*Daedalus and Icarus, from a Roman stone relief*

# The Icarian Impulse

***by Paul R. Gross***

As the ancients tell it, Daedalus was no mere bench scientist. Yes, he invented tools, such as the ax, the hand drill, and the wedge, but he also made statues that moved as if alive. He was not a god. For example, he had a personality disorder. There being no psychotherapists to fix it, Daedalus, in a jealous rage, killed a nephew. Forced to flee Athens, he took his skills and his son, Icarus, to Crete, for whose monarch, Minos, he built a labyrinth to imprison the Minotaur. But that confinement allowed Minos's queen, Pasiphae, to satisfy her unnatural lust for the monster. Wherefore a vengeful Minos immured Daedalus and Icarus in

the maze. Ah, but such a prison is *horizontal*. A scientist can think vertically: so the old artificer made wings for himself and his son and attached them with wax. They took off and all might have gone well, but Icarus, ecstatic in flight, soared too close to the sun. The wax melted. He plunged to his death in the Aegean Sea.

Did anyone care? No. W. H. Auden, taking his cue from Pieter Brueghel, shows us our terrifying indifference,

> how everything turns away
> Quite leisurely from the disaster: the ploughman may
> Have heard the splash, the forsaken cry,
> But for him it was not an important failure; the sun shone
> As it had on the white legs disappearing into the green
> Water; and the expensive delicate ship that must have seen
> Something amazing, a boy falling out of the sky,
> Had somewhere to get to and sailed calmly on.

We fail to notice; or if notice is taken, we shrug. Sensible people, like pigs, do not fly, do not wing heedlessly upward in sunlight. There is a day's work to be got through. But the Icarian impulse lives in a few scholars, E. O. Wilson among them. Will they fly and land safely, or plunge with a forsaken cry into the green?

Yaneer Bar-Yam, who teaches courses on complexity theory at the Massachusetts Institute of Technology and Boston University, has published an impressive book, *Dynamics of Complex Systems* (1997), one of the first textbook treatments of a young but important discipline, sometimes just now overly exalted and also, perhaps, unfairly dismissed. Near the start of the author's preface, he writes that "Science has begun to *try to understand* complexity in nature, a counterpoint to the traditional scientific obiective of understanding the fundamental simplicity of laws of nature. It is *believed*, however, that even in the study of complexity there exist simple and therefore comprehensible laws. The field of study of complex systems *holds that* the dynamics of complex systems are founded on universal principles [emphases added]."

Note: to "try to understand" is to seek (simple) principles, to find the universals, among phenomena. That this is the best way to get at how nature works has been believed by some thinkers, not iust since the Scientific Revolution ofthe 17th and 18th centuries, but since the Ionian, Thales of Miletus, pondered the world's composition 2,600 years ago. Survival of the method required sharp criticism of the intervening idealism of Plato and restatement of the Ionian principle of cognitive unity, by Epicurus, 300 years later. But survive it did. That way of "trying to understand" is what

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Fall of Icarus *(c. 1560), by Pieter Brueghel the Elder*

physicist-historian Gerald Holton, and E. O. Wilson (who borrows the phrase), call the Ionian Enchantment. By contrast with ordinary thought, this is a strange impulse. It is a reaching for, a delight in, the common features of all things, all humanity, all cultures, all knowledge, all reality—rather than for the local oracle's incense and delirium.

Central to the Ionian Enchantment is a conviction reinforced by experience: that humanity is a part of nature; hence the universals of nature apply to us. That much is a faith, the truth of which cannot be proven. Not all the triumphs of natural science, taken together, are proof, although to "believe" *is* to hold something as true. Now it begins to appear that the belief will extend to complexity itself. Still, it remains a belief. Idealists, theists, epistemic relativists, different though their views may be, remind us of it constantly, and are just now having an exhilarating ride in the academies of the West. They are right to remind us, but not to forget conveniently that their arguments are old and weak.

The search for understanding, for explanations of how things are and why, has come down to us as to streams of thought, the central channels of which are separate but whose shallows, where the streams touch, have always been roiled, regions of eddies and suspended mud. The stream of simple universals is natural science. Its metaphysics is that Ionian Enchantment—naturalism, and with it commonly now, materialism (that is, the concept that the relevant universals have to do with matter). The other stream, measured by the number of its adherents, is immensely larger. It too is a faith, and its channel is dualism: the division of the world into matter and spirit, mind and

body. Dualism is the conviction that matter and spirit exist and are distinct, that whatever universals may apply to the behavior of matter or body do not, cannot, govern spirit, or mind, and vice versa.

Of course, naturalism and dualism have changed over time, especially since the Enlightenment, whose philosophical, but not practical, children have plunged again and again into the Romantic sea. In principle, the opposite of "dualism" (or pluralism) is not naturalism but "monism." Metaphysical naturalists have often made concessions to spirit, and not just because it is always prudent—politically correct—to do so. Many leading dualists concede the truth (more recently, the "truth") of mature natural science, denying truth only to those parts, such as evolutionary biology,`that seem too clearly to exclude spirit, or that deal with qualities of matter that are "irreducible" because infused with spirit, or just too complex. But the naturalist stream, while by far the smaller, has floated many, perhaps most, of the new vessels of human thought these past 300 years. It has borne success, too much success, according to its enemies. As they see it, naturalism and materialism are responsible, via that feathers and wax contraption, technology, for the imminent collapse of Earth's life-support systems. How odd it is that modern dualists, for *supporting* evidence of this threat, depend solely upon seleced results of naturalist science; and how ironic that some of the most eloquent naturalists, including E. O. Wilson, are leading prophets of the collapse!

Twister *(1996) by Jan Harrison*

But this gets ahead of my story. I want to discuss the boldest prognosis yet for the future of the Ionian Enchantment, made by the Icarian, Wilson, a quintessential naturalist. (Granted: the Platonic echo in "quintessential" is inappropriate.) I can barely touch here upon the likely response to it from adherents of the current version of dualism, whose condition has been described, even by some of them, as "biophobic"—the claim that biology (body) has little or nothing to do with human behavior (mind), especially with social behavior. I will epitomize it brusquely (actually, it can be quite subtly argued): *biology explains nothing interesting about human behavior.*

The code phrase is "biological determinism." To be sure, such dualism has more to do nowadays with culture, or nurture, as antitheses of nature or body or matter, than with spirit or deity. Nevertheless, it is

## Is Consilience a paean to the god of Science? Wilson replies, 'No—to human ingenuity.'

thoroughly dualistic and transcendentalist. The push for it now among Western intellectuals is more from politics (according to its defenders, from "the struggle for social justice") than from religion. It is dualism nevertheless in its denial that laws of nature coming from science offer any true or useful explanation of human behavior and society, or provide us any guidance.

In *Consilience*, Wilson offers his latest and most mettlesome rejection of that dualistic denial. He asks, "Is this [his book] a paean to the god of Science7" And replies, "No—to human ingenuity, to the capacity in all of us, freed at last in the modern era. And to the fortunate comprehensibility of the universe." *Consilience* is therefore visionary, but it is also detailed and documented for the remarkable range of knowledge discussed. It is—as I expect Wilson means it to be—a retrospective in maturity of his life as a working scientist and of ceaseless study and hope for the elucidation of human nature. It is worth noting in Wilson's output of respected books such titles as *On Human Nature*, *Biophilia*, and *Promethean Fire* (the last with Charles J. Lumsden). For his newest title, he has chosen well in using the almost-forgotten word *consilience*.

Consilience of inductions was one of William Whewell's criteria of inductive truth. Scientist, theologian, poet, translator, editor, administrator, Whewell (1794-1866) was for 24 years Master of Trinity College, Cambridge, and called, deservedly, a polymath. He began, a Young Turk among equals, undergraduates of vast future accomplishment (Charles Babbage, John Herschel, George Peacock), with the modest project of revolutionizing mathematics at Cambridge University. They succeeded, not least in replacing Newton's (England's own!) dot notation in the differential calculus with the continental *d*. This illustrates, for those who know a little about calculus and Cambridge, the considerable ambitions of those clever undergraduates.

Whewell's mature goal was nothing less than unification of the intellectual achievements of his time. At the center was his attempt to bring up to date, in that era of optimism and progress, Francis Bacon's pleadings for scientific method: to create a self-consistent logic of induction. It is by induction (rather than deduction) that the raw materials of natural science—the facts—enter into knowledge creation. Two of Whewell's monumental works, his *History of the Inductive Sciences* and *Philosophy of the Inductive Sciences*, set forth the findings and arguments. The most important were meant to distinguish excellent science from anything less. For Whewell, excellent science means true hypotheses. True hypotheses can be identified. The most important qualities upon which the diagnosis is made are the consilience of inductions and progressive simplifica-

tion. "Consilience" is Whewell's coinage: it means "jumping together." It is that property of inductions (sets of facts brought under the purview of a proposition) by which different sets become, unexpectedly, related, that is, the property of *explanatory surprise*. Think of it this way: You propose that the facts a, b, c . . . have explanation X. You or some other honest investigator turns, in the fullness of time, to an independent set of facts m, n, o . . . , for which the going explanation is W. But voila! You, or that other investigator, or a third, notice, not only that X applies also to m, n, o . . . but that it explains them *better* than W, or than any other hypothesis you can think of. This is explanatory surprise: sets of inductions have jumped together under X. Under X they are *consilient*. The range of X-phenomena has been expanded. And, not only is X common to a, b, c . . . m, n, o . . . but it is simpler than X + W. For Whewell, X is then true, or an approach to truth.

He was a theologian, therefore not shy about truth, especially the truth of the dazzling achievements on which he built: universal gravitation and the undulatory nature (wave theory) of light. Relativity and quantum mechanics played havoc in the 20th century with 19th century philosophy of science, which had invested too heavily in such cases. And Whewell has been unfairly ignored in the resulting dustup. Yet his prescriptions, consilience and simplification, have had effect: on Charlel Darwin, on James Clerk Maxwell, on the standards by which science judged excellent or not, likely to be true or not, to this day. Whether not they have ever heard of Whewell or consilience (usually not), scientists today have Whewell's standards in mind. Excellent inquiry about the physical world is consilient.

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Now I repeat myself—almost: E. O. Wilson's mature goal has been nothing less than unification of the intellectual achievements of our time. Given the growth ofknowledge since Whewell's day, this is an act of hubris even greater than Whewell's. Nor is Wilson's version of consilience exactiy Whewell's. He has borrowed but also modified the idea. Whewell may have hoped for refinement of theology to bring it into line with science, but he would surely not have applauded a public project of explaining religion through science. Whewell's consilience was of inductions within the best science, which was physical science. Wilson's version is much more than explanatory surprise within one or between two adjacent fields (although he gives us some stunning examples). It is more daring than that. Whewell, and other metascientists before modern Darwinism, might well have imagined in privacy a role for natural science in the understanding of human nature. But Wilson, armed by the scietific explosion of the last half-century, has already tried on wings and

made some famous preliminary jumps. In *Consilience* he flies. Whether the wings stay on remains to be seen. Whether they do depends, oddly, upon how many others, similarly talented, care enough to join in the effort of flight. Wilson's consilience, a proposed standard of inquiry leading to truth, refers not only to propositions illuminating the facts within fields of inquiry and levels of organization, but across all the disciplines of knowledge, bottom-up and top-down—*all* of them.

Are there examples? Yes. Wilson's book is devoted to them. All it needed for such a book to be written was hubris, encyclopedic knowledge, a sweatshop work ethic, and literary gifts. It needed a Wilson to offer the obvious conclusion to the 20th century knowledge explosion, anticipating and ignoring the inevitable sneers of reductionism and crude scientism. It took, above all, mastery of modern-evolutionary-biology, available to a thinker who has himself helped to create the subject and followed out its implications (what Daniel Dennett called "Darwin's dangerous idea"), all the way from ions at bilayer membranes to neurons, to brains, to emotions, to societies, across the boundaries of discipline and organization. There are a few such thinkers at work nowadays, not just one, but E. O. Wilson, by age and achievements, is first among equals.

I leave for the reader's pleasure his book's case studies: physics to cell biology and neuroscience, neuroscience to mind. Genes to natural selection and evolution. Evolution to human nature. Human nature to culture. Culture to ethics. Ethics to religion. Instead, for variety and brevity, here is a case of my own, of consilience observed.

When I studied cell biology (then general physiology) in the 1950s, the senior faculty paid little attention to advances in physics and chemistry, or to biochemistry (it was still physiological chemistry). I needed special permission to take chemistry courses. Chemists needed the same for quantum mechanics in physics. Organic chemrstry, the chemistry of life, was a hodgepodge of ad hoc mechanisms; organic chemists were clever but had no basic (that is, physical) idea of how reactions work. I—young, lazy, avoiding all memorization, and in love—did not, shall we say, distinguish myself in that subject. But my mentors in biology cared not; they knew all about, and had a name for, *the stuff of which living cells are made*: "protoplasm." They saw an unknown, possiblv unknowable, quality of "the living state"—not something one should waste time investigating with chemistry, organic or otherwise, for to do chemistry one had to break up cells ("homogenize" them) so that chemical components could be identified. A minority, but then still influential, opinion was that a broken cell, hence a dead one, has not the living quality. Its chemistry would thus be irelevant to understanding protoplasm. J. F. Danielli, for example, a distinguished general physiologist, issued a book advancing such an argument.

Believers in consilience ignored it. Using homogenates, they expanded the older physiological chemistry (whose laboratory practicum students called "Secretions and Excretions") to a serious biological chemistry. The recognized consilience of mathematics, physics, and chem-

istry (including organic) created what soon became molecular biology, and that style of investigation, venturing into the formalisms of genetics, became molecular genetics. And there emerged this truth about protoplasm: it is a structured soup of *perfectly ordinary molecules*, some of which are huge, of specific structure, and information-rich, but ordinary molecules nevertheless. Properly constituted extracts of broken (dead) cells proved capable of most of the transformations once thought to require "life."

This was not a sequence: it happened pretty much all at once, over a decade or two. It included not only discovery of the structure and functions of DNA but the reduction of mutation to physicochemical and cytological detail, answering still-worrisome questions about rates and mechanisms of variation and evolution. Within a decade there was intellectual continuity, all the way from convergent physical theories of molecular structure (molecular orbitals and vaience bond theory) to convergent theories of developmental information (how the fertilized egg knows what to do in starting to make a plant or animal). All this emboldened neuroscientists (then called electrophysiologists) to learn molecular and cell biology, and therefrom, the ontogeny of nervous systems, thence of brains, and their emergent properties.

Aside from fun for scientists, was that push for consilience useful for anything else, socially useful? I am continually astonished to discover, among intellectuals, some highly influential, that the answer can be given as "No" or "Not really." But of course it *was* useful. In two ways. First, because what I have just described revolutionized medicine, among other applied sciences, as the sober history and the hard data since 1940 demonstrate. There were such sharply positive outcomes for the quality of human (and animal) life, at least in the fortunate West, that only a professional sourpuss, social or philosophical, would deny the utility, referring darkly to overpopulation, out-of-control healthcare costs, and "they never did win the war on cancer." Such commentators on science have a restricted notion of social utility, centering on who gets elected to, or installed after the revolution in, public office. The second way I leave for the end of these remarks on Wilson's proposals.

Here, however, a little more about Wilson's consilience. He is advertising, after all, an unfamiliar notion. In a chapter of his book entitled "Ariadne's Thread he takes Daedalus's Cretan labyrinth for a "mythic image of the uncharted material world in which humanity was born and forever struggles to understand." Ariadne, the daughter of Minos, loved Theseus. The clever girl gave her hero-lover a ball of thread, by the aid of which he found his way in the maze, killed the anthropophagous Minotaur, and returned to safety. The thread is Wilson's metaphor of consilience. With it, although we can never chart fully the knowledge labyrinth of this world, we (Theseus) can at least move about in it with confidence.

But a less literary analogy may be, for all that, more instructive. Philosopher Susan Haack, author of *Evidence and Inquiry* (1993), has an

analogy for the relevance of experience (sense data plus introspective awareness of mental states) to the justification of belief. (Remember: to believe is to hold a proposition true). Her model is a crossword puzzle. I simplify it for the present purpose, acknowledging its origin in Haack's work, and that said work is detailed epistemology, while what I offer here is not. Still, it seems to preserve the good sense of the original, which Haack has herself applied, in the Romanell Phi Beta Kappa Lectures, to the unity of inquiry. The clues to the crossword are the available experiential evidence (including recorded results of other, trustworthy inquirers). The filled-in downs and acrosses are beliefs about the clues, or the reasons for such beliefs. The probability that any new entry fits correctly depends upon the quality of the clue, *the quality of entries already completed, and how much of the whole puzzle is complete*. The better the clues, the more efficient the choice of entries, the faster the cells fill up. The more filled in, the better later entry guesses will be.

Then, if we take the whole puzzle to refer to a body of knowledge—the past, present, and future of "human nature"—it is clearly prudent to include as many clues from science (such as evolutionary biology) as possible, alongside clues from other kinds of experience of "human nature." Surely, the past and present of human nature are to some degree explained by science. And good fits becoming evident as we proceed, even in unlikely crossings (such as, perhaps, cephalization with cubism), *are consiliences*. They reassure us when we are on the right track. There is every reason to expect that such consiliences will illuminate human nature, however we defined it initially, including such features of it as the idea of justice, features that seem, with most cells in the puzzle still empty, remote from science.

Now, my distinguished colleague, philosopher Richard Rorty, who must here stand for other thinkers of like stature, is one of those who might well dismiss, not necessarily science in the practices of medicine and public health, or engineering, but its utility in the greater struggle—for social justice. "I do not have much use for notions like `objective value' and `objective truth,'" he admits. "I think the so-called postmodernists are right in their criticisms of traditional philosophical talk about 'reason.' "And he writes in the same place ("Trotsky and the Wild Orchids") that "at 12 [years of age], I knew that the point of being human was to spend one's life fighting social injustice." Rorty likes being attacked from the left as well as the right, to position himself as the sort of thinker who can do without the (Platonic) absolutes of the Right and the political illusions of the extreme Left. But utopianism remains for him the proper activity of intellectuals who care about social justice, about the elimination of cruelty. And therein he sees no significant role for science. Of the sciences since the 18th century, he wrote in *Contingency, Irony, and Solidarity*, "they have nevertheless receded into the background of cultural life.... It is not something to be deplored, but rather something to be coped with. We can do so by switching attention to the areas which *are* at the forefront of culture, those which excite the imagination of the young,


Minotaure *(1939) by Diego Rivera*

namely art and utopian politics." In "Trotsky. . ." he makes this point: "There is nothing sacred about universality which makes the shared automatically better than the unshared. There is no automatic privilege of what you can get everybody to agree on (the universal) over what you cannot (the idiosyncratic)."

But in science, the universal *is* better than the idiosyncratic. Wilson's argument is that we must exploit the actual and potential consilience of natural science with the human sciences and the arts in order to get at the uniformities, the basics, of human nature; that knowledge of those basics is necessary for an adequate understanding of the human condition, which is a social condition. That without it social justice will remain—just—a utopianism. Rorty seems to me (with all due respect) to be wrong on a number of issues regarding science, but here, especially, on universals. For him universals and searching for them are Platonism, elitism, invidious comparisons. Universalism distains or suppresses "idiosyncrasy." The odor of authority clings to it. Implicit is the humiliation of others, the work of bullies. But I see no justification thereof in history or in the outcomes of science. Rorty himself admits that since the 18th century the sciences "have...made possible the realization of political goals that could never have been realized without them." How did they accomplish that? Why, by identifying true (or nearly true) universals, such as the common origins, physiologies, aspirations, and feelings of all humankind, *and refuting the false ones*, such as the divine right of kings, natural slavery, and the general inferiority of women. Yes, by some scientists, and at various times, science has offered false universals, but those have been overthrown *only by better science*. And without reaching for true, or better-approaching-true commonalities, we would have only the idiosyncrasies of tribes, including those of whatever tribe you or I happen to belong to.

Now, finally, I can touch the second utility in the consilience of world knowledge, in filling gaps between standing disciplines, not just among the natural sciences. The first, remember, was immediate utility: consilient science broadens knowl-

edge of human biology to the point that some troubles (for example, infection) can be fixed, and life made better, more secure. That, surely, is a kind of social justice, by any definition. But the definitions of social justice themselves are of interest. Whence come they? To what extent do they differ among human societies? To what extent do all of them, if there are uniformities (which seem to exist), differ from whatever social justice means to chimpanzees? Since thtre are social arrangements most of the way down the phylogenetic tree, what regularities have they? How are they related to the conditions of life—reproductive strategies, physiology, development, ecosystem organization? What delights us? What, if anything, delights *them*? How did the physics and chemistries of delight and avoidance become embedded in brains, in societies? Filling such gaps in the puzzle must have eventual utility in application, like, but *much broader than*, the utilities of consilient physiology, pharmacology, and biochemistry in healing. What we can learn about the biological correlates of poetry, music, mathematics, a sense of justice, the urge to give comfort, the impulses of religion, must help us to understand—that is, *to appreciate*—them better. And to appreciate the deep meanings of these things is surely to diminish cruelty, to foster a fundamental kind of justice based upon respect for life.

Wilson devotes his last chapter to utility. He identifies what he sees as the gravest problems facing all life on this planet, and attempts to show how important it is for us to recognize "a seamless web of cause and effect" in the operation of the world. Among such problems are the prospect of diverting evolution itself through molecular genetics (and genetic engineering), and of damaging the biosphere irreversibly by failing to check the human population explosion and our power to alter the landscape (both consequences of science). This is not the place to judge these. Wilson updates the advocacies of his earlier books. It is, as said, an irony that a pre-eminent metaphysical naturalist should see doom in successes of metaphysical naturalism. But I don't deny the formal cogency of his arguments. While they have to be taken one at a time and examined, his larger point is unexceptionable. These gravest of human issues are not social problems, are not scientific problems, not matters of]ocal politics, tastes, traditions, beliefs, idiosyncrasies. *They are all of those, together, at one and the same time*. That is the strongest argument for a scholarship of the gaps, that reports honestly and regularly to everyone, not just to allies and competitors in the business. The only question, for me, after long years among intellectuals, is this: are there *ever* going to be enough of them with the brains, skills in knowledge acquisition, honesty, self-confidence in humility, energy, and social support, to follow Ariadne's thread through the labyrinth, to complete enough of the crossword puzzle, to make a difference—really to put an end to human (and animal) sacrifice?

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