Towers of Babble

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Abstract

How answerable discourse is to reality varies by kind and occasion as well as by individual user. Lack of knowledge about the extremely large and small before the 20th century made theories of the cosmos and microcosm speculative and unreliable. Until that point, prevailing assumptions about the universe and the planet's place in it were out of line with what astronomy, geology, evolutionary biology, and physics were finding to be the case. Together with relativity, these disciplines made possible the first plausible master narrative from beginning to a projected end and from particles to galaxies. Both discourse and math could accommodate the extremes of the radically revised universe but only by going beyond the normal human range. The gaps between science, philosophy, and common sense expanded much as the cosmos itself was doing.

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1. A Reliability Index for Discourse?

A lot happens in the passage from what triggers sensations to the semantic codes into which we translate and store them. Determining what is relatively trustworthy in the end result in language and math and what is less so isn't an uncommon task. We do it in some form every day. It isn't exclusively individuals that are reliable or not in the translation of experience into semantic codes but kinds of discourse and occasions as well. Casual talk characteristically takes greater liberties with facts than the formal discourse of reviewed books and lectures do. April first as an occasion brings straight-faced lies from pranksters who may not deceive anyone the rest of the year. Lovers in literature are notoriously more likely to deceive one particular person and in any case aren't noted for objectivity, the word we use for the frame of mind relatively free of personal truth twisting. The consignment of unsound theories to the dustbin in science too has also been important in the sorting process, and it applies to current theories as well as to past ones. As John D. Barrow (2000) points out, extrapolating too much order from nature in disregard of asymmetries and irregularities "is an understandable by-product of an activity that sets out to codify and organize our knowledge of the world" (332).

As a consequence, "physicists have made progress as much by overthrowing bogus laws of Nature as by discovering new ones" (332). Once an error has gained general acceptance it is difficult to dislodge. It wasn't just the church that resisted the findings of Copernicus and Galileo in insisting on a geocentric cosmos. Nearly everyone did including other stargazers. Francis Bacon found the chief sources of error to be in the mind itself. It is a "mirror or glass capable of the image of the universal world, and joyful to receive the impression thereof" (Major Works, 123), but it also craves order and finds it where it doesn't exist. The mind "is far from the nature of a clear and equal glass, wherein the beams of things should reflect . . . rather like an enchanted glass, full of superstition and imposture" (227). Some of the difficulties of matching math and language to reality are insurmountable, because the universe itself, as the preface to The Great Instauration puts it, "is framed like a labyrinth," riddled with ambiguities, "deceitful resemblances," and things "irregular in their lines and . . . knotted and entangled." That much seemed self evident to Bacon even without frames of reference differing by velocity as Einstein's special relativity put it in 1905. Relativity has since eliminated standard measurements in an undermining of objectivity that Bacon never dreamed possible. Yardsticks shrink and clock slow down at great speed.

What were taken to be standard measurements turned out not to be that at all but earth-bound measurements, no more inclusive than the human sensory range that fails to register most of the universe. Because of the attractions of myths of origin and cosmic management and the imperfections of human mental machinery, I place accounts of the material world that have proved to be incompatible with the comprehensive natural history narrative near the bottom of the reliability scale. Especially remote from demonstration are ritual incantations meant to summon invisible beings. Hag speech and rhythmic incantations that summon a Beelzebub or Mephistopheles are dark versions. Whether or not actual toads ever got thrown into a cauldron, words of the "Double, double, toil and trouble" kind, including all beseeching of invisible powers, were tried to see if they might not work this time. The now generally recognized oddities in reality twisted and turned aren't entirely things of the past. Incantation and beseeching of invisible forces crop up in one or another form nearly everywhere. The oddest of them are now more likely to be parodied than taken seriously, as in one staging of Dvorak's Rusalka a witch tosses stuffed animals into a caldron. Less fanciful in extant primitive tribes, the Iban headhunters of Borneo, looking to recharge their sagging fortunes by collecting newly severed heads, might have noticed sooner than they did that their expeditions and follow-up ceremonies were having no effect. Their taking captives in a semi-ritualistic way is a physical form of discourse that used acts rather than, or along with, words, like sacrifices on altars accompanied by raised arms and chants.

Magical rites and sacraments no more logical than that are practiced in most cultures. Whatever the effect appeals to invisible powers are presumed to have, natural history continues on. Species continue to go extinct, the environment grows less sustainable, and faulty hearts continue to fail. That points up a generic contrast between language generated by an older part of the brain and language of demonstrable reference. It has nothing to do with individual reliability or deceit. It comes built in. Anything habitual such as animations indicates a cast of mind that is much as we would expect from Bacon's two sides of consciousness: "we raise our Imagination above Reason; which is the cause why Religion sought ever access to the mind by similitudes, types, parables, visions, dreams" (218). In naturalism and empiricism, what counts are efficient explanations and observations keyed to tangible things subject to planetary standard measurements and analysis? Theories usually precede confirmation in a hypothetical phase of that process of confirmation. In the testing, a single contrary fact unseats the theory. Observation and testing are primary, and theory stands or falls as they dictate. Thinking about what Karl Popper and Paul Feyerabend say about falsification in that regard, Lee Smolin (2007) concedes that imaginative science must work through an initial stage before it can arrive at postulates and axioms. Once established, these are simultaneously high in reliability and sparse in detail. It is true of all discourse that it cannot simultaneously generalize and cite numerous specific instances, though it can go back and forth by way of example and illustration.

2. Casual Talk

The variable forms and moods of gossip are as far from science as language gets. Outside of incantations and miraculous stories forwarded from a legendary past, it is the least reputable, most casual way of collecting impressions and observations into generalized points of view. When we sort through kinds of representation, we haven't finished with social tossed salads until we include it, and we can readily see why it is culpable in spreading popular misconceptions. It characteristically mixes opinion, information, and some purposeful misinformation (i.e. lies). Sociologists are aware of many of the factors that bind groups together, but along with illusions gossip is under represented among them. Fads and stereotypes sweep though populations like communicable fevers.

In lowering something overly exalted, gossip also sets the record straight, drawing on mockery and parody, the street or folksy way to deflate anything considered to be puffed up, but despite that reduction of hyperbole gossip remains the least reliable form of discourse outside of calculated deception and hypnotic group fantasy. It is also the most prevalent and powerful in terms of influence. Casual talk does more than the podium and pulpit combined to disseminate public opinion. Customs are consigned to its care, as one imagines Iban elders over dinner teaching their offspring about the potent magic of severed heads. Most language training in childhood comes casually. The Roman historian Polybius goes so far as to say that historians, too, should circulate among contemporaries to gather information by word of mouth. That is more purposeful than ordinary gossip and more professionally sifted, but it is true that personal contact is more apt to elicit details surrounding events than memorial prose, letters, and news are. Courtroom probing for truth draws on the personal narratives of eye witnesses.

Consider a table-talk exchange in Iain Pears' The Dream of Scipio (2002) in which Claude Bronsen, a Jewish businessman born in Germany, plays host to friends in the midst of War II. Bronsen traces the course that each item on the table has taken, foie gras from Dordogne; Dover sole from the Atlantic; Vandée lamb; cheeses from shepherds and from farmers with goats, sheep, and cows; wine harvested and processed "with a dash of inspiration"; cigars from Havana. That network of regions and occupations comes to bear on conversation with an international bent: Gossip? You say. Idle chitchat? Yes, gentlemen. Men in trenches, men starving, men in chains, do not have the leisure to gossip. Gossip is the product of spare time, of surplus and of comfort. Gossip is the creation of civilization, and the product of friendship. For when my friend here made his inquiry he passed on the information necessary to keep the delicate fabric of friendship together. A question about a friend known for decades but hardly seen, an acquaintanceship which would fall into the past unless its shade was sustained by the occasional offering of gossip. And think again: My friend, an Alsatian businessman, was asking a question of a half- Italian writer about the marriage of a Norman lawyer and a Parisian lady of faintly aristocratic origin.

All this at a dinner given by myself, born a Jew. What better distillation of civilization is there than that? . . . Repeated often enough [gossip] binds society together (141). Distillation is the key. Each guest takes in not only the products of shepherds, fishermen, farmers, merchants, and wine makers but events filtered through successive minds. Hanging over the pleasantry of the dinner is the worst devastation of all three eras of the novel, classical, medieval, and modern. Bronsen finds civilization closing down despite having been "the finest product of the mind of man." It is closing down because of rabid beliefs spread by Third Reich propaganda. The guests will soon turn into beasts or victims, repeating age-old patterns as gossip untouched by science and philosophy usually does. Conquering barbarians, as the Scottish historian Adam Ferguson once pointed out, build their hovels in the shadow of palatial ruins. Having misjudged the strength of the French army and the swiftness of the German advance, Bronsen is overtaken, arrested, and imprisoned. Within a few months he is dead of pneumonia and malnutrition, a bitter irony after a feast based on cooperative trade and friendship. Illusions captured, imprisoned, and killed him, illusions magnified by becoming Third Reich policy. What Bronsen doesn't say about gossip is that it helps spread the hostility racing across Europe. It is partly by word of mouth that the network of fascist operatives dooms its millions. The roundup of Jews would not work, at least as effectively, but for this individual eyeing that one and whispering. We are reminded that in social novels like Jane Austen's, household talk is the main engine of the plot. Before the advent of electronic devices it was gossip, podium speech, essay, and treatise that planted ideas and reinforced customs. Whatever stature the influential have is propped up by it.

3. Systematic Nomenclature

Thomas Huxley (1893, 2004) was among the first to put incessant change in the context of evolution beyond the range of recorded history and make a philosophical point of it. The concept of prehistory gained ground in the post Darwin era when, rather than being in on the beginning of the world and the reason for its creation, mankind became an afterthought in a process of unknown but extraordinary length. Nothing up to that point quite matched the displacement of the planet in the scheme of things. Huxley's observation that all things are "the transitory forms of . . . parcels of cosmic substance" wasn't in itself new but including species was. No one in Huxley's day or among the Greek atomists knew what the indivisible building blocks of matter were. They only knew something like that had to exist if motion was possible. Otherwise, every incremental change would be infinitely divisible. To Huxley, particles had wended "the road of evolution from nebulous potentiality, through endless growths of sun and planet and satellite; through all varieties of matter" (50). Nebulous is justified by the large scale heterogeneity nature has produced and the unpredictable future stages of evolving forms.

The point with respect to systematic nomenclature is that without knowledge of the building blocks it lacks a foundation. In disintegrating and freeing their components to go elsewhere, compounds abandon their previous makeup and move on to something else, thus belying the nomenclature formerly applied to them. If we were to follow Einstein's frames of reference into the microcosm, isotopes would be the first integral units moving with respect to other objects. The best form of discourse for that basic level of locked-together components is the periodic table of elements. The atomic weight of each element and the number of protons, neutrons, and electrons are clearly designated. The interior movement of particles is measured with respect to velocity in larger composites, usually in minute fractions of a second. Each larger rigid body from there on up combine's elements moved collectively, again at a velocity relative to similar composites. These are fragile and subject to disintegration. Finding anything that doesn't change in makeup carries down to what Lucretius, after Hippocrates, Leucippus, Anaxagoras, Democritus, and Epicurus thought of as atoms.

We call them particles, waves, or strings, the title atom having once again been used prematurely. In any case, only the smallest possible things don't separate, and they move of course at their own velocities, as detached neutrinos and photons also do. Systematic or scientific language begins at that level and builds increasingly complex units up to galaxy clusters. These aren't rigid bodies but more like the viscous shapes Einstein allowed to be frames of reference in general relativity (1916). They move collectively but also have numerous internal movements. The planet as an overall rigid body likewise has many such subordinate movements, one of them the convection currents of the molten layer. Great heat in any large mass prevents its elements from locking into a rigid composite. Social aggregates, too, splinter or flow if not quite like stars and other viscous bodies.

As David Hackett Fischer (1970) points out they aren't closely analogous to any of the material bodies: "A human group is something more than a heap of people and something other than an organism or a machine or a great person or an idea. A group is not exactly born, and it does not precisely die. It has a beginning and an end, but no life cycle, no organic pattern of growth and decay. It has no roots or branches; no fruits or flowers; no mind or heart or soul; no cogs or gears or wheels or levers. It does not possess a will or a personality" (216). In naming such an aggregate a society we aren't using quite the same logic we apply to a class of vertebrates or any integral material body. The internal movements are too complex. Hence, we have trouble doing without analogies and trouble with them. They explain and misconstrue simultaneously. People are wolfish sometimes but never wolves, have pecking orders but aren't birds. Political discourse, too, is littered with fictions of convenience such as "all men are created equal," meaning equal before the law. Created is a fictionalized version of 'born'. (Except for the Frankenstein of science fiction, humans don't come in any other way.) Social discourse is full of such semi fictions half way between gossip and the categorizing devices of the social sciences.

The social body is viscous in the sense of having internal movements. Misnaming isn't just a matter of change and the variations that come of the natural permutations. Other errors are built into naming and numbering however systematic they aim to be. Stereotyping and hasty labeling are excusable at times on the grounds that indecision can be worse than error, and detailed accuracy can be overwhelming. Tribal members spotting intruders in a rain forest must decide immediately whether to advance or retreat. Armies wear uniforms and the Taliban beards for similar reasons. Even so, the uniform and the flash impression are partial stories and can easily become twisted ones. They seize upon one factor and make it stand for the whole, a problem with much labeling. Words single out something salient and treat the rest as nonexistent, a prominent part-for-whole error. Hence systematic isn't synonymous with accurate. The nomenclature pyramid is misleading if it implies a reality for upper tier names equal or superior to that of instances, down where the details are innumerable. The higher the classification the more it sits out. Pearness exists only in individual pears, not a startling insight but counter to essentialist thinking that grants Reality to nomenclature categories.

Except for the inconvenience, we could omit pear altogether and go directly to fruit. Individual objects and individual organisms are never exactly alike, merely close enough to justify their being lumped together. The referential value of most words is conventional. Since we've come so far from the Old English buttorfleoge, it would be just as logical to speak of smarms of flutter byes as swarms of butterflies. Adverbs and adjectives fare no better than nominal classifications in catching a salient part of the whole and ignoring the rest. Fast in a runner is a hundred meters in ten seconds. Slow in computers is under a petaflop, a thousand trillion computations a second. Moreover, the speed of a runner is a composite movement. Inside that frame of reference are the motions of nerves, blood, lungs, and beating heart. Inside the computer, some parts are moving at a pace not nearly as fast as the electronic process. The runner and the computer are frames of reference like the rigid planet moving relative to Mars. Relativity proceeds down in size of units all the way past isotopes to quarks. In natural history and natural philosophy, numbers and names, to be complete, must get to that level. They are in pursuit of reality, and that's where it begins. The only hope to get naming and numbering more exactly answerable to the sum total of material things is to establish, at long last, a complete itemization of particles distinguished one from another by exactly measured properties. Progress in exact classification beginning at that level has been slowed by a general reluctance in cultural indoctrination to concede nature's extent and its confusion, neither of which is as human friendly as most mythic forces are. In any setting influenced by public opinion, tradition, usually minus its furies, sells better than our simian ancestry and the residual glow of the big bang.

4. Natural History

A major part of getting labels right is getting the time sequences and durations better defined and thus the place of any given phenomenon in the master narrative of some 13.8 billion years.

The naturalist essay first gained a reputable place in the 17th century in Isaac Walton writing on fishing (The Compleat Angler, 1653) and soon added to it in the step-by-step presentation of experiments in the Royal Society. Later naturalist essays filled the encyclopedias of the French compilers Compte de Buffon and Georges Cuvier before expanding into full-length studies by Jean- Baptiste Lamarck (1744-1829) in biology, Erasmus Darwin (1731-1802) in botany, and Charles Lye (1797-1875) in geology. It followed from there into a post Darwin explosion of essays. When in the opening chapters of The Mountains of California (1894) John Muir makes western glaciers the product of "snow flowers," glaciers become to snow storms what blooms are to water, sun, soil, and plant genetics, namely, evidence of past shaping events. Reading history backward as the cause of what is presently visible is the common practice, and it results in one of the more reliable forms of discourse, mostly within the sensory range, the essay in natural history. It is often aware of geologic eras as background. Rocks, for instance, in that context become as much the ruins of past events as fossils are of life. Muir's compressed metaphor asks us to fill out the cyclical mixture of growth and recycled materials with an encompassing mountain-altering sweep of time. Glacial erosion, canyons, and moraine deposits are products of those snow flowers. That isn't immediately apparent in their lightweight form, but we know how the compacting works once they land and fuse into ice, and the ice under gravity begins the erosion process. Farms and crops come at the gritty stage down in the valleys. Cities spring up as further growth from the decay of the icy flowers. In Muir that kind of language is attention-getting in its own right, but when he is splayed out on a Mt. Ritter cliff with an abyss beneath him, he as a creature of rock, gravity, and fragile biology he becomes an illustration. The present meets the ancient. The matchup is terrifying: "After gaining a point about halfway to the top, I was suddenly brought to a dead stop, with arms outspread, clinging close to the face of the rock, unable to move hand or foot either up or down. My doom appeared fixed. I must fall. There would be a moment of bewilderment, and then a lifeless rumble down the . . . precipice to the glacier below" (64).

The word doom is distinct from the fated casualties of Homer, Virgil, Lucan, and Polybius. In this context, fate, destiny, and doom mean what gravity, biology, and rock dictate. As Muir's sense of gravity and elevation grows acute, the incident becomes a naturalist's exemplum. Inner-earth heat, tectonic plate shift and uplift, and glacial erosion set the scene. Life fragile in its biology is on trial against an implacable mass. This one moment becomes a frozen instant in one mountain-making phase of the planet. The longer biological narrative is what produced the grasping fingers and diagnostic mind. Human musculature reflects the long-term pull of gravity. The brain's directing of the will reflects the survival advantage of courage and ingenuity. To understand the scene is to understand some of that ancient history. Knowing that won't help Muir out of his predicament, but it will help him write the essay if he lives. When he forces himself to resume climbing, every obtruding rock and recess gets his full attention as a handhold or foothold, fitted, or not fitted, to a bipedal form with hands and feet. Together environment and biology define a moment-by-moment struggle. The easier partnerships of ecological cooperation resume down in less barren terrain, but in memory, the incident reminds us that living conditions are narrow in range. How narrow and fragile they are is a recurrent refrain of naturalist essays. Even those expert at naming and describing just what is there can fall prey to misinterpreting that point, as Marston Bates does in The Nature of Natural History (1950) in going in a few pages from calling "this competition, this struggle" a superficial thing, "superimposed on an essential mutual dependence" (108) to accounts of parasitism and the competition that results from an individual fungus producing 700 billion spores, a tobacco plant 360,000 seeds, a salmon 28 million eggs in a season, and an oyster 114 million eggs in a spawning (172).

As Darwin and Malthus showed, struggles to survive aren't superficial but close to the essence of biological history. Muir moves on from what becomes a successful climb to take in more of the Sierras, still a harsh environment but less drastically so. The evidence available to perception and systematic thought often narrows and broadens like that, up close, then out and away, immediate scene, long range prospect. The journals of explorers like Shackleton, Livingstone, and Franklin likewise pause to generalize if not literally take in a larger prospect. That flexibility makes use of a ladder of intellect from particulars to precepts and from an instant to an age. The broadening in this case puts the mountains together in a line and sees regional earth movement and climate in uplift and glaciation: "Here are the roots of all the life of the valleys, and here more simply than elsewhere is the eternal flux of nature manifested. Ice changing to water, lakes to meadows, and mountains to plains. And while we thus contemplate Nature's methods of landscape creation, and, reading the records she has carved on the rocks, reconstruct, however imperfectly, the landscapes of the past, we also learn that as these we now behold have succeeded those of the pre-glacial age, so they in turn are withering and vanishing to be succeeded by others yet unborn" (70).

The speeded up motion of withering and vanishing puts hyperbole to apt use. Where geologic time is the subject, it normal human measurements are to be engaged some such variability in the time frame is inevitable. Zooming in and out, focusing close up and far away, and linking the perspectives parallels manipulating the verbal ladder from instances to general categories. Broadly defined relativity includes levels of abstraction, comparison, and contrast, and other numerical and discourse variants besides material bodies in motion. When Einstein formulated special and general relativity, he was essentially formalizing awareness of that variability. Thinking of stars, planets, and galaxies, he concentrated on the movement of large integral units in the first essay, adding viscous matter in the second. He seemed on the verge of applying relativity to properties besides velocity, as anyone needs to do who wants to understand how numbers and names make their placements. To measure the properties of something has required specific minimal units of mass and density, heat, chemical composition, and spin, in short everything recognizable as a distinguishing property. Location is a matter of trajectory and relative position as well as relative velocity. Placing one integral unit in relation to another draws on comparative naming and numbering, as two is relative to four and eight and rapid to slow.

Every part of measurement is relative, not just velocity but in geometry angle and length of one line in relation to another. Direction, speed, and length of travel are all pertinent, and with integral units, these are influenced by the components, as a sound wave travels at a different pace than an ocean wave because the forces, the medium, and the composition are different. The general culture frame of reference for earlier essays in natural history was broadly speaking European as well as commonly human in psychology. For four centuries, European travelers going westward included fortune hunters, immigrants, militant invaders, refugees, runaways, and explorers, each with a point of view partly typical of their cultures and partly individual. Their essays, personal journals, and books had a democratic openness unusual to Europeans if not entirely new to them. We don't know what the North American wilderness was to the first migrants from Asia, but to those who came went cultivated lands eastward it was overwhelming. They cited it with amazement. That attitude assumes a norm against which travelers assess raw experience. Probably so much that was formerly unknown never struck so many as during that prolonged migration, which began in the late 15th century and was still going into the 20th.

That the immigrants were devoted as much to conquest as to inquiry brings social and economic history into the naturalist essay and cultural difference into the social level of relativity. Peattie continues less happily about that pragmatic exploitation of resources that "we have wasted, we have robbed and slaughtered and made wanton ruin of our wealth. History convicts us of setting fire to our forests, the last great stand of hardwoods in the world, because that was easier than cutting them down. Much of our incomparable system of lakes, brooks, mighty rivers, we turned into sewers where no fish but the worthless German carp will live. Our marshes, cradle of a million water fowl; we drained for crop land we did not need" (155). He cites billions of passenger pigeons along with millions of buffalo and thousands of forested miles, that astounded European immigrants and ended up getting wasted. In their "veracious recordings" we glimpse "deer, elk, antelope and bear, raccoon and fox, water fowl and salmon, whose profusion at the time of the white man's coming made this virgin land the richest in wildlife he had known within the memory of his race" (154).

Where naturalist observation managed to work mostly free of ulterior motives and myths it concerned the identifying of flora and fauna and Native American cultures distinguishable by tribes. It did so usually under folk classifications rather than Latin titles. What John Burroughs (in The Art of Seeing Things, 1904, 2001) sees and hears in a winter wren is typical. That the bird has flown into a forested temperate zone expands the topic from a single specimen to sample ecology. "Such a dapper, fidgety, gesticulating, bobbing-up-and-down-and-out-and-in little bird, and yet full of such sweet, wild melody!" (252-253). As an environment, the hemlock woods tell of climate belts, an ice shelf long retreated, and sun power transformed into biomass. The solar system in motion is implicit in every "fidgety, gesticulating" motion of the subject. So is perturbation descending from far off into the twitches of small muscles hooked up to brains with good reason to be on guard. The diminutive thing becomes another expandable representation; in this case telling us of nervous life and a line of development from dinosaurs that otherwise couldn't change fast enough to meet the post asteroid impact environment.

5. The Universe in a Nutshell: the Master Narrative in Essence

The branches of discourse at the furthest extreme from gossip in method and range are theoretical physics and cosmology. They have the smallest and largest integral units and are highly systematic. That a good deal concerning the universe, its black holes, and its unilluminated matter, are dead reckoning doesn't make the measurements and language applied to them unreliable.

Compressing the universe in a nutshell, as Stephen Hawking (2001) often does, is risky but also necessary if we are to be comprehensive. One science lies adjacent to another in the construction of the narrative. Any tracking of natural history from beginning to a projected end has to link specialized areas convincingly. At that level math leads and language follows. The usual meaning of the nutshell figure is "briefly summed up," and as readers have found not many is as adept as Hawking at compressing much in small. Since this form of discourse is often quite hypothetical, however, I'll dwell mainly on the drawbacks of theory proposed in advance of testing. It dwells in the mutual playground of science and poesis. The most comprehensive omni term traditionally consisted of just three letters, God. That term isn't subject to testing or measurement any more than eternity (all time), nothing (no time or place), and omnipotence (unlimited power) are. The term god has always meant something different to different periods and regions. Indeed, since it has no tangibility it could differ slightly in nearly everyone who uses it without the user even realizing it. Apart from that particular omni terms, what science and philosophy together provide are contexts and laws that have to be included in comprehensive theory.

A great deal of natural history now runs counter to earlier common assumptions. Large areas of chaos and debris, universal perturbation, and the hostility of most of the visible universe to life are major components of the overall narrative. The terminology and measurements of astrophysics and cosmology seem at times to be spinning out of the reach even of mathematicians accustomed to astronomical numbers. As if such theories weren't incredible, enough, Erik Verlinde, a string theorist from the University of Amsterdam, thinks that even gravity may be an illusion. Thanks to the denting or curvature of space around large masses, the apparent speed of gravity transmission raises problem in explanation. That the pull of the sun reaches earth instantly while photons take about eight minutes requires explaining if the speed of light is the fastest thing going. For a Theory of Everything to take that into account may require something like a space/time web assumed always to be there, yet somehow without a material substance. (Ether was ruled out some time ago.) Because particles such as neutrinos, photons, and gravitons (if they exist) have to travel, their movement takes time. A theory of everything that passes all tests will need to explain that and of course the invariables or universal laws. As to gravitons, it isn't that things don't fall if they are unsupported within the range of earth or some other large mass.

That's not the issue. But the pull may not, Verlinde thinks, be due to particles in motion. It may instead be one of many factors emerging from collective gas, dust, and thermodynamics in the way the stock market emerges from "the collective behavior of individual investors," as the New York Times science writer Dennis Overbye puts it. One way of looking at that is first that Verlinde and others are being highly theoretical at this stage, and something that is universal like gravity might as well be considered a law whether or not it includes traveling particles. Even well established constants can get extreme in representation. Martin Rees' (1999) compression of "the deep forces that shape the universe" into just six numbers sounds simple, but one of the six numbers is very large (1036), and another revises the normal three spatial dimensions into string theory's mind-boggling seven additional ones. The initial explosion and inflation episode in 10-36 and 10-33 fragments of a second are likewise hard to imagine. Fractions like the millionth of a billionth of a second that an atom takes to work an internal change are equally so, as are other minimal Planck units. Measurements of temperature variants in the cosmic microwave background (in the instrumentation of the NASA Cosmic Background Explorer) go down to minuscule fractions of a degree. Others run up against dark matter and dark energy. The number of new stars gathering inside gas clouds is beyond calculation. So is the overall number of stars in an accelerating universe, visible parts of which will become invisible should they reach the speed of light. The James Webb space telescope under construction is years away, but once it is launched, astrophysicists will have access to better information about the early formation of galaxies.

It is safe to assume that some of the information will be unexpected. Perturbation is especially difficult to account for either in measurements or in a nutshell summary, but the rules of accountable discourse are clear: no general or universal harmony of the kinds that accompanied traditional cosmologies and religions matches the facts. Setting counter forces to work such as demons and in Plato the resistance of matter to Ideas or Forms showed early awareness of that. The furies, gods of tumult, and Satan himself cropped up to help adjust theory to fact. That stars burn out or explode on schedule according to size, makeup, mass, and heat doesn't consort well with animated demons. Second generation stars, planets, and satellites collect from exceptionally large ones that have reached the disintegration phase. That doesn't consort well with intelligent design. The collisions among second generation materials thrown off by supernovas may look random, but each celestial mass obeys laws of motion, direction, and impetus. Seen from abroad, a patch of local disorder may appear to be part of a greater order, but a still broader picture reveals yet another scatter.

Going from one to many galaxies does that whether or not a recent disturbance has sent debris flying. Galaxies bunch in clusters from hundreds to thousands ranging from 1014–1015 solar masses bound loosely together by gravity, but nothing–at least nothing yet known–binds one cluster to another except the overall gravity of the universe. That cohesive power doesn't prevent the galaxies from separating. The sum total of perhaps as many as 200 billion of them meets most definitions of chaos. The total could as well be called a great welter as a cosmos. The elements of some composites remain at odds even when they are bound together, as in the lumpish rock aggregates of sedimentary breccia. "Potato shaped," astronomers call Kuiper belt debris and seek to limit what we call a planet to the spherical shape of pieces sufficiently large to have heated when they collided. In terms of ontology, debris and potato-shaped lumps are as real as spiral galaxies and thus can't be excluded from accountability. Nothing measurable can be. That is where nutshell terminology gets tricky, especially if it is animated in the typical omni terminology of theology.

Extremes of measurement may seem to undermine the naturalist master narrative, and they do out on the fringes of speculation. The key point with respect to rating naturalism high on a discourse reliability index, however, is that either nature accounts for the dimensions and movements of matter or animation do. Where natural laws explain something, nothing more is needed. When something outside is called on it violates the Occam's razor or 'simplicity first' principle. Nothing compels us to add complications from outside that involve planning and purpose. In some traditional schemes, projecting anything other than natural law into phenomena shifts the blame for what isn't perfect to mankind. Instead of an inventive species braving an often hostile environment and showing courage and tenacity along with ingenuity, humankind becomes guilt-wracked and responsible for deserts, mountains, and hungry crocodiles. Putting anything moral into accounts of the material universe spreads human ego contamination far and wide, perhaps the most common subjective element still being mixed into objectivity. If progress in natural history and natural philosophy over the past few centuries is any indication, at its best ours is an enduring, inventive species seeking to get the facts straight. Even apart from an impressive technological vocabulary that goes by disciplines, the comprehensive terminology has become impressive. After quite a few wild goose chases, discourse now has an equivalent to GPS guidance through the Great Welter. The ultimate goal is to find an ontology and epistemology that fit the phenomena and dispense altogether with magic.

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