

Filling the Empty Niches

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When surveying the spectrum from pop psych to neurology in works addressed to general readers, one is struck by how few major figures there have been - certainly when cognitive neuro is compared to a far smaller field⁽¹⁾, evolutionary biology, where real literary talents like Loren Eiseley once flourished, where "media dons" like Richard Dawkins regularly clarify our thinking, where there are magnificent series like those of Stephen Jay Gould (fifteen major essays a year, plus scholarly books and research papers, spanning three decades) which have influenced millions to read more. Many writers in the cognitive spectrum have occasionally written an influential book or two, but only a few could fill the largest available campus auditorium on name recognition alone, even without announcing a topic for the lecture - or have their name be the answer to a column in a crossword puzzle.

I don't have any answers for why this is so (though I'll presently quote Jacob Bronowski on the subject), but all those empty niches certainly indicate an opportunity for anyone hoping to contribute to the popularization of cognitive neuro. A niche, in ecology, is all that a species needs to function: the right food, climate, protection from predators, nesting sites, migration routes, and so forth. An empty niche is a proven niche going unused - say, that of the late Stephen Jay Gould. I argue that the popularization successes in an adjacent field, evolutionary biology, suggest that a similar niche is there for popularizing cognitive neuro. I will name these empty niches for suitable role models elsewhere ("The Lewis Thomas Niche").

Migration Routes (Where Do the Readers Come From?)

Science reporting is very uneven in its coverage (just try comparing what the *New York Times* covers with a list of major projects funded by foundations and governments). That's because science reporters (or, more likely, their editors) find it hard to imagine that potential readers are readily available for many subjects. There's an "entry level" aspect, from which one can later make a transition to serious stuff -- but general circulation magazines, newspapers, and trade publishers often have an entry-level cutoff. They're not multilevel. It's the same sort of widest-possible-audience reasoning that has made television news programs so shallow. Even though very important for our battle with a changing climate, ocean currents long seemed, to editors, like a subject with few ready-made entry-level readers⁽²⁾.

Fortunately, we in cognitive neuroscience don't have the same problem as oceanography - or, indeed, most other important fields of research -- because everyone comes with an innate interest in other people's psychological makeup. Unless they've been terminally put off by the froth of some pop psych (the ones where it's easy to read an entire chapter which has no memorable content), they're likely to give a glance to something featuring minds/brains. No other field of popular science comes with the built-in advantages of anything involving cognition.

Though it may take a while to convince some that the mind is surely in the brain, this bleed-over from popular psychology into cognitive neuro is easily the major source of readers (those writing about other fields can likely identify similar major migration routes). We also have some secondary sources: there's the medical route, as when stroke

or dementia patients in the family serve as an impetus to read more. And the "neat mechanism" route which attracts readers in from physics and computer science. Finally, let me mention the coffee-table-book niche: colorful images of the brain-in-action as an art form seem possible. Alas, there is also another more cynical use of coffee-table books from which authors occasionally profit, e.g., all those unread copies of Stephen Hawking's *A Brief History of Time* serving to advertise to visitors that the inhabitants of the house are the kinds of people who are capable of reading serious books. This niche aspect is closely related to one of the rationales in gift book selection: people give books like Hawking's to flatter their bosses or friends -- saying, in effect, "I may not be able to read books like this, but I know you're the sort of person who can understand Hawking." Authors should not turn up their noses at this: it seeds a lot of homes with books that unintended recipients end up reading during school vacations.

Beyond entry level appeal, there is the "serious readers" level: an audience that is capable of following a sustained line of argument without constant re-motivation⁽³⁾ and the pretty-but-irrelevant pictures that clutter modern textbooks. While academics in adjacent fields are one example (hopefully, neurophysiologists will read some linguistics now and then, and vice versa), there is a much broader base when it comes to cognitive neuro: the entire range of creative people, from poets to programmers. They're curious about how they pull off their successes. University Presses readily publish these serious-readers books, but trade publishers may do so only if they anticipate an additional draw via name-recognition, entry-level, coffee-table, or flattery-by-gift types. Serious readers are an influential readership but not (for cognitive neuroscience, in the US) a large one - not compared with the readership implied by my four decades of examples from evolutionary biology.

Readers in adjacent fields are an extremely important audience, just for the progress of science. Pharmacologists are likely to get much of their information about cerebral localization of function from newspapers, television specials, and popular books, reading a review article only if they actually have to give a lecture involving the subject. Many interdisciplinary research opportunities have been opened up by an article intended for a more entry-level reader. Certainly, I got my beginning education in evolutionary biology back in 1980 via Steve Gould's monthly columns.

There are some hazards to this cross-fertilization. Every time that I see a watered-down and somewhat misleading article about a subject I know well, I shudder - because I realize that my own information about other fields has often come through exactly such a distorting filter, but one I cannot appreciate yet. Writers who aim at general audiences have to remember that busy scientists are also going to read their simplification attempt - and be misled if it's misleading. Errors that may seem innocuous, when considering only the lay audience, may be serious if they mislead working scientists in other fields. Yes, they should know better than to rely on such popular articles, but the conclusions they draw may cause them to lose interest and never get to the library, or to assume something is so well established that there's no need to read the details.

Such considerations are why it took me six months to write what was the first major magazine article on abrupt climate change (it was the *Atlantic Monthly* cover story for January 1998). I already knew most of the science, having followed the subject since 1984, but translating it for general readers meant inventing metaphors - and then

discarding most of them as misleading to some segment of the audience.

Protection from Predators

The scientist contemplating writing for a wider audience will often assume that others in the field will be critical, that such a writer will constantly have to justify simplifications or omissions. Or that others will be suspicious that the writer is seeking fame via bypassing the long hard grind of academic publication. While such comment surely happens on occasion, the writer is more likely to be nearly invisible within the field, even if moderately-well-known outside the field.

The reason for this invisibility is simple. Scientists, as I have said, are also general readers. They only have so much time to read, and so they mostly read outside their own field. Neuroscientists will tend to read popular books on cosmology or evolutionary biology, not popular books on brains (they'll assume they know it all, even if you're sure they don't). In my experience, experts learn about a popular book on their subject only years after publication, and then only because a new student tells them about it or because they go looking for supplementary reading material for an introductory course.

If, of course, you attain prominence and then criticize a whole field such as evolutionary psychology in the *New York Review of Books*, a thick hide will then be needed. But this is a rare occurrence, not the usual experience.

Nesting Sites

The widespread curiosity about minds is a start, but writers also need an established way to reach their audience. Attention is a precious commodity, and people tend to rely on trusted gatekeepers, such as magazines, newspapers, television -- though this is breaking down somewhat, with the web's ability to bypass them.

The "op-ed" pages of local newspapers provide a place for well-written articles of about 700 words. This is an entry-level niche that didn't exist several decades ago, and it will likely expand with the expansion of web portals having editor-selected commentary. I have been totally unsuccessful in getting even an acknowledgement, let alone a published piece, when I have attempted this route a dozen times.

Regular columns have played an important role, particularly if later converted into books. Lewis Thomas and Stephen Jay Gould came up by this route, thanks to far-sighted editors of the *New England Journal of Medicine* and *Natural History*, but the regular column for a wide audience is largely unexploited in cognitive neuro.

Science journalists have largely filled this niche in many fields; they write as observers rather than participants in the great exploration, but the sustained output of someone like Daniel Goleman reporting on psychology is very important. It doesn't require a Ph.D. in your subject (as Goleman has) to be a good reporter; many science reporters are simply literature or journalism majors who have developed into real fans of science over the years, and they are often better at judging what will confuse general readers than are people used to dealing with students who have taken all the prerequisites. Many of the people who write popular books do not come up via writing shorter pieces, nor are they first famous within their own fields⁽⁴⁾. They simply start, as I did, with writing books⁽⁵⁾. They have, however, all the usual problems in finding publishers (actually, in first finding a literary agent that will take them on). What they are initially judged on, the book proposal, is often no longer than 1,500 words - just twice the length

of an op-ed piece. Editors don't have time to read much more. So the entré for getting to publish a full-length book is generally via a very well written short preface to such a book, one that can "hook" an agent and then some editors. You can't avoid writing short succinct pieces, even if you confine yourself to books!

It may be possible to bypass some of these getting-space obstacles in other media. Given the "re-invent everything" attitudes seen among web developers, there are now nonprint analogies to columns and books, perhaps with important multimedia advantages and new entry-level options for science popularizers.

Where the writer comes from

Interlopers from other scientific fields have their advantages and disadvantages as writers. When I ventured outside my own field to write a cover story for *The Atlantic Monthly* about abrupt climate change, its history and likely oceanographic mechanisms; the editor really had to twist my arm for weeks to get me to undertake it but, in retrospect, I worried too much.

I fully expected that people within geophysics would be somewhat unhappy about this trespass. I reasoned that even if I were to avoid all the usual conceptual errors, even if I managed to use all those tricky qualifications ("nearly all," double negatives, and so forth) meant to show that you understand their concerns and have neatly sidestepped the confounding issues, that they'd still be unhappy -- probably with my metaphors, with who I'd left out, with my own interpretations of instability mechanisms. I actually got very little such feedback; it was mostly along the lines of "Well, it's really even more complicated, you know" -- and that's the inevitable problem (as most of them appreciated) when reducing a book-length topic to a mere 6,600 words.

The hardest part of writing the article was finding suitable metaphors for a whole series of technical terms, processes, and possibilities; I might have figured out the oceanographers' unique use of the word "water" but I knew it would throw most readers - - and that they'd never wind up reading my finale. It took months before the trial-run metaphors settled down.

I also realized that what made it possible for a neurophysiologist to write about geophysics was that the oceanographers and atmospheric scientists have been very good about putting teaching materials (including huge glossaries with literature references), grant proposals, and review papers up on web pages. They are years ahead of the neurosciences in this regard, one reason why it would be hard for someone in geophysics to undertake a similar article about the latest spectacular findings in cognitive neuro. One advantage of a scientist writing about other scientific fields is this sensitivity to terminology and reader's hardships. And such an outsider -- if also a good writer -- may be better at spotting what piece of the whole makes for a good story. Researchers immersed in a field tend to see things as a morass of unfinished problems and unsatisfactory precision, with lots of loose ends -- but a writer who can navigate around the research area may often see some part of it that can stand alone and be memorable, constitute a "good story." An example in my formative years was the astronomer Carl Sagan writing about neurobiology in his 1974 book, *The Dragons of Eden*.

One disadvantage of interloping scientists, of course, is that some may come with an agenda, such as an answer in search of a question (quantum physics as the answer to - Well, how about *consciousness*!). Or the interloper may invent an unfortunate term.

Consider how the term "neural networks" was coined by the physicists to represent a web of abstract elements, in ignorance of the more concrete, structured connotations among neurophysiologists who had been working for decades on actual neural networks like those in *Limulus*. Every time we had to say "*real* neural networks," we cursed the physicists for hijacking *our* term.

The exploitation of scientific ignorance

But most such borrowing is, of course, an innocent search for analogies. There are examples, however, where outsiders borrow terminology in order to borrow the prestige of science or technology. "A little knowledge is a dangerous thing," in part, because there are people who will exploit the situation with a shell game that calls one thing by another's name.

The classic is when someone appends "Science" to the name of their nonscientific enthusiasm. But sometimes they simultaneously borrow from three fields -- say, from neuro, linguistics, and programming -- to suggest a magnificent convergence that few among the involuntary donors would recognize.

Companies that make agricultural machinery have been known to change their corporate name to suggest celestial navigation (though the maneuver was unlikely to impress farmers, it might have fooled some in banking and the stock market). Some advertising agencies specialize in this sort of renaming. This cynical exploitation of scientific prestige will diminish only when more people actually know something about science, only when scientific societies take more of a role in defending their terminology from misappropriation.

Part of the bad reputation of popularized science within science itself is, of course, due to seeing too many examples of what happens when people of little understanding grab something and run with it, particularly when they do it to exploit those who cannot tell the difference between science and hyperbole. There are, of course, inevitably areas where knowledge is thin and wisdom is hypothetical; that's just the current state of affairs and there is no point in trying to hold up some new therapy to the standards of physics. But some fields are nothing but the popularization of some notion: one book and its one idea will become the "bible" of a movement. Even the well-intentioned ones may exhibit some of the problems of the advertising agencies and their exploitation of scientific terminology. While most fads will merely constitute a waste of time and money, some -- repressed memory therapies are likely an example -- may not be harmless and their incautious fans unlikely to diligently adhere to that Hippocratic aphorism, "First, do no harm."

One appropriate response is more popularization, not less. So long as the power of science and technology is known to the public, there will always be a niche for impressing the clueless - and we all, at some stage in our life, are ignorant. We are all, in some areas, gullible. And expertise in one area may not produce appropriate caution in other areas (some physicians, for example, have a reputation for gullibility regarding investments, despite their everyday experience in dealing with patients who were gullible about "natural" therapies and delayed too long in seeing someone more knowledgeable). It's not that the public is uninterested in science - they are, and certainly in matters cognitive. But they don't have the time to become experts and learn all the pitfalls that

experts eventually learn to avoid. The best statement on the subject that I know was made by Carl Sagan in *Broca's Brain*:

There is a vast untapped popular interest in the deepest scientific questions. For many people, the shoddily thought out doctrines of borderline science [parapsychology, astrology, ancient astronauts] are the closest approximation to comprehensible science readily available. The popularity of borderline science is a rebuke to the schools, the press, and commercial television for their sparse, unimaginative and ineffective efforts at science education, and to us scientists, for doing so little to popularize our subject.

And there's that memorable warning in C. P. Snow's novel, *The Search*, where one of the characters says

The *how* of human beings -- every village gossip has been doing that since talking started.... It's the *why* of human beings you've got to understand.... Or else you'll be giving all your science to a mob of children. Whatever they do with it, they won't know why. We can never trust them. Unless they know the why about themselves, then everything in the world is like giving a child some poison and telling it to go and play in the kitchen.

Delivery Vehicles

The very short pieces needed for entrée into science popularization (whether op-ed columns or book proposals) rely heavily on exposition, pure and simple. Longer pieces may benefit from some structure. Scientists usually will think in terms of a logical development of concepts, but let me also suggest some of the principles of narrative and story-telling.

They offer two major advantages: hanging the material on a narrative framework makes it more memorable, more likely to still be there two weeks later. And it makes it more likely that the reader will make it all the way to the end of the article or book. "Spontaneous abortions" are very common in reading, and the writer needs to constantly worry about losing the audience. Consider this description of our orientation toward narrative by the writer Kathryn Morton⁽⁶⁾:

The first sign that a baby is going to be a human being and not a noisy pet comes when he begins naming the world and demanding the stories that connect its parts. Once he knows the first of these he will instruct his teddy bear, enforce his world view on victims in the sandlot, tell himself stories of what he is doing as he plays and forecast stories of what he will do when he grows up. He will keep track of the actions of others and relate deviations to the person in charge. He will want a story at bedtime.

Nothing passes but the mind grabs it and looks for a way to fit it into a story, or into a variety of possible scripts....

The medical detective stories make implicit use of such narrative structure, and some books are crafted more explicitly around journeys. My rationale for writing a 600-

page book around a two-week-long float trip down the Colorado River⁽⁷⁾ was that the Grand Canyon was full of ways of illustrating evolution on both geological and cultural time scales - and that the journey itself gave me the freedom to gamble a little with material that some subset of readers would consider "more than they wanted to know."

Skimming over the hard parts is thought not to be possible with science (indeed, because of the logical progression of science textbooks, if you don't understand chapter two, you'll never make it through chapter six) - and this attitude, carried over to popular writing about science, may cause the reader to needlessly drop out, to never finish the book. But with a familiar framework such as a journey, the floundering reader is more likely to skim the hard part in anticipation of picking up the thread of the journey. This sense of continuity and expectation was surely the case back in the days before stories such as the *Iliad* and the *Odyssey* were written down.

Neuroscience Niche Examples

There are easily a dozen levels of organization within the neurosciences, ranging from membrane channels up through synapses and cells to circuits and regional specializations between the cerebral hemispheres. And that's just the anatomy: functionally, we have reflexes, one-trial memories, learning, and so on, all the way up to hallucinations, obsessions, and creativity. We have time scales ranging from milliseconds to lifetimes.

I don't propose to survey the people who write popular books about some part of the cognitive spectrum. But I would like to identify several "neighborhood niches," both perspectives from slightly outside of the research mainstream. It's almost as if there were "licensed commentators," people coming from disciplines that are expected to have a broad perspective. First there's the viewpoint from philosophy into cognitive science. It's occupied presently by a number of people, one of the most quotable of which is Daniel C. Dennett. In *Kinds of Minds* (1996, p. 147), he writes:

There is no step more uplifting, more momentous in the history of mind design than the invention of language. When *Homo sapiens* became the beneficiary of this invention, the species stepped into a slingshot that has launched it far beyond all other earthly species in the power to look ahead and reflect.

In *Darwin's Dangerous Idea* (1995, p. 460), Dennett writes:

We, unlike the cells that compose us, are not on ballistic trajectories; we are *guided* missiles, capable of altering course at any point, abandoning goals, switching allegiances, forming cabals and then betraying them, and so forth. For us, it is always decision time, and because we live in a world of memes, no consideration is alien to us, or a foregone conclusion.

That's the level of writing, and mastery of ideas, that it takes to influence a lot of readers.

The other neighborhood niche is the perspective from the medical end of the spectrum. It too has a number of contemporary practitioners, and the neurologist Oliver Sacks is widely known for very good reasons. He is not especially quotable, because he is

the master of the humanistic narrative -- everything's too connected to excerpt -- but here, from *Seeing Voices*, is his description of an eleven-year-old deaf boy, reared without sign language for his first ten years, showing what life is like without syntax:

Joseph saw, distinguished, categorized, used; he had no problems with *perceptual* categorization or generalization, but he could not, it seemed, go much beyond this, hold abstract ideas in mind, reflect, play, plan. He seemed completely literal - - unable to juggle images or hypotheses or possibilities, unable to enter an imaginative or figurative realm.... He seemed, like an animal, or an infant, to be stuck in the present, to be confined to literal and immediate perception, though made aware of this by a consciousness that no infant could have.

More consistently quotable is Mel Konner⁽⁸⁾, who views cognitive neuro both as a research insider and from the perspective of medicine and anthropology:

At the conclusion of all our studies we must try once again to experience the human soul as soul, and not just as a buzz of bioelectricity; the human will as will, and not just a surge of hormones; the human heart not as a fibrous, sticky pump, but as the metaphoric organ of understanding. We need not believe in them as metaphysical entities -- they are as real as the flesh and blood they are made of. But we must believe in them as entities; not as analyzed fragments, but as wholes made real by our contemplation of them, by the words we use to talk of them, by the way we have transmuted them to speech. We must stand in awe of them as unassailable, even though they are dissected before our eyes.

Most popular writing about matters cognitive does not aspire to this literary level. And it can be effective without such poetic density. Most of our information comes from science journalism, plain unadorned prose from a writer who has taken the time to understand something of the subject and to select a limited piece of it which will make a good story.

The Available Empty Niches

But any writer who aspires to a wider audience has a number of role models to choose from. So let me conclude with a selection of role models from outside cognitive neuro, though I have tried to select quotations from the occasions when they are addressing cognitive topics. First let me show some selections from the literary world:

The highest activities of consciousness have their origins in physical occurrences of the brain, just as the loveliest melodies are not too sublime to be expressed by notes.

W. Somerset Maugham

The way we think in dreams is also the way we think when we are awake, all of these images occurring simultaneously, images opening up new images, charging and recharging, until we have a whole new field of image, an electric field pulsing and blazing and taking on the exact character of a migraine aura.... Usually we sedate ourselves to keep the clatter down.... I don't necessarily mean with drugs, not at all. Work is a sedative. The love of children can be a sedative.... Another

way we keep the clatter down is by trying to make it coherent, trying to give it the same dramatic shape we give to our dreams; in other words by making up stories. All of us make up stories. Some of us, if we are writers, write these stories down, concentrate on them, worry them, revise them, throw them away and retrieve them and revise them again, focus on them all our attention, all of our emotion, render them into objects.

Joan Didion, 1979

The search for truth is predatory. It is a literal hunt, a conquest. There is that exemplary instant in Book IV of *The Republic*, when Socrates and his companions in discourse corner an abstract truth. They halloo, like hunters who have unearthed and run down their quarry.... [Even if enjoined from the scientific quest,] somewhere, at some moment, a man alone, a group of men addicted to the drug of absolute thought, will be seeking to create organic tissue, to determine the nature of heredity, to produce the cloud-chamber trail of quarks. Not for renown, not for the benefit of the human species, not in the name of social justice or profit, but because of a drive stronger than love, stronger than even hatred, which is to be interested in something. For its own enigmatic sake. Because it is there.

George Steiner, 1978

Language, like other cognitive structures, is useful for some tasks and worthless for others. I cannot tell you, because I do not know, what my language prevents me from knowing. Language is itself like a work of art; it selects, abstracts, exaggerates, and orders.

Annie Dillard, *Living by Fiction*, 1982

I don't think writers are sacred, but words are. They deserve respect. If you get the right ones in the right order, you can nudge the world a little or make a poem which children will speak for you when you're dead.

Tom Stoppard, *The Right Thing*, 1982⁽⁸⁾

But my main effort is to select scientists from other fields, those that have made a sustained effort at popularizing science and commenting on a larger scene, each creating a significant niche. Some of these niches are now entirely unfilled: Loren Eiseley and Jacob Bronowski died in the mid-seventies, Carl Sagan and Lewis Thomas in the mid-nineties, Stephen Jay Gould more recently – and there's still no one around who is comparable, not to any of them. Other niches are empty only in the sense that no one has become established as a cognitive counterpart to such evolutionary biologists as Richard Dawkins.

Opportunity awaits.

The Loren Eiseley Niche

The salt of those ancient seas is in our blood, its lime is in our bones. Every time we walk along a beach some ancient urge disturbs us so that we find ourselves shedding shoes and garments, or scavenging among seaweed and whitened timbers like the homesick refugees of a long war.

The Unexpected Universe, 1969

Parts of [the world] are neither land nor sea and so everything is moving from one element to another, wearing uneasily the queer transitional bodies that life adopts in such places. Fish, some of them, come out and breathe air and sit about watching you. Plants take to eating insects, mammals go back to the water and grow elongate like fish, crabs climb trees. Nothing stays put where it began because everything is constantly climbing in, or climbing out, of its unstable environment.

The Night Country, 1971

Curious, I took a pencil from my pocket and touched a strand of the [spider] web. Immediately there was a response. The web, plucked by its menacing occupant, began to vibrate until it was a blur. Anything that had brushed claw or wing against that amazing snare would be thoroughly entrapped. As the vibrations slowed, I could see the owner fingering her guidelines for signs of struggle. A pencil point was an intrusion into this universe for which no precedent existed. Spider was circumscribed by spider ideas; its universe was spider universe. All outside was irrational, extraneous, at best raw material for spider. As I proceeded on my way along the gully, like a vast impossible shadow, I realized that in the world of spider I did not exist.

The Star Thrower, 1976⁽⁹⁾

The Richard Dawkins Niche

Evolution is an enchanted loom of shuttling DNA codes, whose evanescent patterns, as they dance their partners through geological deep time, weave a massive database of ancestral wisdom, a digitally coded description of ancestral worlds and what it took to survive in them.

Climbing Mount Improbable, 1996

Any suggestion that the child's mathematical ineptitude might have a genetic origin is likely to be greeted with something approaching despair: if it is in the genes "it is written", it is "determined" and nothing can be done about it; you might as well give up attempting to teach the child mathematics. This is pernicious rubbish on an almost astrological scale. Genetic causes and environmental causes are in principle no different from each other. Some influences of both types may be hard to reverse, others may be easy.

The Extended Phenotype, 1982

Our genes may be immortal but the *collection* of genes which is any one of us is bound to crumble away. Elizabeth II is a direct descendant of William the Conqueror. Yet it is quite probable that she bears not a single one of the old king's genes. We should not seek immortality in reproduction. But if you contribute to the world's culture, if you have a good idea, compose a tune, invent a sparking plug, write a poem, it may live on, intact, long after your genes have dissolved in the common pool. Socrates may or may not have a gene or two alive in the world today... but who cares? The memes of Socrates, Leonardo, Copernicus, and Marconi are still going strong.

The Selfish Gene, 1976

The Jacob Bronowski Niche

A difficulty of lay discussion on scientific subjects is usually this, that there exists no common language in which scientists and laymen can talk together about scientific ideas. In each generation, the subjects which blaze into the headlines are therefore those rare exceptions where such a language does happen to exist. This is why the nineteenth century got so excited about the age of the earth and the descent of man. Those were not the largest, the most interesting, or even the most popular advances of science. No, they were typical scientific ideas, but they were in the one field where everyone knew the language. Here therefore the issue between traditional opinion and the new scientific approach could be clearly understood and argued.

The Common Sense of Science

The hand is the cutting edge of the mind. *The Ascent of Mind*, 1973

The Stephen Jay Gould Niche

We have become, by the power of a glorious evolutionary accident called intelligence, the stewards of life's continuity on earth. We did not ask for this role, but we cannot abjure it. We may not be suited to it, but here we are.

Natural History, 1984

There may be nothing new under the sun, but permutation of the old within complex systems can do wonders.

Ontogeny and Phylogeny, 1977

The Carl Sagan Niche

We've arranged a global civilization in which most crucial elements -- transportation, communications, and all other industries; agriculture, medicine, education, entertainment, protecting the environment; and even the key democratic institution of voting -- profoundly depend on science and technology. We have also arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces.

The Demon-haunted World, 1996, p.26

An extraterrestrial being, newly arrived on Earth -- scrutinizing what we mainly present to our children in television, radio, movies, newspapers, magazines, the comics, and many books -- might easily conclude that we are intent on teaching them murder, rape, cruelty, superstition, credulity, and consumerism. We keep at it, and through constant repetition many of them finally get it. What kind of society could we create if, instead, we drummed into them science and a sense of hope?

The Demon-haunted World, 1996, p.39

The Lewis Thomas Niche

Social insects behave like the working parts of an immense central nervous system: The termite colony is an enormous brain on millions of legs; the individual termite is a mobile neuron. This would mean that there is such a phenomenon as collective thinking, that goes on whenever sufficient numbers of

creatures are sufficiently connected to each other. It would also mean that we humans could do the same trick if we tried, and perhaps we've already done it, over and over again, in the making of language....

in *Discover Magazine*

Only two centuries ago, we could explain everything about everything, out of pure reason, and now most of that elaborate and harmonious structure has come apart before our eyes. We are dumb..... We have discovered how to ask important questions, and now we really do need, as an urgent matter, some answers. We now know that we cannot do this any longer by searching our minds, for there is not enough there to search, nor can we find the truth by guessing at it or by making up stories for ourselves. We cannot stop where we are, stuck with today's level of understanding, nor can we go back. I do not see that we have any real choice in this, for I can see only the one way ahead. We need science, more and better science, not for its technology, not for leisure, not even for health and longevity, but for the hope of wisdom which our kind of culture must acquire for its survival.

The Medusa and the Snail⁽¹⁰⁾

End Notes

1. Evolutionary biology encompasses perhaps 3,500 workers. The largest neuroscience society has about 33,000 researchers and that doesn't include many people who identify themselves primarily with psychology or neurology-neurosurgery.
2. William H. Calvin, "The great climate flip-flop," *The Atlantic Monthly* 281(1):47-64 (January 1998). See also <http://WilliamCalvin.com/1990s/1998AtlanticClimate.htm>.
3. For example, Derek Bickerton and I aimed our book, *Lingua ex machina: Reconciling Darwin and Chomsky with the Human Brain* (MIT Press, 2000), at the people we were talking with at dinner every night, during a month's stay at the Rockefeller Foundation's Bellagio Study and Conference Center.
4. My second book, *The Throwing Madonna* (McGraw-Hill 1983) was a collection of 17 essays, but none appeared separately. I wrote them as writing exercises, rewriting the earlier ones when my style had improved. I had some journalistic experience back before college, which was very helpful in converting from a standard academic style into something more like my current style.
5. Kathryn Morton, "The Story-Telling Animal," *New York Times Book Review*, pp.1-2 (23 December 1984).
6. William H. Calvin, *The River that Flows Uphill: A Journey from the Big Bang to the Big Brain* (Macmillan 1986).
7. Melvin Konner, in *On Doctoring: Stories, Poems, Essays*, edited by Richard Reynolds and John Stone (Simon & Schuster, 1991).
8. Tom Stoppard, *The Right Thing* (Faber and Faber 1982), p.53.
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