific naturalism, and Haeckel's monism exemplify the transition from methodological success to comprehensive worldview : as measurable physical causes explained increasingly many phenomena, it became tempting to infer that only what could ultimately be physically explained was fully real (Büchner, 1855 ; Tyndall, 1874 ; Haeckel, 1899). The inference was philosophically intelligible, but it exceeded the experiments from which it drew authority.

During the twentieth century, the vocabulary changed. The development of relativity, quantum theory, field theory, and modern particle physics made the older image of matter as inert, self-contained substance increasingly inadequate. Materialism therefore tended to become *physicalism* : what mattered was no longer that everything consisted literally of material particles, but that everything real was ultimately physical, physically realized, or dependent upon the physical. The ontological ambition remained broader than physical science itself. Physics had transformed its conception of physical actuality ; the philosophical thesis responded by widening the meaning of 'physical' rather than abandoning the claim that physical reality was ontologically exhaustive. Contemporary physicalism is accordingly formulated not as the thesis that everything is composed of nineteenth-century matter, but, in its broadest form, as the thesis that *everything is physical or ultimately depends upon the physical*.

Logical positivism gave this tendency a different and more epistemological form. The *Vienna Circle* did not simply revive nineteenth-century materialism. Its scientific world-conception sought the unification of knowledge through empirical science and logical analysis, while Carnap's attack on metaphysics attempted to show that many traditional metaphysical propositions were not false scientific hypotheses but cognitively defective pseudo-statements (Hahn, Neurath & Carnap, 1929 ; Carnap, 1932). Physicalism within this movement initially concerned, among other things, the possibility of a *common intersubjective language for unified science* rather than the crude thesis that everything is material substance. Nevertheless, the consequence was powerful : scientific and logically analyzable discourse acquired *privileged* cognitive status, while metaphysics was increasingly excluded from the domain of legitimate knowledge.

Scientism may be understood as the *further inflation* of this privilege. It is not identical with science, nor is it a scientific discovery. It is the philosophical attitude that the methods and categories of the sciences provide the sole, or at least finally authoritative, route to understanding everything that can legitimately be understood. A methodological restriction becomes a theory of rationality and, eventually, a theory of reality. Questions of organization, meaning, value, normativity, first-person presence, or metaphysical totality are then under pressure either to become scientific questions, to be reconstructed in a scientific vocabulary, or to lose cognitive standing. The success of science thus becomes an argument not merely for science within its domain, but for the extension of its explanatory register over domains whose objects and warrants may differ.

Functionalism complicated rather than simply continued this history. Early functionalism rejected the straightforward identification of every mental state with one particular type of brain state. Putnam argued that a mental state could instead

be characterized by the role it performs within a system, while Fodor subsequently defended the relative autonomy of the ‘special sciences’ against the demand that their laws reduce without remainder to physics (Putnam, 1967 ; Fodor, 1974). Functionalism was therefore not crude materialism. Yet it also allowed much twentieth-century cognitive science to remain thoroughly *naturalistic* : mental operations could be analyzed through causal, computational, or functional organization while their concrete realization remained *physical*. The materialist demand for identity was weakened, but the expectation that mentality must ultimately fit within a *physically realized causal order* often remained.

The resulting outlook remains highly influential in contemporary academic thought, although academia is too heterogeneous to be described as uniformly physicalist. The 2020 PhilPapers Survey provides one useful quantitative indication from professional philosophy : 51.93 percent of respondents accepted or leaned toward physicalism concerning the mind, while 32.08 percent accepted or leaned toward non-physicalism (Bourget & Chalmers, 2023). Contemporary neuroscience likewise quite properly investigates the neural correlates and mechanisms associated with consciousness rather than invoking non-testable causes (Koch, Massimini, Boly & Tononi, 2016). Neither fact establishes ontological physicalism. They do show how naturalistic and physically oriented explanation continues to provide a powerful *default framework* within major sectors of contemporary inquiry.

The scientific fruitfulness of this orientation should not be underestimated. Reduction, decomposition, measurement, controlled intervention, and the search for physical mechanisms have produced immense explanatory gains. Complex systems can often be understood by identifying their constituents, isolating causal dependencies, and determining the physical processes through which changes are realized. Nothing in the present critique contests this achievement. The problem begins when a successful research strategy is *converted* into an *ontological* principle : because physical analysis explains one indispensable dimension of a phenomenon, the phenomenon as a whole is assumed to be nothing but what that analysis describes.

Several losses can follow from this conversion. First, relations and levels of organization may be treated as *dispensable* once their physical constituents have been identified. Yet knowing the constituents does not necessarily explain the organization they instantiate, the constraints under which they operate, or the new regularities appearing at higher levels. Anderson’s argument that ‘more is different’ and Fodor’s defense of the relative autonomy of the special sciences both challenge the assumption that complete knowledge of lower-level physical laws automatically supplies the explanatory vocabulary required at every higher level (Anderson, 1972 ; Fodor, 1974). Reduction can therefore become *explanatorily impoverishing* when decomposition removes precisely the organization whose functioning is to be explained.

Second, ontological reductionism can transform a limitation of method into a limitation imposed upon reality. Physical science works through publicly measurable states, relations, interactions, and effects. It is therefore exceptionally powerful in investigating what can be operationalized *in that register*. But semantic content, normative validity, first-person presence, meaning, valuation,

and intentional agency are not thereby shown to be unreal merely because they are not exhausted by the same descriptions. If only what can be rendered in *physical* terms is admitted as ultimately real, the conclusion has partly been secured in advance : whatever does *not* fit the *selected* vocabulary must either be *translated* into it, *declared derivative*, or *eliminated*. The danger is circular. The method first restricts what it can register and then treats what it registers as an exhaustive inventory of actuality.

The alternative is not anti-reductionism in the sense of refusing analysis. It is *non-reductive explanatory pluralism under critical control*. Physical explanation remains indispensable wherever energetic realization and efficient determination are at issue. But explaining the physical realization of something does not automatically explain its organization, and explaining its organization does not automatically explain its conscious presence, meaning, or value. The sciences become more, not less, comprehensive when distinctions among explanatory registers are preserved rather than collapsed. Materialism becomes problematic precisely when the unquestionable reality and explanatory power of matter are converted into the much stronger claim that matter exhausts what is real.

The irreducibility of material operation does *not* entail ontological materialism. Materialism moves from the indispensability and success of physical explanation to the thesis that *everything real is physical or reducible without remainder to physical objects, properties, or laws*.

That thesis is metaphysical rather than scientific. No experiment surveys actuality as a whole and establishes that every legitimate object of explanation is identical with a physical description. Physics tests determinate theories concerning physical phenomena. The universal claim that only physical actuality exists *exceeds* those tests.

Methodological physicalism remains appropriate within physical inquiry. A physicist should not introduce consciousness, Divine intervention, or metaphysical purpose where established physical variables suffice. Explanatory economy requires that the physical sciences investigate physical processes through physical theories.

Ontological materialism adds a further claim : because physical explanation is methodologically successful, *all* other explanatory registers are ultimately identical with or eliminable in favor of it. This converts an *epistemic restriction* of scientific method into an *ontological identity*. The conversion is unwarranted. A complete account of physical energy, mass, fields, and interaction does not *by itself* specify the organizational architecture through which a system performs one function rather than another. Nor does a third-person physical description become, merely through completeness, the first-person presence of the conscious state it describes.

The point is not that informational and mental operations occur *outside* the physical world. Concrete information requires physical realization, and individualized consciousness depends upon embodied and informational conditions. Dependence is indispensable.

Identity is the disputed conclusion.

Materialism gains strength from causal continuity. Bodily processes possess physical causes, and mental activity affects the public world through bodily pathways. A theory introducing an independent mental substance exerting an additional force would conflict with this continuity and invite causal overdetermination.

The three-operator thesis introduces no such substance. Conscious intention becomes physically effective through organized neural, bodily, linguistic, and environmental processes. Informational constraint directs materially possible pathways without adding a second quantity of energy. The operators distinguish modes of determination within one process rather than external causes entering from separate worlds.

Physical explanation can consequently remain complete relative to physical questions. This does not entail that physical vocabulary exhausts biological function, semantic content, conscious presence, personal reasons, or social action. Different explanatory questions isolate different difference-makers within one interdependent actuality.

A spoken promise is physically realized as sound, neural activity, and bodily action. Its physical description does not identify its normative meaning, remembered commitment, or role in later deliberation. These are not supernatural additions to the sound waves. They belong to informational and conscious organization instantiated through them.

The transcendental position also blocks materialist closure. Scientific knowledge must *presuppose* a subject capable of observation, concept formation, testing, argument, and judgment. The epistemic conditions under which physical facts become known cannot simply be redescribed as one further known physical object and then declared eliminated. Such a move confuses the conditions governing knowledge with one object represented within knowledge.

This does not make the transcendental subject an immaterial substance. It means that ontology cannot ground or abolish the normative conditions already operative in the scientific claim by reducing them to its object.

Matter is therefore *irreducible but non-exclusive*. Without physical realization, there would be no public interaction, embodiment, measurement, or worldly consequence. Without information and consciousness, the architecture of organized systems and the occurrence of first-person presence would remain unexplained. Matter without materialism affirms physical science in full while rejecting the metaphysical inflation of its domain. The mistake of materialism is not that it takes matter too seriously. It is that it converts one indispensable operator into the whole of actuality.

10. Matter in Relation to Information and Consciousness

Matter never operates as *formless* efficacy. Fields possess determinate structures ; particles are defined through properties and transformation rules ; interactions occur through couplings and symmetries ; bodies possess boundaries ; and physical processes follow constrained pathways.

The same available energy and comparable material constituents can produce different outcomes under *different organizations*. A current follows one circuit rather than another because the pathways differ. Chemical components react differently according to molecular configuration, concentration, and boundary conditions. Organisms respond differently because their tissues, regulatory networks, and neural architectures differ.

Information names this *formative organization*. It specifies differentiated constraints, relations, codes, pathways, and recurrent structures through which physical efficacy becomes determinate. Organization does not inject another force or supply an independent stock of energy. It conditions how materially possible transitions are selected, sustained, inhibited, or transformed.

Concrete information nevertheless *requires physical realization*. A code that is neither inscribed, instantiated, retained, transmitted, nor interpreted remains an abstract possibility. A computation must occur through distinguishable physical states. A neural architecture requires living tissue. A sentence requires sound, inscription, or retained mental form.

Matter, information, and consciousness are interdependent without being identical. Matter secures physical realization and efficacy ; information secures differentiation and organization ; individualized consciousness depends upon both without being exhausted by their descriptions. Dependence is indispensable, but identity does not follow from dependence.

Conscious intent becomes publicly consequential only through informationally organized material processes. Information therefore mediates functionally between matter and consciousness by organizing physical differences into usable structures and embodied action. Mediation introduces neither an intermediary substance nor an ontological gap : the three operators are conjointly instantiated within one process.

The material operator is universally proposed within the scheme because every concrete actuality must become physically efficacious to enter public interaction, but this universality is immanent-metaphysical rather than experimentally established. Material dominance means explanatory salience : where physical states, interactions, energetic transformations, and spacetime relations suffice for the question at issue, no appeal to semantic meaning or individualized consciousness is required. Dominance does not imply exclusive instantiation.

The existence of three operators must never lead to three parallel worlds. The familiar analogy of hardware, software, and a user (userware) is nevertheless convenient when it depicts their *working conjunction*. Hardware provides physical realization, software provides organized architecture, and the user introduces understanding, intention, and choice ; a functioning problem-solving system depends upon their *coordinated activity*. In this restricted sense, the analogy gives an accessible picture of conjoint operation. It becomes ontologically misleading only when the three are treated as *independently* existing components. Matter is active rather than inert hardware ; information is not a detachable software-like substance ; and consciousness is embodied rather than an external user standing outside the system.

The three operators are distinguishable within one actual process and become concrete through their interdependence. The more adequate relation is *conjoint operation*. Energetic efficacy becomes determinate through formative organization. Formative organization becomes concrete through physical realization. Individualized sentient presence depends upon both and becomes publicly effective through their conjunction.

Matter is therefore necessary to information and consciousness without being sufficient for either. It is their indispensable physical efficacy, not their exhaustive explanation.

11. Critical Verdict

The scientific findings support a *dynamic conception of physical actuality*. Contemporary physics investigates fields, particles, interactions, symmetries, spacetime relations, probabilities, conservation laws, and scale-dependent effective theories rather than relying exclusively upon the classical image of inert corpuses.

These findings weaken substantialist interpretations but do not uniquely establish process metaphysics. Particle ontology, field ontology, structural realism, dispositionalism, event ontology, and process ontology remain competing philosophical interpretations of overlapping scientific formalisms.

The concept of matter as *energetic efficacy* is therefore an immanent-metaphysical reconstruction. It coordinates physical realization, interaction, transmission, resistance, and transformation. It does not name a substance, identify matter with energy, or add an operator behind the physical processes themselves.

Its strongest scientific support concerns physical efficacy and realization. Its processual interpretation is philosophically argued. Its status as one of exactly three irreducible and universally conjoint operators remains metaphysical and scientifically underdetermined.

Matter is *indispensable*. Without it, no organization could become concretely instantiated, no conscious intention could enter public action, and no achieved actuality could transmit physical consequences.

Matter is also *insufficient*. Energetic and interactional descriptions do not by themselves specify formative architecture, consciously understood meaning, valuation, or first-person presence.

Ultimate analysis removes the final temptation to reify the operator. Matter, energy, fields, particles, spacetime, laws, and actual occasions lack inherent existence. Their conventional identities depend upon relations, conditions, organization, and actual process ; their scientific identification additionally depends upon measurement, conceptual determination, and designation. Their emptiness does not abolish their conventional existence or efficacy.

The final verdict is exact : matter is critically admissible as the operator of energetic efficacy and the principal physical realization of efficient determination. It is real without being self-grounding, irreducible without being exhaustive, and

scientifically investigated without being scientifically established as a metaphysical operator.

Matter is not what remains beneath change. It is the physical efficacy through which change acquires consequence.

References

Anderson, P.W. : *More Is Different : Broken Symmetry and the Nature of the Hierarchical Structure of Science*, in : *Science*, American Association for the Advancement of Science – Washington, volume 177, issue 4047, 1972, pp. 393-396.

Aspect, A., Dalibard, J. & Roger, G. : *Experimental Test of Bell's Inequalities Using Time-Varying Analyzers*, in : *Physical Review Letters*, American Physical Society – College Park, volume 49, issue 25, 1982, pp. 1804-1807.

ATLAS Collaboration : *Observation of a New Particle in the Search for the Standard Model Higgs Boson with the ATLAS Detector at the LHC*, in : *Physics Letters B*, Elsevier – Amsterdam, volume 716, issue 1, 2012, pp. 1-29.

Bell, J.S. : *On the Einstein Podolsky Rosen Paradox*, in : *Physics Physique Fizika*, Physics Publishing Co. – New York, volume 1, issue 3, 1964, pp. 195-200.

Bohr, N. : *The Quantum Postulate and the Recent Development of Atomic Theory*, in : *Nature*, Macmillan – London, volume 121, 1928, pp. 580-590.

Bourget, D. & Chalmers, D.J. : *Philosophers on Philosophy : The 2020 PhilPapers Survey*, in : *Philosophers' Imprint*, Michigan Publishing – Ann Arbor, volume 23, issue 11, 2023, pp. 1-53.

Büchner, L. : *Kraft und Stoff : Empirisch-naturphilosophische Studien*, Meidinger Sohn – Frankfurt am Main, 1855.

Casimir, H.B.G., Polder, D. : *The Influence of Retardation on the London-van der Waals Forces*, in : *Physical Review*, American Physical Society – College Park, volume 73, issue 4, 1948, pp. 360-372.

Carnap, R. : *Überwindung der Metaphysik durch logische Analyse der Sprache*, in : *Erkenntnis*, Felix Meiner Verlag – Leipzig, volume 2, issue 4, 1932, pp. 219-241.

CMS Collaboration : *Observation of a New Boson at a Mass of 125 GeV with the CMS Experiment at the LHC*, in : *Physics Letters B*, Elsevier – Amsterdam, volume 716, issue 1, 2012, pp. 30-61.

Donoghue, J.F. : *General Relativity as an Effective Field Theory : The Leading Quantum Corrections*, in : *Physical Review D*, American Physical Society – College Park, volume 50, issue 6, 1994, pp. 3874-3888.

Einstein, A. : *Die Grundlage der allgemeinen Relativitätstheorie*, in : *Annalen der Physik*, Johann Ambrosius Barth – Leipzig, volume 49, 1916, pp. 769-822.

Einstein, A., Podolsky, B. & Rosen, N. : *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete ?*, in : *Physical Review*, American Physical Society – College Park, volume 47, issue 10, 1935, pp. 777-780.

- Englert, F. & Brout, R. : *Broken Symmetry and the Mass of Gauge Vector Mesons*, in : *Physical Review Letters*, American Physical Society – College Park, volume 13, issue 9, 1964, pp. 321-323.
- Fodor, J.A. : *Special Sciences (or : The Disunity of Science as a Working Hypothesis)*, in : *Synthese*, D. Reidel Publishing Company – Dordrecht, volume 28, issue 2, 1974, pp. 97-115.
- Goldstone, J., Salam, A. & Weinberg, S. : *Broken Symmetries*, in : *Physical Review*, American Physical Society – College Park, volume 127, issue 3, 1962, pp. 965-970.
- Haeckel, E. : *Die Welträtsel : Gemeinverständliche Studien über monistische Philosophie*, Emil Strauss – Bonn, 1899.
- Hahn, H., Neurath, O. & Carnap, R. : *Wissenschaftliche Weltauffassung : Der Wiener Kreis*, Artur Wolf Verlag – Vienna, 1929.
- Higgs, P.W. : *Broken Symmetries and the Masses of Gauge Bosons*, in : *Physical Review Letters*, American Physical Society – College Park, volume 13, issue 16, 1964, pp. 508-509.
- Koch, C., Massimini, M., Boly, M. & Tononi, G. : *Neural Correlates of Consciousness : Progress and Problems*, in : *Nature Reviews Neuroscience*, Springer Nature – London, volume 17, 2016, pp. 307-321.
- Kochen, S. & Specker, E.P. : *The Problem of Hidden Variables in Quantum Mechanics*, in : *Journal of Mathematics and Mechanics*, Indiana University Mathematics Department – Bloomington, volume 17, issue 1, 1967, pp. 59-87.
- Noether, E. : *Invariante Variationsprobleme*, in : *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen, Mathematisch-Physikalische Klasse*, Gesellschaft der Wissenschaften – Göttingen, 1918, pp. 235-257.
- Prigogine, I. : *Time, Structure and Fluctuations*, Nobel Foundation – Stockholm, 1977.
- Putnam, H. : *Psychological Predicates*, in : Capitan, W.H. ; Merrill, D.D., editors : *Art, Mind, and Religion*, University of Pittsburgh Press – Pittsburgh, 1967, pp. 37-48.
- Schlosshauer, M. : *Decoherence and the Quantum-to-Classical Transition*, Springer – Berlin, 2007.
- Tyndall, J. : *Address Delivered Before the British Association Assembled at Belfast : With Additions*, Longmans, Green & Co. – London, 1874.
- von Neumann, J. : *Mathematical Foundations of Quantum Mechanics*, Princeton University Press – Princeton, 1955.
- Weinberg, S. : *Phenomenological Lagrangians*, in : *Physica A : Statistical Mechanics and Its Applications*, North-Holland – Amsterdam, volume 96, issues 1-2, 1979, pp. 327-340.
- Weinberg, S. : *The Quantum Theory of Fields, Volume I : Foundations*, Cambridge University Press – Cambridge, 1995.

Whitehead, A.N. : *Process and Reality : An Essay in Cosmology*, corrected edition, edited by D.R. Griffin and D.W. Sherburne, The Free Press – New York, 1978.

Yang, C.N. & Mills, R.L. : *Conservation of Isotopic Spin and Isotopic Gauge Invariance*, in : *Physical Review*, American Physical Society – College Park, volume 96, issue 1, 1954, pp. 191-195.

Zurek, W.H. : *Decoherence, Einselection, and the Quantum Origins of the Classical*, in : *Reviews of Modern Physics*, American Physical Society – College Park, volume 75, issue 3, 2003, pp. 715-775.