Dewey and the Future of Naturalism

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Dewey united realism and idealism for an *empirical* naturalism. This naturalism would disarm metaphysical rivals and defuse internal schisms. The prospects for naturalism were not favorable in his time, and naturalism remains fragile for our time. Dewey did not blame the sciences. As science became increasingly theoretical, philosophers grew insistent that inferential methods are non-empirical. This was the neo-Kantian bargain offered to science: a scientific field expecting its theoretical posits to be accepted realistically had to admit that such objectivity was guaranteed by philosophy and its storehouse of conceptual necessities and logics. If a science dared to bypass rationalist epistemology for allying with mathematics then it paid the positivistic price, surrendering realism and clutching only useful calculations. Schism ensued and metaphysics revived, without clarifying what scientific realism could be. Is robust naturalism beholden to a priori principles beyond scientific purview? Or, without rigid framings, does weak naturalism get no farther than inductive empiricism?

Transcendentalism has had many labels since, all claiming knowledge of non-empirical certainties. Much of analytic philosophy remained neo-Kantian down to Quine and his heirs. The three-fold schism that erupted in the 1880s still set the discussion table by the 1980s and beyond. Empirical science gets caught in the middle between transcendentalism and positivism. One symptom is the battle over reductionism; another is the duality between classical and quantum physics. Dewey diagnosed the crucial issues and prescribed philosophical remedies. First, he denounced philosophy's obsession with permanence and necessity, neither of which characterize reality. Second, he showed how mathematics and logic developed within empirical inquiries and experimental investigations. I will not discuss these two agendas here. Third, Dewey's philosophy of science attempts to *naturalize* naturalism, against transcendentalism or positivism. As I outline here, that naturalization of naturalism completes his fusion of realism and idealism to restore the unity of naturalism. His philosophy is not a instrumentalism for anti-realism, but it does recognize the idealizing role of theoretical constructs, which in turns points in the right direction of naturalism's realism.

Dewey lived long enough to observe how microphysics abandoned substances, forces, and particles as fixedly fundamental. Dewey is an operationalist about scientific formulas; the quantum wavefunction satisfies his ideal-realism about scientific terms. All of physics and chemistry tracks innumerable energies to be formulated as interactive fields of indefinitely elastic potency. This is akin to Dewey's ontology of activity distributed in events across situations. All that dynamism means that reality is mainly qualitative and intensive, not quantitative and extensive. This view is not panpsychism or pan-experientialism; those extravagances insert as elemental what materialism scorns. Dewey's naturalism lies far from materialism, where no metaphysical mystery about mentalism ensues. That refusal to join materialism or physicalism was necessary for Dewey's project to naturalize naturalism.

Naturalizing Naturalism

Dewey's philosophy might be ineligible as a naturalism practically by definition. If naturalism requires a realistic confidence in scientific knowledge, but Dewey's approach to science discourages realism about theoretical entities, how does he offer a genuine naturalism? The philosophical issue concerns rival understandings of "realism." Dewey is a profoundly realistic philosopher; so realistic indeed that he countenances as entirely real many matters deemed illusory, inexplicable, or unreal by so-called scientific realism, such as experiential qualities, organic purposes, and natural values. Scientific naturalism seems quite unrealistic by comparison.

Scientific naturalism expected better cooperation from pragmatism. After all, pragmatism built a high wall around the scientific worldview to keep metaphysics and supernaturalism out because they don't work. Pragmatism's motto says, "Without a way to do real work, an idea cannot be true." Science got the message that "With a way to do work, an idea can be truly real." Did science get the wrong message? Pragmatism sometimes says that scientific theory isn't describing reality although it truly works. Now pragmatism seems to be confused. If a theory is *true* while working fine, its postulates should be *real*. After all, pragmatism holds that metaphysics and supernaturalism can't get real: their intellectual and spiritual necessities won't appear before the court of empirical trials. Yet when theoretical science does pass experimental trials, pragmatism next says that a theory's unobservables aren't real either. Does pragmatism insist on a double standard? If what is real is what works, then the workings of quantum laws should be as good as any naturalistic theory, and surely better than anything unscientific.

Pragmatism cannot contradict quantum physics and never suggests that it doesn't work. With regard for philosophy, pragmatism examines how scientific formulations and mathematical formulas perform their distinctive work for conducting experimental successes. With regard to science itself, Dewey's philosophy has no difficulty agreeing that science aims at accurate explanations about the workings of worldly affairs great and small. This approach offers a philosophy of *science*, however, and not an epistemic philosophy *about* science. Poor epistemology won't explain how any sort of knowledge is sought and acquired. By examining scientific methods, rather than mentalistic dialectics, Dewey was unable to agree that scientific hypotheses are mainly representational in meaning. Even where theories can be described to non-scientists in terms of picturable models, picturing is not the aim of a scientific field itself. Exceptions such as ornithology or surveying prove the rule that *experimental* science leaves pictures to introductory textbooks. In advanced science, complex models and diagrams are serving a different cognitive function of tracking potentials, properties, and interactions. An electron's "spin" is about quantum wavefunctions allowing discrete values for its angular momentum, not to be adequately depicted by a drawn model. An electron's conceptualization is constructed for formulaic equations, not its observational verifications. This understanding is not Dewey's own interpretation, but a feature of the logic of physics itself.

For Dewey, science aims at accurate explanations not through imagistic representations but through experimental *reproductions*. By reliably reproducing the predicted results of an controlled experimental process, confidence rises that theorized matters are participating as postulated. A postulated entity must be conceptualized as as engagingly participating in its own realization under experimental conditionings. The entity may itself come into instrumental observation, or perhaps only its sure effects manifest its presence, but that entity must be theorized as dynamic and interactive with experimental conditions. If not, both its conceptualization and its participation are left mysterious and useless for science, as far more metaphysical than anything natural. If a scientific realist can agree that a postulate about an entity consists of factors permitting its conditioned realizability, there is little left for disagreement, unless some non-scientific epistemic dogma gets inserted. For example, if the scientific realist also requires a postulated entity to possess its own intrinsic substantiality utterly independent from empirical conditions, Dewey must disagree on behalf of science with that metaphysical realism. As another example, if the scientific realist requires that scientific terms must comply with the referential semantics of ordinary language (e.g. subject-predicate propositions), Dewey sees no scientific reason for this linguistic reductionism.

The relation of philosophy of science to experimental science is as restaurant reviews are to chef recipes. Truth in general cannot determine realities in particular. Can philosophy determine how every successful theory must be referencing postulated real objects? Similarly, restaurants survive thanks to menu popularity, but nothing about the "real" secret to recipes can be inferred. Shall restaurant reviewers array themselves into instrumentalists, subjectivists, and realists, as philosophers of science do? "There must truly be an essential recipe factor common to all successful menus," says the cuisine realist, "otherwise there's no real explanation for these good restaurants staying in business for decades!" The subjectivist replies, "The only secret is an open secret, that each customer enjoys the fine dishes for themselves to know what a great recipe is really all about."

In frustration the instrumentalist answers, "Since none of us get into the restaurant kitchen, it is idle to suppose that anything can be known about any recipes, so they are just fictions while the eaten food is real." The realist cannot accept such agnosticism. "So you think terrific dishes just fly out of the kitchen without getting made in some special manner by those chefs? We must attribute all that deliciousness to something very real about such special cooking." The subjectivist retorts, "Each diner brings their particular expectations of deliciousness with them to the table for their own confirmations."

Each critic, like their philosopher counterpart, gets one thing right and one thing wrong about recipes. The would-be realist equates the successful "truth" of fine results with refined cooking procedures, but wrongly assumes that "the great recipe" has a singular form matching a substantial essence shared by all fine dishes. The philosophical realist similarly claims that all true theories ultimately are about the same fundamental reality awaiting all scientific investigations. As for chefs, if we could hear from them, they would confess to using refined techniques and also confess that adding salt and sugar is the only common tactic in the whole kitchen. The subjectivist is right to demand some particularity to the circumstances surrounding the consumption of menu entrees, but the eaters aren't dictating the qualities of the food. After all, as the restaurant critics admit, the same sorts of dishes stay popular for thousands of diners for many years, so the taste can't be all the tasting.

The instrumentalist, unable to believe with the realist that all those dishes have a substantially common form, hastily infers that the useful fiction of a "recipe" is the safe bet that lets cooks cook without giving the culinary credit to the diners. The chefs wouldn't agree with that forced alternative of "one recipe" or "no recipes" dilemma. If a master chef tried to explain that refined recipe techniques can achieve high culinary art with most any ingredients suitably prepped and combined in a "trial-by-fire" recipe invented as needed, would the philosophers understand? "But you chefs always deliver successful dishes with such reliable regularity, so something substantially the same must be in those dishes!" Can the chef explain how a great sauce is usually involved with entrees without the realist supposing that every dish has the same "true" sauce? The instrumentalist would grasp how "the right sauce" cannot be one single sauce for so many different dishes, since it only labels a formulaic method and not any particular ingredients. The ingredients can stay uncertain even for the chef, who may have to whip up a sauce on occasion from whatever happens to be on the kitchen shelves that day. And the chef can only smile at the subjectivist's view of the dining room, which would not stay full night after night unless diners' observations upon the menu dishes were reliably consistent.

A philosophical chef would point out how various kinds of cuisines involve differing uses of recipes. Some cuisines have simple recipes with common herbs and vegetables for gentle preparation and visual presentation. Other cuisines have complex recipes only suggestive of ingredient selections and staged blendings beyond all recognition. This philosophical chef also perceives the distinct yet coordinated roles for the cooking procedures in the restaurant kitchen, the consumed dishes for the discriminating diners, and the culinary traditions of recipe techniques. That is the realistic scenario sufficient for explaining the entire phenomena of popular restaurants. Accordingly, it is unrealistic to suppose that (a) just any recipe technique is about particular identifiable ingredients; (b) dish recipes are so objectively valid that they must exist independently from chef techniques; (c) entrees can objectively exist where there are no operating kitchens at all; and (d) fine dishes can dictate the terms of their recipes for culinary traditions to imitate.

Dewey's philosophy offers a humble scientific realism, within his overall *empirical* naturalism. All inquiry for Dewey is conducted within the experiment, the experimenters included. Knowledge is gained through *realization*: the created object known through its constructed conception as experimental design prescribes. (This is the fusion of the object and subject of scientific experience.) Knowers are operating within nature, not outside it; there is no "experimenter's eye view" external to a genuine experiment. Any scientific method discerns real things *where* and *how* they are confirmably *realizable*. That requires four tenets about the context of realization: (a) terms defined entirely in formulaic relations are not candidates for natural actuality; (b) no entity is known to exist independently from situations for its realization; (c) no entity objectively exists as known beyond conditions of its realization; and (d) conceptions of postulated entities are the responsibility of scientific communities.

Dewey in effect proposed a rule about operational methodology for the Conservation of Reality: scientific theory cannot put more reality into a postulate than scientific experiment can realize out of it. Four Methodological Conservation Constraints:

Rule 1. Conservation of Concreteness: a postulation only conceived relationally in generalities (e.g. definitions, formulas, equations) is not about a reality-bearing entity.

Rule 2. Conservation of Contextualization: a postulation is unrealistic apart from contexts for its realization.

Rule 3. Conservation of Conditionalization: a postulation is unrealizable absent conditions shown to yield it.

Rule 4. Conservation of Conceptualization: a postulation involves a candidate for realization while scientific theorizing treats its so.

The Contextualization and Conditionalization rules yield a rule about operational indeterminacy as a corollary,

Rule 5: Realizability Indeterminacy: where the context of assessing a system must entirely condition the manner of assessment, a postulation can display sets of mutually indeterminate properties or traits.

The unavoidability of indeterminacy is not a barrier to precise identification or evaluation where multiple modes of interaction can be directed at a system. All systemic contexts partly condition assessments, but varying contexts would allow perspectival and coordinate results. For example, the susceptibility of a molecule to synthesis will reveal some properties with precision while leaving other properties in obscurity. However, the combination of analytic and synthetic reactions expose a molecule's main set of stable exact properties. Indeterminacy becomes both on ontological and epistemological issue where just one relational context is uniquely available for assessment.

Transcendental naturalism ignores the methodological constraints and reality conservation rules. Against (a) there is the position that any postulate as a part of a successfully theory poses as a realistic candidate for actuality no matter its defined role. Against (b) there is the position that scientific knowledge is primarily about universal necessities and entities fulfilling those necessities. Universalist structuralism perpetuates a neo-Kantian prioritization of a priori factors to objective knowledge over empirical contingencies. Against (c) there is the position that entities known by science are real wherever they independently exist regardless of whether discovery conditions prevail. Absolute objectivism takes this standpoint against what it disdains as empirical mentalism. Against (d) there is the position that real physical entities determine their correct conception rather than scientific imagination and invention. Rigid representationalism requires this tenet for raising its strenuous opposition to the risk of unscientific relativism and subjectivism.

Positions (a), (b), and (c) together define scientific Fundamentalism: the entities formulated in the most universally independent manner are the most real and anything else has to be reduced to them to exist. For modern science, those entities are elemental as in the Greek tradition of Arche: they are the necessary parts within anything everywhere. Positions (c) and (d) together define Natural Kind scientism: Nature consists only of a large but finite set of natural kinds to be accurately represented in essential terms by scientific knowledge. All together, scientific fundamentalism together with natural kind scientism (compatible where independent reals aren't too nominalistic or pluralistic) combine for Elemental Physicalism: reality ultimately consists of a small set of universal micro-entities, accurately represented by realistic modeling, which in turn allow the existence of any other kinds of things.

Taken together, these positions of Transcendental Naturalism only appear to fulfil the fantasies of scientific realism but in fact they fail to be scientifically realistic.

Universal structuralism elevates formulaic laws of energy transformation (from cosmos-level gravity to quantum-level forces) into the truly real "prime movers" of anything else. However, laws at their finest only describe and prescribe the courses of events without causing them or taking responsibility for any actual existence. They are like the ideal constitutional laws for a country without any citizens. That is why structuralism seeks to pair up its schemas with concrete content. Absolute objectivism is ready to take responsibility for asserting the independent reality of natural beings and welcomes the regimentation imposed by lawful formulas to moderate what could otherwise be an infinitely pluralistic anarchy. As with Aristotelianism and Kantianism, welding matter to mind looks eminently objectivist: independent entities conduct themselves in rationally necessary ways. With nature in itself so ordered and well-mannered, its scientific knowability seemed quite simplified prior to the nineteenth century. However, post-Newtonian scientific advancement eventually lost confidence in idealized representationalism, as successful theories across scientific fields no longer appeared to be trying to mirror pre-formed and distinctive natural kinds.

The logic of scientific terminology does feature one distinction affecting the extent of Dewey's scientific realism. Postulates entirely conceptualized in only formulaic terms won't have any realistic physical interpretation. Nor do they need a realistic interpretation to perform their entirely theoretical functions for physical explanations. They describe regular patterns of energies and efficacies; they are not actual matters themselves. A realistic conceptualization of a postulated entity – as contrasted with equations, tensors, matrices, operators, Hilbert spaces, algebras, laws, and similarly abstract formulas – would supply its candidacy for ontological status. If scientific field needs to ensure a realistic ontological status for some sort of postulated entity, that scientific community can attempt to construct a realizable conception for it. Philosophy cannot compel physics to get real. Pragmatism recommends the four Reality Conservation rules.

Applied to a specific theoretical entity such an electron, the four Reality Conservation rules yield the following tenets:

Concreteness: as a postulate universally defined by charge, spin, and the wavefunction, "electron" is not conceived realistically, especially not as proton-bound in an orbital cloud.

Contextualization: as a postulate operationally defined, electrons emitted from heated or ionized molecules display detectible trajectories and impacts, so those contexts treat electrons as a producible kind. Electrons do not pre-exist ready for their emission or transmission outside such contexts.

Conditionalization: There is no wavefunction concept of what an electron is "really like" apart from energetic conditions allowing detection, and no individuated electrons are conceivable under experimental conditions. However, where natural conditions around the universe are similar, electrons are likewise produced regardless of observers.

Conceptualization: Future theoretical developments from quantum electrodynamics may permit a reconstruction of "electron" to permit a finer and firmer realizability. For now, scientific realism need not affirm entity realism for individual electrons.

The relevance of Rule 5 also assists with understanding how electrons are conceptualized. At the quantum level, Heisenberg's Indeterminacy Principle (as he called it) points out how detecting a particle's position, only possible through energetic constraints inherent to an experiment, forbids measuring its momentum precisely (or vice versa). This principle also holds at a macroscopic scale but stays practically undetectable. It is not about the experimenter's subjective uncertainty or a calculation's uncertainty. According to quantum physics, there's no instrumental purpose served by attributing those joint traits with independent exactitude; quantum laws reflect how nothing realizable would operationally follow from that excessive attribution. Lacking (as yet) any other way to measure quantum properties without managing energies at subatomic levels, physical law stays realistically indeterminate about electrons and other subatomic events.

This assessment from pragmatist physics might not seem to answer the simple question, "But are electrons real, Yes or No?" Simple reality belongs to simplistic metaphysics, while pragmatism is methodologically contextual. As we see, the "electron" is theoretically non-realistic and operationally realistic as an energetic kind of thing, countable but not individuatable. There is no contradiction in methodology here, and both conceptualizations by quantum physics deny that electrons have a static independent existence apart from energetic conditions permitting their realizability.

The scientific realist, seeking substantial natural kinds, refuses to agree with pragmatism here. If pragmatism only respects pragmatic grounds, the realist points out how radios and toasters wouldn't work without electrons. Indeed, technological formulas for electromagnetic processes, functional for such things as batteries, circuitry, lighting, and radio, really work. Operational success at most implies operational realizability, without automatically necessitating an independent reality for singular terms embedded in formulas. According to science, electrons are the kind of thing able to be realizable under a range of energetic conditions, but that range includes a very close range where a menagerie of virtual photons help to make up an electron's charge. Reality isn't so simple after all. Pragmatist physics is not treating the electron any differently from any other postulated matter, from astrophysical and earthly scales down to subatomic levels. Electrons according to physics are more realizable than undetectable quarks, but less realizable than quasars or quartz.

Dewey doesn't have a philosophy of science for telling scientific fields about which entities have to get credited with ontological materiality and which cannot. He is not doing revisionary or metaphysical philosophy of science when he is describing the internal logic of scientific methodology. The reason why exclusively formulaic terms lack ontological candidacy is not because they aren't explanatory (they surely are explanatory as aspects of established theories), but because they aren't conceived by science in terms of conditioned realizability. Only an unrealistic metaphysical fallacy demands that anything with an explanatory role must stand in full dress on the ontological stage. With experimental science, much is indicated by the theoretical script to indicate off-stage contexts never to be seen. Laws, for example, formulate and prescribe how matters can be patterned and propagated, but they are not themselves controlling causes or powers.

What does Naturalism become after the demise of substantial natural kinds? The idea of "natural law" must shift dramatically, because there can be no laws about non-existent kinds. What do laws of nature govern? Scientific representationalism continued to worship the ghost of the departed natural kind, erecting the "structure" of matter as an idol so that laws of nature could dictate the activities of elemental matters. Physicalism in philosophy marched on during the 20th century with the banner of its idol held high. That idol worship in turn fostered churches for reductionism, emergentism, and domesticated dualisms. However, elemental physicalism had already broken apart as the quantum realm became better understood.

Pragmatist Physics

Dewey's philosophy of science resists epistemic mystifications and metaphysical reifications imposed on experimental sciences. That is why his philosophy doesn't seem realistic enough to philosophers, and looks divergent from scientific naturalism. Because Dewey's natural philosophy is actually quite realistic, he won't comply with regimes of representationalism, reification, and reductionism. His pragmatic naturalism only looks defeatist or deflationary to mentalistic, linguistic, and metaphysical inflations of scientific realism. Dewey's naturalism raises scientific resistance against metaphysics, and does not give yet another metaphysical interpretation of physics. That resistance to metaphysics gets exemplified by the approach that Dewey's philosophy of science applies to quantum physics.

As the 21st is acquiring greater familiarity with the quantum realm, little pragmatism is needed for doubting whether scientific realism applies to quantum matters. Rather than labeling this approach as Quantum Pragmatism, which suggests that pragmatism takes the quantum realm as a special case, we shall here only discuss one Pragmatist Physics for all micro- to mega- spacetime scales. Nor would pragmatist physics reduce quantum theory to subjective representations abut the belief or knowledge states of particular experimenters. Pragmatism mainly serves as a way to take serious everything that physics, whether classical or quantum physics, has to require for experimental confirmations, while fending off unwarranted metaphysical interpretations. In that way, pragmatist is more scientifically realistic than strong philosophical realism. By taking quantum physics seriously about its manner of understanding basic laws, pragmatist physics denies that quantum entities are real in order to get realistic about quantum energies. What quantum physics reveals about inherently dynamic reality is what Dewey's philosophy says about naturality as a whole.

Realism has traditionally demanded that the known object must stably exist independently from that knowledge gained by a detached observer was an axiom wielded for repelling idealism. However, idealism soon returned, not from the direction of the knower but from the nature of the known. The quantum entity, as quantum physics utilizes it, had to be conceived non-realistically, due to lacking inherent fixed traits of its own, behaving collectively and never in isolation, and displaying variable traits depending on the manner of its detection. Its detectability allowed some traits to be precisely measured but not others, leaving in doubt whether it has any intrinsic stable properties of its own, or any steady properties between detections.

Quantum realists impressed by the verified truths of quantum equations insist that those formulas are surely real. That stance is idealistic by crediting mathematical relations with truth. Realism may have no other choice but to seek reality in ideality. The entire conception of something subatomic consists of formulaic equations in which terms only convey meanings related with other mathematical terms. The equations hold together without any need for any of the terms to represent something physical. What if a subatomic particle had its own individuating features, making it a little substantially different from others? Every actual 10-penny two inch nail in hardware stores microscopically differs a bit in weight and length. The tiniest variability at a subatomic level would compel the reliability of quantum laws to collapse. Metaphysics may ponder if there are actual objects corresponding with terms in quantum equations, but the equations truly forbid correspondence, or even approximate isomorphism. They are notoriously silent with regard to what their formality could be about in actuality.

What should count as "realism" about the subatomic realm has been split over observability, continuity, individuation, localization, causality, and essentiality. Quantum theory does not treat subatomic things or properties in a realistic manner. The quantum level lacks continuities between interactions, the notion of trajectory or path for a particle cannot apply (and time itself may be quantized), and even motion has to be a statistically probabilistic matter (even subatomic motion may be discontinuous). No strict temporal ordering of subatomic events is possible. We can neither know *where* nor *when* any quantum entity definitely exists; none of them are even discrete and detached from others. The way that statistical “superposition” and particle-wave “complementarity” characterizes the quantum additionally confirms the non-realistic status of the quantum realm. In addition, it is impossible to individuate subatomic entities. For example, each electron is absolutely identical by definition, only to be differentiable by its cloudy habitat. Without precise observability, continuity, individuality, or locatability, realistic causality no longer seems applicable within quantum physics.

If non-deterministic correlations among non-specifiable entities can count as causes, that “quasality” of statistical system evolution could substitute for the outdated notion of causality as a transmission of force among substances. This is a quasi-realism at best, given that nothing subatomic can be fully specified prior to interactions, only transitions and transmissions of energies can be formulated, quantum fields describe force propagation without causing it, pervasive entanglement is everything’s fate, and any observation is the unique creation of detection. If this interpretation of mathematical formulas counts as realistic enough for the quantum realm, it must be an idealized-realism. That’s pragmatist physics’s stance. The rival stance that quantum formulas are themselves the structurings of potent quantum events sounds reminiscent of universalist structuralism. However, any metaphysically realistic interpretation for the “quanta-in-itself” beyond the reach of experimental realizability only adds unnecessary confusion for both philosophy and physics. No formulated terms in quantum equations *must* have an ontological reference in order to permit accurate experimental results. Physical laws primarily function preferentially, not referentially. Those term-laden formulas are indicating predictive preferences about measurement outcomes, rather than making realistic references about unobservables.

Pragmatist physics would be unsurprised how the results of an interaction (a measurement) depend on the type of interaction imposed experimentally. It views the label of “wavefunction” as a wise warning against substance, structure, or nomological realism. The wavefunction doesn’t function like a classical law of nature, and it does not lend itself to any clear objectification. Particles are manifestations of their quantum fields, and so are fleeting “virtual” particles (such as electron-positron pairs), but all particles are just more or less temporary excitations through quantum fields. It is impossible to get reductive about quantum fields themselves because there’s no unique ontological way to “rightly” describe them and they are not formulated to be substantially “elemental”. The reason why multiple interpretations all fit the experimental data is because *no* realistic interpretation is needed to account for predictive success. Shall the quantum field itself be credited with reality? That field just consists of the formulaic equations allowing its predictive power, but no field is a “power” in and of itself. Fundamental quantum laws are scientifically operational and not themselves “real” in any realistic sense.

Pragmatist physics takes into account everything that subatomic physics is able to say about eliciting the production of quantum-level events. Forgetting the participatory role for experimental conditionings was a privilege of low-energy classical physics. That innocent transparency and honesty of scientific instrument was dogmatically enshrined ever since Galileo humiliated theological skeptics suggesting that odd imperfections in the heavens were actually inside any telescope’s human construction. Eventually, however, that question of instrumental interference ended up as a scientific necessity. Modern astronomy had to deconstruct light from stars or atoms with spectroscopes and interferometers in order to reveal its secrets. In physics and chemistry, that aloofness assigned to instrumental function had to collapse. Similarly, in quantum physics, that “collapse” of the wavefunction occurs, not because a pre-existing isolated particle has an indeterminate state prior to its detection, but rather because the attempt to first experimentally get a particle into isolation puts it into that indeterminate energetic phase, which is next simplified with its detection through interaction. The introduction of the detection device is not the first step of the experiment: the energetically controlled conditions introducing the subatomic affair to be measured takes initial control over energies for the subatomic system under examination. Injecting energies into a dynamic system and watching energetic particles come out amounts to the observation of predictable energy conversions.

The ”discovery” of the positron illustrates how pragmatist physics treats physical equations. The Dirac equation for relativistic electron motion had multiple solutions, suggesting an electron with “negative” energy. Positing this “positron” was just as legitimate for the equation. As a particle produced from high-energy discharges from superhot plasma and radioactive decay, the positron must manifests energy conversion and conservation, just as any other ripple in quantum fields, and it finds its dissolution upon meeting an electron to yield electro-magnetic waves. What got labeled as a positron was Dirac’s discovery of the energetic satisfaction of certain formulaic operations, and not something defined realistically.

The 20th century achievement of “breaking” subatomic matters into finer subparticles should no longer be treated like analytical chemistry by philosophy. Would a chemist conclude that the synthesis of rayon from cellulose dissolved in hot acids really shows how rayon was already hidden inside wood pulp? Energies manipulated in experiments do elicit subatomic manifestations matching the amounts of energy applied, but the newly freed particle did not exist prior to those energetic infusions. Besides, those subparts principally act to hold together what had been whole. The way that any subparticle conveys its binding influence calls for an internal flux-like dynamics, suggesting sub-subparts within each subpart, and so on. Writing in 1902, Charles Peirce anticipated the discovery of subatomic components but he also predicted how subatomic bits of matter would dissolve into energetic fluxes, only to harbor even smaller particles embedded within those fluxes.

> “But a question at this moment under consideration by physicists is whether matter consists ultimately of minute solids, or whether it consists merely of vortices of an ultimate fluid. The third possibility, which there seems to be reason to suspect is the true one, that it may consist of vortices in a fluid which itself consists of far minuter solids, these, however, being themselves vortices of a fluid, itself consisting of ultimate solids, and so on in endless alternation, has hardly been broached.” [Peirce, CP 1.249, 1902]

Pragmatist physics does not forbid such theorizing, but it cannot endorse entity-realism “all the way down.” Peirce and Dewey understood how physics would have to surrender its fixation with elemental substances and natural necessities. If Peirce were shown how the atomic nucleus has proton and neutron parts composed of subparts called quarks, and how the quark had to be analyzed into 12 types differentiated by roles exemplifying the nuclear strong force, which bind to each other thanks to eight sorts of gluons conveying that strong force among them, he would be impressed but unsurprised. Subparticles convey attractive or repulsive influences in the form of fields, of which they are prominent concentrations. Not long after a subparticle is proposed an account of its properties is required, which in turn suggests sub-properties, but those aspects wouldn’t persist together without a binding energy in turn. As for Dewey, he lived into the atomic age, and his daughter Jane Dewey did research with Niels Bohr and Werner Heisenberg in the 1920s. He occasionally wrote about relativity and subatomic physics as confirmations of his philosophy.

Pragmatist physics understands quantum laws as realistically as they themselves demand. Scientific realists rushing to protect the honor of quantum physics misplace where its kind of realism is actually located. The Reality Conservation rules offer the way to get comfortable with non-locality. It must not be metaphysically presumed that any sort of subatomic affair is awaiting its spotlight in a pristine state prior to energy-induced observation. That wavefunction of Schrödinger’s equation is instead a contextually emergent feature of the experimentally controlled system. Schrödinger himself saw no subject-object separation involved. That detection event merely re-unifies in measurement what was never locally divided within such a holistic system. Indeed, in a manner of speaking, the experimental measurement is as much about the state of the detector as the state of the detected. Pragmatist physics makes no place for a dichotomy in principle between quantum processes without measurements occurring and quantum behavior while measurements are made. Non-locality and contextuality implicate each other. In general, there is no place for anything but a functional distinction between the “system” and the “apparatus”.

Dewey's Idealism-Realism unification accounts for the holistic character of quantum physics. The scientific conception of a quantum entity or event is more idealistic than realistic, not because mind is lurking around beneath atomic level, but because quantum terms are about idealized formulas for predicting experimental observations under specified energetic conditions. This "Ideal-realism" about the quantum realm does not demand more realism than allowed by the idealizations of quantum laws. Pragmatist physics is not anti-realist. It agrees that some sort of energetic action in the form of processive activity is ongoing at subatomic levels, and it concurs that detections and measurements really occur where experiments succeed. All the same, demanding anything more "realistic" from quantum physics is scientifically unrealistic. Rival interpretations for quantum theory that require no modifications to fundamental quantum laws or predicted experimental trials are seeking ontological differences that *so far* make no difference. However, ambitious ontological interpretations may imply quasi-realist conceptions about conserved values, such as the Bohmian probability density through time, or interpretations may suggest new mathematical formulations that suggest decisive empirical testing.

Pragmatism does not resort to an "underdetermination" argument denying any degree of realism to the quantum realm, because pragmatist physics is not anti-realistic. Unlike anti-realist empiricisms, pragmatism encourages abductive theoretical innovations with the potential to yield realizable implications. Quantum theory may attain some sort of completeness. The atom itself was once regarded as entirely theoretical without a realistic chance at empirical realizability, but energetic physics successfully tested atomic models. Pragmatism is not a philosophy for looking back at past scientific advances to see where realism was theoretically vindicated. Realism is a bet placed on theoretical innovation to extend the range of experimental trials.

Ideal-realism at the quantum level must suffice philosophically, just as quantum mechanical formulas suffice experimentally. However, it would be another metaphysical leap to suppose that this Ideal-realism is not an objectivism but instead subjective. Pragmatist physics is objectivist about experiments and their outcomes, it holds that quantum laws are about objective natural processes, and it asserts that quantum physics gets experimentally confirmed because of the way the world works. Dewey's Ideal-realism has nothing to do with subjective idealism or mind-centered metaphysics. His Nature Philosophy requires Objective Ideal-realism in which scientific theory is responsible for postulations, researchers control experimental conditions, and nature responds accordingly. The natural fact that observers are within the natural system of experimentation implies nothing about mentality dictating experimental outcomes. This Objective Ideal-realism, while a contextualism, is not a sort of relativism or perspectivalism.

Contextualism, both epistemic and ontological, bridges the quantum and classical realm with the same approach to experimental science. Putting macroscopic matter into the state of superposition, or entangling photons across great distances, is quite consistent with pragmatist physics. It is a legacy of elemental fundamentalism to worry about a paradoxical state of entanglement permitting supraluminal effects. In fact, two discrete "particles" once entangled do not get disconnectedly separated, and their measurements are conducted on the same spread-out entity. Packets of quantum energy must be blobby and clumpy, rather like ordinary matters. Besides, what counts as "local" is always a relative matter; a photon-pair spread across miles is still fairly local compared to cosmic scales. After all, subatomic particles are more like crests of fluctuating fields than they are like discrete countable objects.

For Dewey, nothing about Nature is discretely atomistic and causally deterministic at any level. Holistic systems have ontological priority over fractional elements: this pragmatist physics would replace universal atomism with "globule globalism". This "globbiness" should not be scaled up to engulf the entire universe. Quantum "superdeterminism" would contradict opportunities for local chanciness in experimental actions. However, given the weight of evidence for quantum non-locality, we probably do not live in a single Blob Universe of the sort to offend William James's aversion to a Block Universe of determinism. Dewey wouldn't be able to lend realistic credence to a scientific standpoint outside the universe to judge the total activity within.

From the pragmatist physics, the alleged divide between classical and quantum levels is eliminated. Classical mechanics was the aberration for philosophical realism, not quantum mechanics. All science is about controlling transactions with dynamic natural processes. Quantum physics and statistical quasality are entirely scientific and better exemplify pragmatism's expectations than classical mechanics. That universality to quantum fields betrays their holistic applicability, not their essential fundamentality. For Dewey, science can only track and predict the dynamical progressions of affairs under constrained conditions, as wholes develop from wholes. What subparts must be doing in and of themselves can be postulated, but only as transactional phases of holist progressions, and never as inherently independent components only exchanging external effects among each other. Holism and contextualism characterize all physics. If "emergence" can be a pragmatist term, it must be transactional: the atomic (and subatomic) emerge from high-energy chemistry as much as the chemical and biological levels of complexity emerge from the atomic.

Pragmatist physics makes a better match with all of physics. It dispels the dichotomy between the quantum and classical realms, since it does not demand elemental isolatable parts, effective regulative laws, or strict causal determinism anywhere in the natural world. Dewey's nature philosophy expects all entities to be in perpetual modes of conditioned arising and probabilistic entanglement. Scientific laws only formulate how nature can be observed to act under various energetic conditions. general, that operational theorizing must respect the symmetrical conservations of energies and the methodical conservation of realities. Those conservation principles are, for pragmatist physics, what would be expected from investigations embedded within the natural whole getting investigated.

<u>Minding Nature</u>

Recent experimental science itself has undermined transcendental naturalism, although most philosophers of science haven't noticed. The supremacy of quantum physics was celebrated by scientific fundamentalists and neo-Kantian structuralists, but there remained no guarantee of concretely independent particles. Elemental physicalism requires a strong realism that the quantum physics won't deliver. Quantum fields aren't even elemental and any substantial sense; their unstable flux among each other and through each other confound localization, determination, and representation. While that dynamic and fluid micro-ontology makes vital sense as a relief from materiality's inertness (and accords with process philosophy from Hegel and Herder to Whitehead and Dewey), quantum formulas by themselves lack realistic import, allowing metaphysical interpretations to multiply.

What quantum systems do realistically require is interactivity for any determinativeness, so the procedures of investigation cannot be isolated apart from the entity's behavior. Mentalism is not thereby ruled into the equation, despite follies about the "observer" causing the observed measurement. Instead, the mind's metaphysical role (per absolute objectivism) as an aloof perceiver gets ruled out. Attempts to insert an unnatural mind into natural processes begs the question against naturalism. Mentalism has claimed that, "Observers collapse quantum wave functions, so resulting particles are consciousness-dependent, and hence physics must admit how the unnatural is responsible for the natural." This claim commits three fallacious steps: (a) premising that naturalism flimsily can't handle statistical causality; (b) assuming that 'consciousness' is unnatural too; and (c) forgetting that naturalism includes naturally interactive knowers within nature.

As other scientific fields have also had to admit, the processes of executing a careful experimental project automatically engages the prior state of whatever is the investigation's target: its performance is always relationally staged. Ordinarily, this transactional relationship makes no difference to the validity of the results. Running a current through a wire must modify both the behavior of moving electrons and properties of the wire (its temperature, for example) but the resulting amperage measurement is valid given those experimental conditions. What would be fallacious is to attribute to electrons the same behavior in the absence of that conditioning differential potential.

Although science in practice understands how a carefully controlled experiment adjusts natural conditions to bring the intended object of inquiry into existence, that sounds like cheating or even fraud. The twentieth century has surpassed the simpler stages of accumulating obvious facts, sorting out innumerable types of natural things, and bringing even things great and small more into instrumental view. Advanced science then had to design experiments not to bring a hypothesized entity into view but rather to gather evidence of its postulated effects.

Dewey can be a realist about scientific entities where science treats them realistically. He is no sort of phenomenalist, positivist, verificationist, or anti-realist instrumentalist. However, Dewey denied that scientific method must presuppose or infer that entities must exist precisely as known beyond their conditioned contexts of realization. It is a metaphysical claim, and not a scientific principle, that once an entity has been empirically confirmed it must have pre-existed precisely that way absent any inquiry. Metaphysics depicts the experimental effort to discern it as merely the staging for letting Nature reveal itself exactly as it is in itself unstained by human intercession. On the contrary, for pragmatist science, the object that becomes known is affected by the processes of its empirical detection. Experimental conditions do allow Nature to yield the postulated entity in action, but not necessarily as it was beyond those conditions. Mechanistic materialism is a false naturalism by halting at reductionism without respecting the broader productionism making matter possible.

Dewey consistently denied the reality of atoms as conceived by philosophical materialists. By drawing attention to materialism's thin conception of atomic theory, Dewey points out how materialism denies reality to atoms all the more that it philosophically conceives them to satisfy metaphysical principles. Physics need not do this, and physical chemistry would soon conceive an atom very differently, as a bundle of variable repulsions and attractions due to electron orbits permitting characteristic bonds in the formation of molecules. Dewey never objected to that effective-affectual model of atomic inter-reactivity.

Dynamism and consociation (not just motion and association) are the traits of energetic reality. If anything deserves the status of a "universal" trait of reality, it is being-in-activity. Scientific modeling should accordingly be more than "formal" by postulating entities that are "conformal": in their inter-reactivity, they are mutually modifying each other's form. Like Peirce and his attribution of thirdness to reality, Dewey expected more than contingent impacts (secondness) by looking for regular affinities and productive syntheses proposed by scientific models. The world's complexities cannot be "built up" from insubstantial simplicities. His objection was not raised against science's right to formulate idealizations, but only against philosophy's projection of them into antecedent and independent realities.

Dewey remained staunchly opposed to materialism for the rest of his career. Critics struggled to understand why an advocate of naturalism refused to incorporate material nature into his philosophy. His insistence that experience is just nature itself proceeding with special modes of dynamism, and that physical objects remain inherently qualitative and quantitative in their activity, was the position of Ideal-Realism that left neither camp satisfied.

Dewey's 1925 *Experience and Nature* demanded that experience is natural, as natural as anything in a physics textbook. Just as experientiality extends down deep into nature itself, natural objects generate expansive qualitative experiences. If atoms are realistically conceived then they must be experientially realizable. He wrote in 1925: "It is as much a part of the real being of atoms that they give rise in time, under increasing complication of relationships, to qualities of blue and sweet, pain and beauty, as that they have at a cross-section of time extension, mass, or weight." [LW 1: 91]

This pronouncement upon atoms exemplifies Nature Philosophy. This view is not the reductionist's emergentism calibrated for distancing qualities away from atoms themselves. Dewey denies that philosophy should imagine that the qualitative world emerges from the quantitative realm. Qualities have temporal stretch and intensive depth whereas quantities such as shape and volume lack duration, affect, or influence. The quantitative cannot be more naturally fundamental. Does current physics deny such qualitatively expansive properties to atoms? Then physics is demonstrably inadequate on its own terms. Physics cannot dictate naturalism by assigning metrical features to atoms and leaving all else as accidental qualities beyond scientific responsibility. Emergentism is just epiphenomenalism by another route of mystery. At least dualism rationally expects matter to stay matter and mind to be just mind. Dewey's view by contrast isn't just scientific naturalism, but Nature Philosophy.

Dewey outlined the only metaphysics that philosophy and science needs. Like Mach, Dewey denied that mechanistic materialism's atoms actually exist. This was no positivistic dogmatizing, but sound philosophy of science. Only a scientific conception of atoms (or of anything physically fundamental) as interfusing and inter-affective could be legitimate. That is why his *Experience and Nature* asserts that real atoms in complex contexts possess intensive qualities as well as extensive quantities. This is not "emergence" as later enthusiasts for mechanism, reduction, and supervenience imagine, because Dewey needs no "... and then a miracle happens" step between the quantitative and qualitative, having never divided them in ontology. Both the quantitative and qualitative are together co-emergent within dynamic contexts, but not from anything more fundamental, and never in any pure manner. Quantities with quality, or quality without quantity, are only seen in the imagination.

Biology and Normativity

For normless naturalism, normality cannot exist, and anything about life or humanity that exemplifies "normality/abnormality" cannot be of this world. Idealism eagerly takes up the story of humanity from there, followed closely by theism. As for norming naturalism, it locates normativity within nature precisely where science examines it, without imposing dichotomies dividing the normal or the mental apart from the natural. We shall accordingly examine the biological realm to discern the natural normativity.

All living processes are chemical processes, but not all chemical processes are living, and life's chemistry has properties and powers absent in non-living processes. It is not merely in the self-sustaining functioning of a chemical process where life exists. A *lifeform* is at minimum a whole with parts that modify their interrelationships in ways conducive to the whole's changing interactions with its surroundings that allow it to persist. Failing that dynamic persistence, the lifeform perishes by degenerating into mere chemistry.

More complex definitions for life, inclusive of "reproduction" and "speciation", are unnecessary here, since we are seeking norms anywhere they can be accurately located in nature. Where there is life, there is chemistry; life is always composed of natural chemistry, although life includes features and functions beyond simple chemistry. A lifeform has a body, which not only displays adaptable functioning with its environs but accomplishes that through the flexible functioning of its parts. This "two level" functioning, of parts within the bodily whole and the body's functioning within its environs, accounts for life's resilience and its tendency to acquire more complex forms. Life can also be studied as "three-level" functioning when the sustenance of life's environs is included, but that ecological perspective presumes the existence of lifeforms, where this discussion is focused.

Life is inherently *telic*: the two-level part-and-whole co-functionings intrinsic to a life form's activities are rightly said to be functioning for purposes. If the whole body seemed to be functioning for some end but its parts are not altering their interrelationships during that activity, then any purpose it serves is due to an external relationship with something else. If a whole's parts are continually altering their interrelationships yet no modified functioning of the whole vis-à-vis its environs is the result, such inflexibility may be convenient but nothing purposive is present either. However, where parts are persistently functioning to serve the whole's perpetuation, the entire process is truly purposive. Life is not merely autocatalytic, and more than self-organizing – a lifeform is adaptively self-*reorganizing*.

Norms possess an operational way of existing – they are neither purely functional nor mechanical in nature. Imagined in the abstract "in themselves" apart from manifestations, norms appear formless and causeless. "A lifeform should survive" conveys nothing specific about how a specific lifeform shall survive, and no concrete organic design swims into view for inspection. Norms of life exist telically and operationally: a lifeform is behaving normatively in its specific purposive behaviors, doing what it should be doing within its environs to maintain its life. "A sunflower plant should twist its flower to follow the sun's track across the sky" is an operational account of its normal behavior.

This is the biological realm where norms exist. The oft-given example of a candle flame, altering its interactions with its fuel while persisting despite breezes and such, is not a lifeform on the operational definition and hence fails to be a counterexample. A candle flame is only a counterexample to a simplistic functionalist definition that finds a norm anywhere there is functioning for continuation. Flames follow no "norms" and lack values in any normative sense. Indeed not; norms pertain to life's processes, not chemistry in general. A candle flame has "parts" of heated carbon residue, but those rapidly rising and cooling residues are not modifying their interrelationships to serve the candle's perpetuation. They stay heated until they aren't, as they dissipate. The heat melts more wax and keeps the flame lit, but the hot carbon molecules are not modifying their interactivity to do so. Nothing about the candle flame is *trying* to melt more wax to better ensure its continuation or avoid its extinguishing.[10]

By contrast, the adaptive activity of a life form – from an amoeba's sensitivity to a saline gradient to an ant's search for food – is evidently for its purposes of its own. The inevitable "extinguishing" of failed life does not deliver a "death blow" to this understanding of norms, either. The very fact that we observe life regrettably failing in death, while the candle flame can't be seriously faulted for going out, means that we are already observing the purposive activity of life as it inexorably journeys towards death. Only life fails in death, but by then it has already succeeded in living.

Biology is *naturally* just complicated chemistry, but life is *normatively* so much more. All the same, no ontological chasm opens up before our wondering eyes. Life is indeed amazing, but it needn't be metaphysically bewildering. There isn't materiality *here*, and then vitality *there*, without shared properties or common ground. Vitality is far-from-equilibrium yet robust chemistry where entropic conditions permit. Just as vitality is grounded in materiality's robustness, normativity is grounded in vitality's persistent resilience. The lifeform is supposed to be perpetuating itself through its characteristic activities, in the form inherited from its genesis. No lifeform entirely constructs itself, but it must continually reconstruct itself. Normativity is conspicuously exhibited in vitality's genealogy and regeneration.

A lifeform comes into its own existence imbued with the purpose of self-sustenance. Only telic goal-directed activity is involved here; some grander teleology is not. Attributing a purpose to the entire genesis and existence of life assigns an external end not of its doing. That sort of cosmological teleology actually eliminates the normativity discernable in vitality. No teleological explanation of life arises from the definition of life offered here. Normativity has no need of teleology, or a designing Creator. Life as a whole need not serve any larger purpose in order for lifeforms to pursue their own values. Normativity is inherent *within* life's pursuits, not behind life to compel it, nor ahead of life to impel it.

Again, norms do not make anything happens for life. It would be a mistake to ask, "The whole with its parts are purposive now, but when is anything normative happening here?" To see the purposive activity is precisely to observe the telic normativity. We are not thinking, “Those parts are doing what they are doing for the sake of following some norm.” What those parts are doing for the sake of the whole’s goals *is* the satisfaction of norm(s). There are no norms lurking nearby or hovering spectrally over the scene. Neither the whole nor its parts are first consulting a norm as matters are set in motion; no “norm” is needed to initiate or guide the purposive processes. When birds are in flight as they pursue their aims, we don’t think, “That bird is flying the way it does in order to follow a norm.” Birds are just normally flying as they should.

Normative naturalism does not amount to transcendental idealism. Idealism takes organisms to be persisting in their activities for the sake of following norms, and those norms have a non-natural and transcending reality beyond all nature. No matter how closely idealism looks into an animal behavior or human practice nothing normative comes into view as the idealist keeps asking, “But what is the norm that so much activity is conforming to?” This notion of a norm is just a pale version of “law” standing over practical matters to ensure their rationality, and such “law” is the faint echo of divine command descending to dictate this world. No naturalism is under compulsion to respect that notion of the normative.

Norms are not yet another kind of goal or end, external to vital activity. If a norm were just some sort of end, it would either be an extrinsic end assigned to life, or a second norm would have to be invoked to explain why life should follow the first norm, but then a third norm is thus implicated too, and so on ad infinitum. However, norms are neither prime movers nor an infinite set. Normativity is an operational attribute of purposive vital activity anywhere in the realm of life. It is not simply a description of its current behavior at this particular moment, nor is it an explanation for the distinctive character of that activity. It is the dynamical mode of that activity itself, for its own sake.

Sentient lifeforms display such complex modes of activity that there is a straightforward explanation of their behaviors in terms of needs and values. An organism *should* normally pursue its values, since failure surely brings death, so values are factually normative. No violation of that notorious “Is-Ought” dichotomy is happening here, since the living “ought” *is* truly a veritable “fact” of life. Subtract the oughtness, and the biological facts disappear. Accordingly, the natural existence of values disproves normless naturalism.

The Scientific World and the Phenomenal World

Subtracting the operative, qualitative, and purposive factors to reality put scientific theory in a palace of splendid isolation. That isolation was only temporary. Quantum physics restored the primacy of operational functionality to theorizing. The transactional dynamism to all physicality restored qualitative efficacy to its rightful place. The metabolisms accomplished by organic lifeforms illustrate how values accompany vitality. Theorizing itself emerges from directed investigations into nature’s stabilities and symmetries. There is no longer anywhere for a metaphysical dichotomy to divide the phenomenal and scientific worlds apart.

Galileo was right about translational invariance but wrong about primary properties, and Newtonian mechanics universalized physical laws but mistakenly applied them to inert matter. Interestingly, Galileo labeled basic properties as “primary affections.” If physics has followed out the energetic affordances to elemental matters, there would have been no “primary vs secondary” dichotomy splitting apart the known from the knower. Qualitative affections or affinities supplies the singular category for reality, differentiated into endless spontaneous novelties and levels of qualitative complexity. Inorganic chemistry involves reactivities such as meltings, oxidations, and crystallizations. In organic chemistry, self-replicators prefer inter-responsivities with environing free energy for combustion.

Nature is inherently dynamic and transactive. Attractings and conservings bind atomic activity and forge molecular bonds. Engaging valencies activate all chemistry, while life’s chemistry seeks nutritive energies. Affinity, affect, affordance, and effort are all-pervasive at distributed degrees of complexity. No mechanistic effects can last any duration or make any difference except as phases of these activities. Only the constraints of artificed conditions construct entirely mechanical forces. The very idea of force only has sense for the animate; for the inorganic realm only detachment or absorption are the rule. Replicative chemistry assembled self-assembling cycles of selective assimilation. The only necessity at far-from-equilibrium conditions must be organic reconstruction or else suffer degeneration. Sensitivity and proactivity need no unnatural introduction into nature, nor does vitality, and ultimately, neither does mentality.

Dewey's naturalism offers a process ontology of qualitative temporal transactions. Rather than postulating discrete substances, reality consists of situational events that overlap through processes with endless continuities. Experience simply names an especially complex sort of process involving organisms, but that dynamically qualitative character to processes in general extends to the smallest and greatest scales. Dewey was not a pan-experientialist, a dual-aspect monist, or a panpsychist, since he denied those extravagant idealisms. Organisms are required for *experiencing* and neither chemicals nor galaxies are organisms. However, all of nature is diffusively qualitative, so organic experiencing must naturally be extended four-dimensionally. Nothing qualitative emerges from the purely quantitative. That tenet is not an invitation to spiritualize quality – nature has always been qualitative and never only metrical.

The reason why experience only exists within nature is not because all nature is made of experience, but simply because organisms are all-natural in their chemical, metabolic, and behavioral activity. No mysteries about where to put experience within nature arise for Dewey's pragmatic naturalism. Dewey's pragmatism naturalized reason with an historical naturalism, rather than reducing thinking to either transcendent forms or mechanistic matters. Our rational capacities developed from countless generations of ancestors undertaking goal-directed interactions with the environment, primarily aiming at surviving and enjoying natural goods. The stages of thought are functional aspects of practical problem-solving as humans invent better tools for interacting with nature. We may behold our cognitive instruments with awe, but there is no justification for projecting them as the "true" realities.

For pragmatic naturalism, since all empirical areas contribute contextual knowledge, naturalism's ontology is synoptically collaborative rather than competitive. Pragmatism only excludes transcendentalisms and supernaturalisms that exclude themselves from empirical trial. Nevertheless pragmatic naturalism is capacious enough to recognize what is humanistic in spirit what isn't realistic in sense, such as figurative, exhortative, rhetorical, and fanciful discourse.