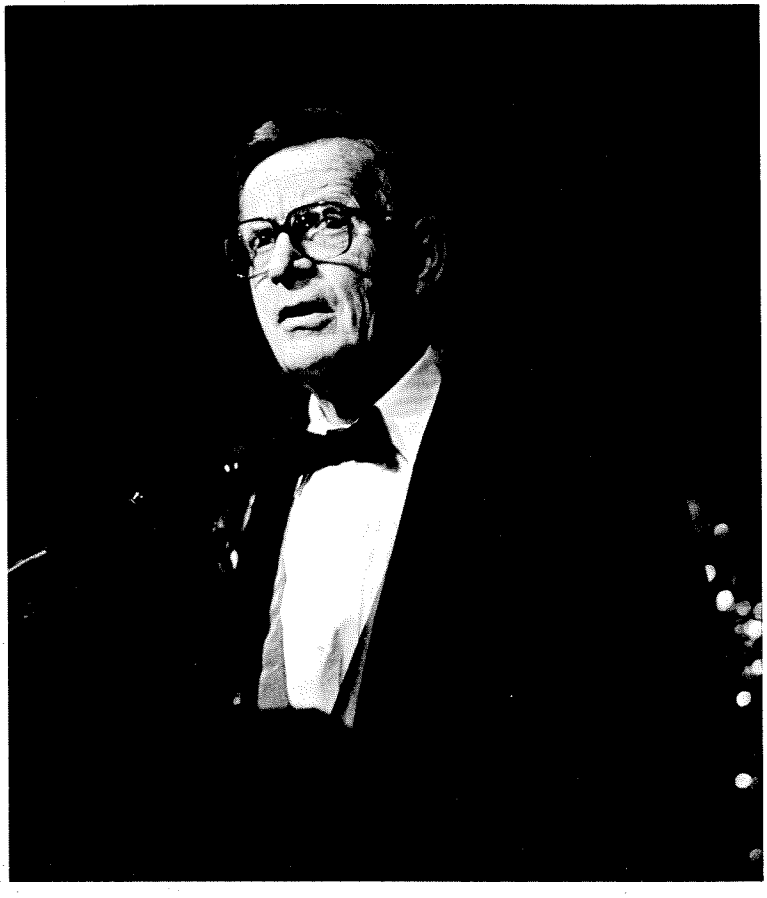
Science and Social Science

by Lewis Thomas

HUMAN BEINGS HAVE never before had such a bad press. By all reports we're unable to get anything straight or right these days, and there seems to be almost nothing good to say for ourselves. In just the past century we've doubled our population twice and will double it again before the next one has run out. We have swarmed over the open face of the earth, occupied every available acre of livable space, displaced numberless other creatures from their accustomed niches, caused one extinction after another with more to come, polluted all our waterways and even part of the oceans.

And now in our efforts to make energy and keep ourselves warm, we appear to be witlessly altering the earth's climate by inserting too much carbon dioxide into the atmosphere, and if we don't pull up short before long, we might be producing a new greenhouse effect around the planet, melting the Antarctic ice shelf and swamping all coastlines including this one and the one I worry the most about — Manhattan. Not to mention what we are doing to each other and what we are thinking seriously of doing in the years just ahead with the most remarkable toy ever made by man — the thermonuclear bomb.



Our capacity for folly has never been matched by any other species. The long record of evolution instructs us that the way other creatures get along in nature is to accommodate, to fit in, to give a little whenever they take a little. The rest of life does this all the time, setting up symbiotic arrangements whenever the possibility comes into view. Except for us the life of the planet conducts itself as though it were an immense coherent body of connected life, an intricate system and even, as I see it, an organism, an embryo maybe, conceived as each one of us was first brought to life as a single successful cell.

I have no memory of ever having been a single cell myself, 70 years ago; but I was, and whenever I think of it, I tremble at the sheer luck. The thought that the whole biosphere, all that conjoined life — all million or 30 million or whatever the number is, it's still an incalculable number of what we call species of living

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things — had their collective beginning as a single solitary cell 3½ billion years ago, sweeps me off my feet.

Our deepest folly is the notion that we are in charge of the place, that we own it and somehow can run it. We are beginning to treat the earth as a sort of domesticated household pet, living in an environment invented by us, part kitchen garden, part park, and part zoo. It is an idea we must rid ourselves of soon, for it is not so; it is the other way around. We are not separate beings; we are a living part of the earth's life, owned and operated by the earth, and probably specialized for functions on its behalf that we have not yet glimpsed. Conceivably, and this is the best thought I have about us, we might turn out to be sort of a sense organ for the whole creature, a set of eyes, even a storage place for some thought. Perhaps if we can continue our own embryologic development as a species, it might be our privilege to carry seeds of life to other parts of the galaxy.

But right now we have a lot to learn. One of our troubles may be that we are still so new and so young. In the way evolution clocks time, we arrived on the scene only a moment ago, down from the trees puzzling over our apposing thumbs and wondering what on earth we're supposed to do with the flabbergasting gift of language and metaphor. Our very juvenility could account for the ways in which we still fumble and drop things and get things wrong. I like this thought even though the historians might prefer to put it otherwise. They might say — some of them do say — that, "Look, we've been at it thousands of years, trying out one failed culture after another, folly after folly, and now we are about to run out our string." As a biologist, I cannot agree. I say that a few thousand years is hardly enough time for a brand new species to draw breath.

And now with that thought, for the moment anyway, I feel better about us. We are not a disease of the planet. We have the makings of exceedingly useful working parts. We are just new to the task, that's our trouble. Indeed we are not yet clear in our minds as to what the task is beyond the imperative to learn. We have all the habits of a social species, more compulsively social than any other, even the bees and the ants. Our nest, or hive, or equivalent, is language. We are held together by speech; we are at each other all day long. Our great advantage over all other social animals is that we possess the kind of brain that permits us to change our minds. We are not obliged as the ants are to follow genetic blueprints for every last detail of our behavior. Our genes are more cryptic and ambiguous in their instructions. "Get along," says our DNA. "Talk to each other; figure out the world; be useful; and above all, keep an eye out for affection."

One important thing we have already learned. We are a novel species, but we are constructed out of the living parts of very ancient organisms. We go back a long way. Sometime around a billion years ago, probably more, the bacterial cells that had been the sole occupants of the earth for the preceding 2½ billion years began joining up to form much larger cells with nuclei like ours. Certain lines of bacteria had learned earlier on to make use of oxygen for getting their energy, and somehow or other these swam into the new cells and turned into the mitochondria of what we call higher nucleated cells. These creatures are still with us, thank goodness, packed inside every cell in our bodies. If it were not for their presence and their hard work, we humans could never make

a move or even create a song.

The chemical messages exchanged among all the cells in our bodies regulating us are also antique legacies. Sophisticated hormones like insulin, growth hormone, and the sex steroids, and a multitude of peptides — including the endorphins, which modulate functions in our brain — were invented long ago by the bacteria and their immediate progeny, the protozoans. And they still make them for reasons that are entirely obscure. We almost certainly inherited the genes needed for things like these from our ancestors in the mud. We may be the greatest and brainiest of all biological opportunists on the planet, but we owe debts of long standing to the beings that came before us and to those that now surround us and will, I hope, help us along into the future.

I used to think of the social sciences as all of a dreary piece, somehow fundamentally different from the kinds of science in which I'd been trained — softer and fuzzier, mainly underpinned by something like guesswork and unlikely, as I thought, to get anywhere in a lifetime. I believed that questionnaires, and surveys, and computers to handle very big numbers, and the uncontrolled use of imagination, and wishing (most of all wishing) were the only instruments available to researchers in these fields. And I thought that people doing social science were overanxious to quantify whatever they had in the way of information and ideas, and that they were all afflicted with what someone has called "physics envy."

I should note here that our colleagues in the physical sciences, I think, have had the same feeling for a great many years about my field — biomedical science — until some of them overheard that we had some neat little structures like nucleic acids, which we could measure by borrowing isotope technologies, and in they came to invade our territory and take over the parts of it they liked, which they named biophysics. But I still sense that the world of physics, where the only language spoken is pure, unaccented mathematics, regards itself as the very pinnacle of intellectual life. And from this austere perch, the physicists look down at us biologists with gentle amusement, murmuring things about fuzzy notions and soft data and incomplete guesses. Science is a hierarchy of snobberies, and right now the social sciences are climbing the ladder from the lowest rung.

This doesn't mean that I'm comfortable with my prejudice. I've known some people who assure me that economics, both micro and macro, is a genuine scientific enterprise with predictive accuracy and solid data, and I know a number of sociologists who strike me as being a lot smarter than I am. And the numberless subdivisions in psychology these days seem to be attracting any number of very bright young people.

Parenthetically I wish the social scientists, wherever they are, and especially the psychiatrists, were further along in their fields than they seem to be. We need in a hurry some professionals who can tell us what has gone wrong in the minds of statesmen of this generation. How is it possible for so many people with the outward appearance of steadiness and authority, intelligent and convincing enough to have reached the highest positions in the governments of the world, to have lost so completely their sense of responsibility to the human beings to whom they are accountable? Their obsession with stockpiling nuclear armaments and their urgency in laying out detailed plans for using them have at the core aspects of what we should be calling lunacy in other people under other circumstances. And just before they let fly everything at their disposal and this uniquely intelligent species begins to go down, it would be a small comfort to understand how it happened to happen. But I digress.

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I do have in mind one field in social science that is a stunning wonder, in which more has been accomplished for the illumination of the human mind and for the explanation of the most species-specific aspect of human behavior than any other endeavor I can think of. And the continuing and dazzling success of this field gives me sharp pause in my casual efforts to appraise other parts of social science. I refer, of course, to that queen of sciences, matching the best of physics and biology, namely, philology or — as it is now called in the academic world — comparative linguistics.

This is really a branch of biology, I like to think, certainly human biology. For I can think

of no scientific endeavor located more centrally at the core of human existence than the study of language. Indeed, I doubt that we could have evolved from whatever we were at our earliest beginnings (small-headed creatures with a tendency to wander about in small clusters trying to make friends) to what we later became (the most compulsively social of all creatures on the planet) if we had not developed the gift of speech. It may be true that we could think without language, but it would not be human thought.

There are two ways of looking at the ancient roots of modern words. One is to dismiss them as fossils or artifacts, meaningless for the meaning of contemporary words, not something to be thought about while speaking or writing — hazardous in fact to try doing this, risking falling off the bicycle because of the concentrated effort. The other approach, which I do like, is to regard the old roots as hidden reminders, memories of old meanings that are really connected to today's meaning as built-in allusions — how a word "human," for instance, comes from an old Indo-European root, *dhghem*, which meant the earth or soil. And "humble" and "human" are sibling words from that same root, teaching a plain, "humiliating" lesson most of us never succeed in learning in a whole lifetime.

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There are some nice words indicating human qualities — "good" itself, which is a word that by actual count by somebody or other is said to have occurred more frequently than any other word in Shakespeare's plays. "Good" came from an Indo-European root *ghedh*, which originally meant simply "to unite." And it moved into Old English as *togaedere* and then into English as "together," "gather," and then "good." And "bad," by the way, came from *bheidh*, meaning "to compel," and hence into German, *baidjan*, meaning to afflict, and then into English as "bad." "Worse" came from an Indo-European root (heaven knows how many thousands of words and years ago), *wers*, meaning "to confuse," which became *werra* in Germanic and then became "war" in English, as well as the worst of things.

Anything "marvelous" or "miraculous" causes the same human response, and the old Indo-European root for these words identifies the response. The root was *smei*, meaning simply "to smile." A marvel is something to smile in the presence of, in "admiration," which, by the way, is a cognate coming from the same root along with, of all telling words, "mirror."

The oddest of all things about language is that we do it with our genes. We are biologically coded to speak not just isolated words but whole strings of words in sentences, and we very likely have genes with instructions for grammar and syntax. Chomsky proposed about 30 years ago that language is indeed a biological trait, setting off a wrangling argument among the linguists, which continues to this day. But we do it collectively, never alone. It's the one aspect of human behavior that does identify us once and for all as the human species. Language, in a sense, is sociobiology at its most complex and puzzling.

We don't have many models of social behavior to study at close hand, but the best and the nearest of them, and the easiest to analyze, involve our most humble cousins, the social insects. There's nothing at all wonderful about a single, solitary termite. Indeed, there really isn't any such creature, functionally speaking, as a lone termite, any more than you can imagine, if you try to do it, a genuinely solitary human being. There's no such thing. Two or three termites gathered together on a dish are not much better. They move about and touch each other nervously, but nothing happens.

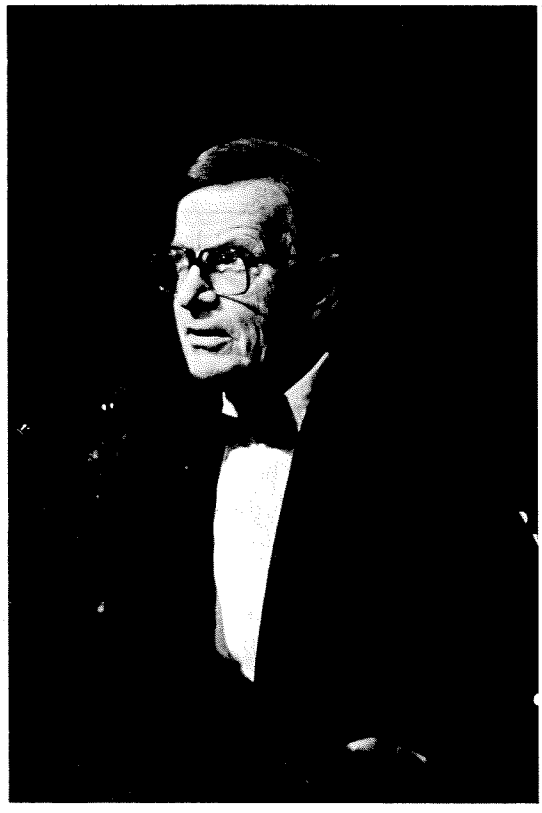
But if you keep adding more termites until they reach a critical mass, the miracle then begins. As though they had suddenly received a piece of extraordinary news, they organize in platoons and begin stacking up pellets to precisely the right height, and then turning the arches to connect the columns, constructing the cathedral and its chambers in which the colony will live out its life for the decades ahead, air conditioned, humidity controlled, and all of this following chemical blueprints coded in their genes, flawlessly and stone blind. They are not the dense mass of individual insects they appear to be; they are an organism, a thoughtful, meditative brain, and a million legs. All we really know about this thing is that it does its architecture and engineering by a complicated system of chemical signals, and a single termite off by

itself doesn't know its own name, much less the time of day. It is a real mystery, something to smile in the presence of.

I used to wonder about human childhood and the evolution of our species. It seemed to me unparsimonious for nature to keep expending all that energy on such a long period of vulnerability and defenselessness with nothing to show for it in biological terms beyond the sheer, irresponsible, feckless pleasure of childhood itself. After all, I used to think, it's one-sixth of a whole human lifespan; why didn't evolution take care of that, allowing us to jump, catlike, from our juvenile to our adult and, as I was then thinking, productive stage of life? I had forgotten about language, the single human trait that marks us out as specifically human, the one property that enables our survival as the most social of all creatures on earth — more interdependent and more interconnected than even the famous social insects. I had forgotten that, and I had forgotten that children do that in childhood. Language is what childhood is for.

What I hadn't known until recently is that children not only learn language, any old language you like, they *make* language — any new language *they* like. Derek Bickerton, who is professor of linguistics at the University of Hawaii, has, I think, come close to proving something like this. In 1880 the Hawaiian Islands were opened up for sugar production, and large numbers of Japanese, Koreans, Chinese, and Spanish-speaking Filipinos and Puerto Ricans came to the islands to work in plantations alongside Hawaiian-speaking natives, and all of them supervised by English-speaking Americans. Nobody could understand anyone else and, as happens in such situations, a crude sort of pidgin speech developed quite quickly, using words borrowed from the various languages, principally from the dominant English. Pidgin English, which is a mispronunciation of "business" English, was not really a language; it was more like a system for signaling, pointing, and naming. But it lacked sentence structure, and it was devoid, or almost devoid, of grammar.

And then sometime between 1880 and 1910 Hawaiian creole appeared as the common language of the worker population — a genuine complex speech with its own syntactical sentence structure, its own tight grammatical rules, containing words borrowed from all the other tongues. Bickerton analyzed this new creole and claims now that it closely resembles in the details of its grammar other creole tongues in other colonial settings elsewhere in the world. It is fundamentally different from the languages spoken in the homes of the different ethnic groups on the islands in 1880. It is therefore a new language. And when it appeared, it could not be understood or spoken by the adult generation who arrived in 1880, nor could the American overseers comprehend it. Bickerton's discovery is that this brand new language, never heard or spoken before, must have been made by the first generation of children — syntax, grammatical rules, sentence structure, metaphors, and all.



And there it is — children make language. Children are not only biologically equipped to learn speech; if necessary they can manufacture it out of their collective heads and in something like perfection, at that. It puts children in a new light, or I think it does. No wonder we need a long childhood; a pity it can't be longer. When human speech first appeared sometime perhaps within the last 100,000 years, maybe more recently (certainly no time at all as evolution goes), and turning then our species from whatever it was into our kind of creature — heads filled with metaphors and memories, awareness, fear of death, and all — maybe it was the children who started it off. Maybe, as in the termite model, language required for its beginning nothing more than the critical mass of

children being raised together and at each other in close quarters for a long enough time. And maybe when it first started up in some newly stabilized agricultural or hunting and gathering community, the parents and the elders around the communal fire wondered wordlessly what those incessant sounds being made by the children were and wondered why the children seemed so pleased.

We named the place we lived in, or someone did, the "world" long ago from the Indo-European root, *wiros*, which meant "man." And we now live in the universe, that stupefying piece of expanding geometry. Our suburbs are the local solar systems into which sooner or later we will spread life and then perhaps further. And of all the celestial bodies within reach or view as far as we can see out to the edge, the most wonderful and marvelous and mysterious is turning out to be our own planet earth. There is nothing to match it anywhere, not yet anyway. And it is a living system, regulating itself, making its oxygen, maintaining its own temperature, keeping all its infinite living parts connected as interdependent, including us. It is the strangest of all places, and there is everything in the world to learn about it. It can keep us awake and jubilant with questions for millennia ahead, if we can learn not to meddle and not to destroy and how to ask the questions.

We can take it, I think, at the present time from what we can see of it that it is one single huge life, made up of innumerable discrete working parts, which interact with each other in continual complicated maneuvers so that the whole being maintains a kind of stability for itself over long stretches of time. On occasion over the 3½ or more billion years of life's existence on the planet, catastrophes of one sort or another have occurred. Continents have split and drifted away from each other on plates that comprise the earth's cracked shell, and volcanoes have clouded the atmosphere and shut off the sunlight, and meteorites have crashed into the surface, ice ages have come and gone, and countless species have emerged and then become extinct. But the life of the whole organism goes on. And now humanity is here — a recent development. It is not all that much human vanity to say that the human species is the most important thing in all those 3½ billion years, depending on what you mean by important. We have the power to become a new kind of endangerment to the earth's life, outmatching any of the natural catastrophes before our time. It is possible, but not necessarily probable. But we might, if we can use our brains and act together as a species, turn out to be useful. And it is up to us.

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The first thing we have to do is to learn a lot more than we now know about how the whole organism works. Without knowledge we could kill off vast tissues of the earth's flesh without realizing what we were doing. Already there are evidences of the risks we pose. We are not only interfering with the balance of constituents in the atmosphere, risking an increase in the mean temperature of the whole planet, we are interfering with the cyclic exchange of nutrients between the land and the sea, endangering terrestrial life by deforestation, desertification, and threatening marine life by pollution. We are surely overpopulating the place with our own species and crowding out other forms of life and destroying their ecological niches. In the end, if we keep it up, we will surely do ourselves in. And if we hasten the process by engaging in nuclear warfare, we could do in much of the rest of the life at the same time.

But we do have excellent brains, and they're good enough to permit us to see what we're doing, and they're ideally constructed for looking ahead. I spend part of my time these days looking about for signs of hope for the future. One of the best ones is a social invention to the credit of this country, the National Aeronautics and Space Administration — not the NASA of the moon shot, or the tour of Mars, or the vehicles now threading their way through the orbits of the outer planets, although this side of NASA is all high marks for the agency. The NASA program that lifts my heart and gives me hope is one entitled Global Habitability. It is a low-key, modest-sounding proposal now awaiting approval and funding, indeed probably now just awaiting attention. The purpose of the project is nothing less than a close-up, detailed, deeply reductionist study of the anatomy, physiology, and pathology of the earth itself.

NASA, I am told, is having a hard time with

its budget these days, partly due to the general shortage of money for science, but mostly because of the immense costs of the shuttle. I don't know where the Global Habitability project stands on the list of priorities, but I hope it is up somewhere near the top. Like everyone else, I am delighted and fascinated by the shuttle. It is surely the world's most exhilarating toy, and I have no quarrels with its expense. However, I do wish NASA could have just a little more money to do this other job, which no other agency on earth can do. Dipping into the petty cash box in the Department of Defense might get the thing nicely started, and nobody is likely to argue that the DOD shouldn't have the defense of the entire planet as much on its mind as the protection of our own borders. We need, for the long run, to be sure that the borders are always there and recognizable, which is one of the problems for which NASA can be exceedingly useful.

The Global Habitability program is no sort of quick fix, which of course means political trouble in getting it under way. It is research for the decades ahead, not just for the next couple of years. And it cannot be done on the cheap, which means wrangles over the budget in and out of Congress. It will require, as well, collaborated efforts by researchers from many different disciplines in science and engineering and from virtually every country on the face of the earth, which means international politics at its most difficult. But the case for beginning the project is as strong as that for any scientific enterprise ever envisioned by humanity.

Working scientists and their astonishing sensory instruments have already been able to look closely at the surfaces of other planets and make predictions about their chemical composition and atmospheric history. Man has walked on the moon, even played a sort of golf on the moon. The public is well aware of these matters, and there is already talk about the prospects for explorations to the edge of the solar system and beyond. What is not yet enough talked about is the golden opportunity now at hand to employ these same technologies for exploring what is by far the most puzzling and the strangest object in the solar system, or for that matter, any solar system that we can guess at.

The earth is a strange phenomenon. The interactions among the land masses, the oceans, and the air seem to be orderly cyclical events keeping the life going, but the life itself produces enormous effects on these natural components of the planet. Events that meddle with the runoff from the land into the sea, or change the exhalation of terrestrial vapor and its condensation over the ocean will alter the viability of life in both places, and this in turn will result in new changes in the climate everywhere. The cyclic exchanges of carbon and nitrogen and phosphorous and sulfur moving back and forth from the water to the land not only sustain life as a whole, but switch it on in one place and turn it off in another, depending on the climate. And the latter is in part dependent on the life.

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Among the earth's numberless species, coordination and cooperating seem to be a more general rule than we used to think. Living things tend to keep an eye on each other as well as on the sky. The tools possessed by NASA for scrutinizing the most intimate details of planetary life are wonderfully precise, revealing the acre-by-acre distribution of fields and forests and farms and wasteland and houses everywhere on the globe, the seasonal movement of icepacks at the poles, and the distribution and depth of the snowfall, the chemical elements in the outer and inner atmosphere, and the upwelling and downwelling of regions of the waters of the earth. It is possible now to begin monitoring this planet, spotting early on the evidences of trouble ahead for our species or for others, especially the kinds of trouble for which we humans are responsible. I cannot think of a better work for the international science community on the ground or out in space, and I hope we will get on with it. The military people are out there too, of course, competitors for their kind of scientific prize, but they are more interested in biological phenomena as targets rather than objects for affection.

Maybe this will change. Already I am told, their photographic equipment is so good that they can make pictures of individual people with upturned faces — even the tears on the faces — anywhere. Keep them at it, I say, and make them take a long, long look. And meanwhile, give NASA a piece of their budget.□