

JUSTICE SCALIA'S MISUNDERSTANDING*

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Charles Lyell, defending both his version of geology and his designation of James Hutton as its intellectual father, described Richard Kirwan as a man “who possessed much greater authority in the scientific world than he was entitled by his talents to enjoy.”

Kirwan, chemist, mineralogist, and president of the Royal Academy of Dublin, did not incur Lyell's wrath for a mere scientific disagreement, but for saddling Hutton with the most serious indictment of all—atheism and impiety. Kirwan based his accusations on the unlikely charge that Hutton had placed the earth's origin beyond the domain of what science could consider or (in a stronger claim) had even denied that a point of origin could be inferred at all. Kirwan wrote in 1799:

Recent experience has shown that the obscurity in which the philosophical knowledge of this [original] state has hitherto been involved, has proved too favorable to the structure of various systems of atheism or infidelity, as these have been in their turn to turbulence and immorality, not to endeavor to dispel it by all the lights which modern geological researches have struck out. Thus it will be found that geology naturally ripens . . . into religion, as this does into morality.

In our more secular age, we may fail to grasp the incendiary character of such a charge at the end of the eighteenth century, when intellectual respectability in Britain absolutely demanded an affirmation of religious fealty, and when fear of spreading revolution from France and America equated any departure from orthodoxy with encouragement of social anarchy. Calling someone an atheist in those best and worst of all times invited the same predictable reaction as asking Cyrano how many sparrows had perched up there or standing up in a Boston bar and announcing that DiMaggio was a better hitter than Williams.

Thus, Hutton's champions leaped to his defense, first his contemporary and Boswell, John Playfair, who wrote (in 1802) that

such poisoned weapons as he [Kirwan] was preparing to use, are hardly ever allowable in scientific contest, as having a less direct tendency to overthrow the system,

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than to hurt the person of an adversary, and to wound, perhaps incurably, his mind, his reputation, or his peace.

Thirty years later, Charles Lyell was still fuming:

We cannot estimate the malevolence of such a persecution, by the pain which similar insinuations might now inflict; for although charges of infidelity and atheism must always be odious, they were injurious in the extreme at that moment of political excitement [*Principles of Geology*, 1830].

(Indeed, Kirwan noted that his book had been ready for the printers in 1798 but had been delayed for a year by “the confusion arising from the rebellion then raging in Ireland”—the great Irish peasant revolt of 1798, squelched by Viscount Castlereagh, uncle of Darwin’s Captain FitzRoy.)

Kirwan’s accusation centered upon the last sentence of Hutton’s *Theory of the Earth* (original version of 1788)—the most famous words ever written by a geologist (quoted in all textbooks, and often emblazoned on the coffee mugs and T-shirts of my colleagues).

The result, therefore, of our present enquiry is, that we find no vestige of a beginning—no prospect of an end.

Kirwan interpreted both this motto, and Hutton’s entire argument, as a claim for the earth’s eternity (or at least as a statement of necessary agnosticism about the nature of its origin). But if the earth be eternal, then God did not make it. And if we need no God to fashion our planet, then do we need him at all? Even the weaker version of Hutton as agnostic about the earth’s origin supported a charge of atheism in Kirwan’s view—for if we cannot know that God made the earth at a certain time, then biblical authority is dethroned, and we must wallow in uncertainty about the one matter that demands our total confidence.

It is, I suppose, a testimony to human carelessness and to our tendency to substitute quips for analysis that so many key phrases, the mottoes of our social mythology, have standard interpretations quite contrary to their intended meanings. Kirwan’s reading has prevailed. Most geologists still think that Hutton was advocating an earth of unlimited duration—though we now view such a claim as heroic rather than impious.

Yet Kirwan’s charge was more than merely vicious—it was dead wrong. Moreover, in understanding why Kirwan erred (and why we still do), and in recovering what Hutton really meant, we illustrate perhaps the most important principle that we can state about science as a way of knowing. Our failure to grasp the principle underlies much public misperception about science. In particu-

lar, Justice Scalia's recent dissent in the Louisiana "creation science" case rests upon this error when it discusses the character of evolutionary arguments. We all rejoiced when the Supreme Court ended a long episode in American history and voided the last law that would have forced teachers to "balance" instruction in evolution with fundamentalist biblical literalism masquerading under the oxymoron creation science. I now add a tiny hurrah in postscript by pointing out that the dissenting argument rests, in large part, upon a misunderstanding of science.

Hutton replied to Kirwan's original attack by expanding his 1788 treatise into a cumbersome work, *The Theory of the Earth* (1795). With its forty-page quotations in French and its repetitive, involuted justifications, Hutton's new work condemned his theory to unreadability. Fortunately, his friend John Playfair, a mathematician and outstanding prose stylist, composed the most elegant pony ever written and published his *Illustrations of the Huttonian Theory of the Earth* in 1802. Playfair presents a two-part refutation for Kirwan's charge of atheism.

1. Hutton neither argued that the earth was eternal nor even claimed that we could say nothing about its origin. In his greatest contribution, Hutton tried to develop a cyclical theory for the history of the earth's surface, a notion to match the Newtonian vision of continuous planetary revolution about the sun. The materials of the earth's surface, he argued, passed through a cycle of perfect repetition in the large. Consider the three major stages. First, mountains erode and their products are accumulated as thick sequences of layered sediments in the ocean. Second, sediments consolidate and their weight melts the lower layers, forming magmas. Third, the pressure of these magmas forces the sediments up to form new mountains (with solidified magmas at their core), while the old, eroded continents become new ocean basins. The cycle then starts again as mountains (at the site of old oceans) shed their sediments into ocean basin (at the site of old continents). Land and sea change positions in an endless dance, but the earth itself remains fundamentally the same. Playfair writes:

It is the peculiar excellence of this theory . . . that it makes the decay of one part subservient to the restoration of another, and gives stability to the whole, not by perpetuating individuals, but by reproducing them in succession.

We can easily grasp the revolutionary nature of this theory for concepts of time. Most previous geologies had envisioned an earth of short duration, moving in a single irreversible direction, as its original mountains eroded into the sea. By supplying a "concept of repair" in his view of magmas as uplifting forces, Hutton burst the

strictures of time. No more did continents erode once into oblivion; they could form anew from the products of their own decay and the earth could cycle on and on.

This cyclical theory has engendered the false view that Hutton considered the earth eternal. True, the mechanics of the cycle provide no insight into beginnings or ends, for laws of the cycle can only produce a continuous repetition and therefore contain no notion of birth, death, or even of aging. But this conclusion only specifies that laws of the *present order* of nature cannot specify beginnings or ends. Beginnings and ends may exist—in fact, Hutton considered a concept of starts and stops absolutely essential for any rational understanding—but we cannot learn anything about this vital subject from nature’s present laws. Hutton, who was a devoted theist despite Kirwan’s charge, argued that God had made a beginning, and would ordain an end, by summoning forces outside the current order of nature. For the stable period between, he had ordained laws that impart no directionality and therefore permit no insight into these beginnings and ends.

Note how carefully Hutton chose the words of his celebrated motto. “No vestige of a beginning” because the earth has been through so many cycles since then that all traces of its original state have vanished. But an original state it certainly had. “No prospect of an end” because the current laws of nature provide no insight into a termination that must surely occur. Playfair describes Hutton’s view of God:

He may put an end, as he no doubt gave a beginning, to the present system, at some determinate period; but we may safely conclude, that this great catastrophe will not be brought about by any of the laws now existing, and that it is not indicated by any thing which we perceive.

2. Hutton did not view our inability to specify beginnings and ends as a baleful limitation of science but as a powerful affirmation of proper scientific methodology. Let theory deal with ultimate origins, and let science be the art of the empirically soluble.

The British tradition of speculative geology—from Burnet, Whiston, and Woodward in the late seventeenth century to Kirwan himself at the tail end of the eighteenth—had focused upon reconstructions of the earth’s origin, primarily to justify the Mosaic narrative as scientifically plausible. Hutton argued that such attempts could not qualify as proper science, for they could only produce speculations about a distant past devoid of evidence to test any assertion (no vestige of a beginning). The subject of origins may be vital and fascinating, far more compelling than the humdrum of quotidian forces that drive the present cycle of uplift, erosion, depo-

sition, and consolidation. But science is not speculation about unattainable ultimates; it is a way of knowing based upon laws now in operation and results subject to observation and inference. We acknowledge limits in order to proceed with power and confidence.

Hutton therefore attacked the old tradition of speculation about the earth's origin as an exercise in futile unprovability. Better to focus upon what we can know and test, leaving aside what the methods of science cannot touch, however fascinating the subject. Playfair stresses this theme more forcefully (and more often) than any other in his exposition of Hutton's theory. He regards Hutton's treatise as, above all, an elegant statement of proper scientific methodology—and he locates Hutton's wisdom primarily in his friend's decision to eschew the subject of ultimate origins and to focus on the earth's present operation. Playfair begins by criticizing the old manner of theorizing:

The sole object of such theories has hitherto been, to explain the manner in which the present laws of the mineral kingdom were first established, or began to exist, without treating of the manner in which they now proceed.

He then evaluates this puerile strategy in one of his best prose flourishes:

The absurdity of such an undertaking admits of no apology; and the smile which it might excite, if addressed merely to the fancy, gives place to indignation when it assumes the air of philosophic investigation.

Hutton, on the other hand, established the basis of a proper geological science by avoiding subjects "altogether beyond the limits of philosophical investigation." Hutton's explorations "never extended to the first origin of substances, but were confined entirely to their changes." Playfair elaborated:

He has indeed no where treated of the first origin of any of the earths, or of any substance whatsoever, but only of the transformations which bodies have undergone since the present laws of nature were established. He considered this last as all that a science, built on experiment and observation, can possibly extend to; and willingly left, to more presumptuous inquirers, the task of carrying their reasonings beyond the boundaries of nature.

Finally, to Kirwan's charge that Hutton had limited science by his "evasion" of origins, Playfair responded that his friend had strengthened science by his positive program of studying what could be resolved:

Instead of an *evasion*, therefore, any one who considers the subject fairly, will see, in Dr. Hutton's reasoning, nothing but the caution of a philosopher, who wisely confines his theory within the same limits by which nature has confined his experience and observation.

This all happened a long time ago and in a context foreign to our concerns. But Hutton's methodological wisdom, and Playfair's eloquent warning, could not be more relevant today—for basic principles of empirical science do have an underlying generality that can transcend time. Practicing scientists have largely (but not always) imbibed Hutton's wisdom about restricting inquiry to questions that can be answered. But Kirwan's error of equating the best in science with the biggest questions about ultimate things continues to be the most common of popular misunderstandings.

I have often mentioned that fifteen years of monthly columns have brought me an enormous correspondence from nonprofessionals about all aspects of science. From sheer volume, I obtain a pretty good sense of strengths and weaknesses in public perceptions. I have found that one common misconception surpasses all others. People will write, telling me that they have developed a revolutionary theory, one that will expand the boundaries of science. These theories, usually described in several pages of single-spaced typescript, are speculations about the deepest ultimate questions we can ask—what is the nature of life? the origin of the universe? the beginning of time?

But thoughts are cheap. Any person of intelligence can devise his half dozen before breakfast. Scientists can also spin out ideas about ultimates. We don't (or, rather, we confine them to our private thoughts) because we cannot devise ways to test them, to decide whether they are right or wrong. What good to science is a lovely idea that cannot, as a matter of principle, ever be affirmed or denied?

The following homily may seem paradoxical but it embodies Hutton's wisdom: the best science often proceeds by putting aside the overarching generality and focusing instead on a smaller question that can be reliably answered. In so doing, scientists show their intuitive feel for the fruitful, not their narrowness or paltriness of spirit. In this way we sneak up on big questions that only repel us if we try to engulf them in one fell speculation. Newton could not discover the nature of gravity, but he could devise a mathematics that unified the motion of a carriage with the revolution of the moon. Darwin never tried to grasp the meaning of life (or even the manner of its origin on our planet), but he did develop a powerful theory to explain its manner of change through time. Hutton did not discover how our earth originated, but he developed some powerful and testable ideas about how it ticked. You might almost define a good scientist as a person with the horse sense to discern the

largest answerable question—and to shun useless issues that sound bigger.

Hutton's positive principle of restriction to the doable also defines the domain and procedures of evolutionary biology, my own discipline. Evolution is not the study of life's ultimate origin as a path toward discerning its deepest meaning. Evolution, in fact, is not the study of origins at all. Even the more restricted (and scientifically permissible) question of life's origin on our earth lies outside its domain. (This interesting problem, I suspect, falls primarily within the purview of chemistry and the physics of self-organizing systems.) Evolution studies the pathways and mechanisms of organic change following the origin of life. Not exactly a shabby subject either—what with such resolvable questions as “how, when, and where did humans evolve?”; how do mass extinction, continental drift, competition among species, climatic change, and inherited constraints of form and development interact to influence the manner and rate of evolutionary change?”; “how do the branches of life's tree fit together?” to mention just a few among thousands equally exciting.

In their recently aborted struggle to inject Genesis literalism into science classrooms, fundamentalist groups followed their usual opportunistic strategy of arguing two contradictory sides of a question when a supposed rhetorical advantage could be extracted from each. Their main pseudoargument held that Genesis literalism is not religion at all, but really an alternative form of science (creation science) not acknowledged by professional biologists too hidebound and dogmatic to appreciate the cutting edge of their own discipline. When we successfully pointed out that creation science—as an untestable set of dogmatic proposals—could not qualify as science by any standard definition, they turned around and shamelessly argued the other side. (They actually pulled off the neater trick of holding both positions simultaneously.) Now they argued that, yes indeed, creation science is religion, but evolution is equally religious.

To support this dubious claim, they tumbled (as a conscious trick of rhetoric, I suspect) right into Kirwan's error. They ignored what evolutionists actually do and misrepresented our science as the study of life's ultimate origin. They then pointed out, as Hutton had, that question of ultimate origins are not resolvable by science. Thus, they claimed, creation science and evolution science are symmetrical—that is, equally religious. Creation science isn't science because it rests upon the untestable fashioning of life *ex nihilo* by God. Evolution science isn't science because it tries, as its major aim, to resolve the unresolvable and ultimate origin of life. But we

do no such thing. We understand Hutton's wisdom—"he has nowhere treated of the first origin . . . of any substance . . . but only of the transformations which bodies have undergone"

Our legal battle with creationists started in the 1920s and reached an early climax with the conviction of John Scopes in 1925. After some quiescence, it began in earnest again during the 1970s and has haunted us ever since. (I have written more than half a dozen essays, most in this series, on the resurgence of creation science.) Finally, in June 1987, the Supreme Court ended this major chapter in American history with a decisive 7-2 vote, striking down the last creationist statute, the Louisiana equal time act, as a ruse to inject religion into science classrooms in violation of first amendment guarantees for separation of church and state.

I don't mean to appear ungrateful, but we fallible humans are always seeking perfection in others. I couldn't help wondering how two justices could have ruled the other way. I may not be politically astute, but I am not totally naive either. I have read Justice Scalia's long dissent carefully, and I recognize that its main thrust lies in legal issues supporting the extreme judicial conservatism espoused by Scalia and the other dissenter, Chief Justice Rehnquist. Nonetheless, though it may form only part of his rationale, Scalia's argument relies crucially upon a false concept of science—Kirwan's error again. I regret to say that Justice Scalia does not understand the subject matter of evolutionary biology. He has simply adopted the creationists' definition and thereby repeated their willful mistake.

Justice Scalia writes, in his key statement on scientific evidence:

The people of Louisiana, including those who are Christian fundamentalists, are quite entitled, as a secular matter, to have whatever scientific evidence there may be against evolution presented in their schools.

I simply don't see the point of this statement. Of course they are so entitled, and absolutely nothing prevents such a presentation, if evidence there be. The equal time law forces teaching of creation science, but nothing prevented it before, and nothing prevents it now. Teachers were, and still are, free to teach creation science. They don't because they know that it is a ruse and a sham.

Scalia does acknowledge that the law would be unconstitutional if creation science is free of evidence—as it is—and if it merely restates the Book of Genesis—as it does:

Perhaps what the Louisiana Legislature has done is unconstitutional because there is no such evidence, and the scheme they have established will amount to no more than a presentation of the Book of Genesis.

Scalia therefore admits that the issue is not merely legal and does hinge on a question of scientific fact. He then buys the creationist argument and denies that we have sufficient evidence to render this judgment of unconstitutionality. Continuing directly from the last statement, he writes:

But we cannot say that on the evidence before us Infinitely less can we say (or should we say) that the scientific evidence for evolution is so conclusive that no one would be gullible enough to believe that there is any real scientific evidence to the contrary.

But this is exactly what I, and all scientists, do say. We are not blessed with absolute certainty about any fact of nature, but evolution is as well confirmed as anything we know—surely as well as the earth's shape and position (and we don't require equal time for flat earthers and those who believe that our planet resides at the center of the universe). We have oodles to learn about how evolution happened, but we have adequate proof that living forms are connected by bonds of genealogical descent.

So I asked myself, how could Justice Scalia be so uninformed about the state of our basic knowledge? And then I remembered something peculiar that bothered me, but did not quite register, when I first read his dissent. I went back to his characterization of evolution and what did I find (repeated, by the way, more than a dozen times, so we know that it represents no one-time slip of his pen, but a consistent definition).

Justice Scalia has defined evolution as the search for life's origin—and nothing more. He keeps speaking about “the current state of scientific evidence about the origin of life” when he means to designate evolution. He writes that “the legislature wanted to ensure that students would be free to decide for themselves how life began based upon a fair and balanced presentation of the scientific evidence.” Never does he even hint that evolution might be the study of how life changes after it originates—the entire panoply of transformation from simple molecules to all modern, multicellular complexity.

Moreover, to make matters worse, Scalia doesn't even acknowledge the scientific side of the origin of life on earth. He argues that a creationist law might have a secular purpose so long as we can envisage a concept of creation not involving a personal God “who is the object of religious veneration.” He then points out that many such concepts exist, stretching back to Aristotle's notion of an unmoved mover. In the oral argument before the Court, which I attended on December 10, 1986, Scalia pressed this point even more forcefully with counsel for our side. He sparred:

What about Aristotle's view of a first cause, an unmoved mover? Would that be a creationist view? I don't think Aristotle considered himself as a theologian as opposed to a philosopher.

In fact, he probably considered himself a scientist. . . . Well, then, you could believe in a first cause, an unmoved mover, that may be impersonal, and has no obligation of obedience or veneration from men, and in fact, doesn't care what's happening to mankind. And believe in creation. [From the official transcript, and omitting the responses of our lawyer.]

Following this theme, Scalia presents his most confused statement in the written dissent:

Creation science, its proponents insist, no more must explain whence life came than evolution must explain whence came the inanimate materials from which it says life evolved. But even if that were not so, to posit a past creator is not to posit the eternal and personal God who is the object of religious veneration.

True indeed; one might be a creationist in some vernacular sense by maintaining a highly abstract and impersonal view of the creator. But Aristotle's unmoved mover is no more part of science than the Lord of Genesis. Science does not deal with questions of ultimate origins. We would object just as strongly if the Aristotelophiles of Delaware forced a law through the state legislature requiring that creation of each species *ex nihilo* by an unmoved mover be presented every time evolution is discussed in class. The difference is only historical circumstance, not the logic of argument. The unmoved mover doesn't pack much political punch; fundamentalism ranks among our most potent irrationalisms.

Consider also, indeed especially, Scalia's false concept of science. He equates creation and evolution because creationists can't explain life's beginning, while evolutionists can't resolve the ultimate origin of the inorganic components that later aggregated to life. But this inability is the very heart of creationist logic and the central reason why their doctrine is not science, while science's inability to specify the ultimate origin of matter is irrelevant because we are not trying to do any such thing. We know that we can't, and we do not even consider such a question as part of science.

We understand Hutton's wisdom. We do not search for unattainable ultimates. We define evolution, using Darwin's phrase, as "descent with modification" from prior living things. Our documentation of life's evolutionary tree records one of science's greatest triumphs, a profoundly liberating discovery on the oldest maxim that truth can make us free. We have made this discovery by recognizing what can be answered and what must be left alone. If Justice Scalia heeded our definitions and our practices, he would understand why creationism cannot qualify as science. He would also, by the way, sense the excitement of evolution and its evidence; no per-

son of substance could be unmoved by something so interesting. Only Aristotle's creator may be so impassive.

Don Quixote recognized "no limits but the sky," but became thereby the literary embodiment of unattainable reverie. G.K. Chesterton understood that any discipline must define its borders of fruitfulness. He spoke for painting, but you may substitute any creative enterprise: "Art is limitation: the essence of every picture is the frame."