A Long Way To Go

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Comprehending the human condition requires more and better science.

Ed. William L. Churchill

by Lewis Thomas, M.D.

Sometime towards the close of the 19th century Lord Kelvin, an eminence in the physics of that day, assured for himself a sort of immortality in his field by announcing that physics was now a finished science, that all the essential information in the field had been acquired, and that now all that remained was to tidy up a few loose ends here and there. Within the following several years, X-rays were discovered; then, quantum theory and relativity, and all the fundamental dogmas of classical physics were modified in a series of swift strokes. Biology and medicine have not yet been put through such a period, primarily because we have not learned enough yet to have achieved the illusory stability of Newtonian physics.

But we do have a tendency to talk like Kelvin from time to time and it must seem to some of our younger and brightest students that we are in possession of an almost-finished science, knowing almost everything about everything. If we are not careful and honest, we can make it seem as though mastery of all today's enormous store of facts in biological science could settle the matter. Just by lining them up in our minds, one after the other, we would be able to comprehend life in all its essential details.

If I were a student today I would not be much attracted to such a field. I would look about for some less-settled discipline where

DR. LEWIS THOMAS, chancellor of the Memorial Sloan-Kettering Cancer Center, receives honorary degree from President Theodore D. Lockwood.

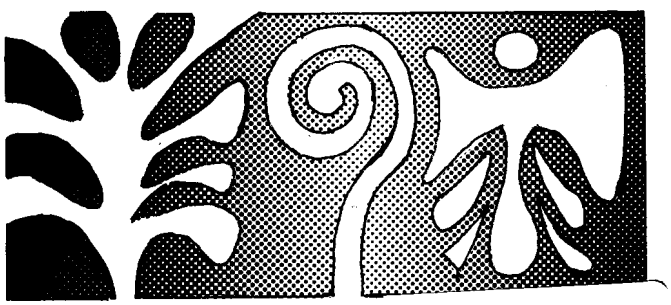
there might be more room to move around — cosmology, say, or the famous social sciences where the answers to most important questions are still out there, totally unknown, waiting to be asked.

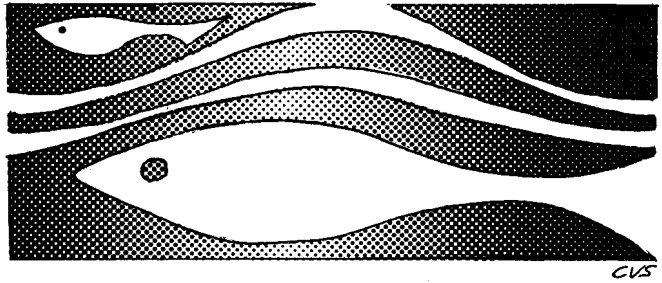
An intellectually fashionable view of man's place in nature today is that there's really no great problem, the plain answer is that it makes no sense, no sense at all. The universe is meaningless for human beings; we bumbled our way into the place by a series of random, senseless, biological accidents; the sky is not blue, it is black; you can walk on the moon if you feel like it, but there's nothing to do there except look at the earth and when you've seen one earth you've seen them all; the animals and the plants of the planet are at hostile odds with one another, each bent on elbowing any nearby neighbor off the earth; genes, tapes of polymer are the ultimate adversaries and, by random, the only real survivors.

Well, this grasp of things is sometimes presented as though based on science, with the implication that we already know most of the important, knowable matters and this is the way it all turns out. It is the wisdom of the 20th century, contemplating as its only epiphany the news that the world is an absurd apparatus and that we are stuck with it and in it. And, in the circumstance, we would surely have no obligations except to our individual selves and, of course, to the genes coding out the selves.

I believe something considerably less than this. I take it as an article of faith that we humans are a profoundly immature species, only now beginning the process of learning how to learn. Our most spectacular biological attribute, which identifies us as our particular sort of animal, is language. And the deep nature of this gift is a mystery. We are aware of our consciousness, but we cannot even make good guesses as to how this awareness arises in our brains or even, for that matter, that it does arise there for sure. We do not understand how a solitary cell fused from two can differentiate into an embryo and then into the systems of tissues and organs that become us. Nor do we know how a tadpole accomplishes his emergence, nor even a flea. We can make up instant myths, transiently satisfying but always subject to abandonment, about the origin of life on the planet. We do not understand why we make music or dance, or paint, or write poems. And we are bewildered, especially in this century, by the pervasive latency of love.

The thing about us that should astonish biologists more than it does is that we are so juvenile a





species. By evolutionary standards of time we only just arrived on the scene, fumbling with our new thumbs, struggling to find our legs under the weight and power of our new brains. We are the newest and most immature of all significant animals — perhaps a million or so years along as the taxonomists would like to define us, but probably only some thousands of years as the communal, speaking creatures uniquely capable of manufacturing metaphors and therefore recognizable as human.

Our place in the life of the world is still unfathomable because we have so much to learn, but it is surely not absurd. We matter. For a time anyway, it looks as though we might be responsible for the thinking of the system — which seems to mean at this stage a responsibility not to do damage to the rest of life if we can help it. This is itself an immensely complicated problem, in view of our growing numbers and the demands we feel compelled to make on the planet's resources. There is no hope of thinking our way through the quandry, except by learning more. And part of the learning — not all of it, mind you, but a good part — can only be achieved by science: more and better science, not for our longevity or our comfort or affluence, but for comprehension, without which our long survival is unlikely.

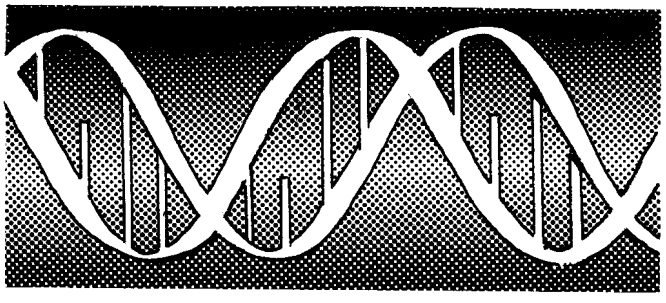
The culmination of a liberal arts education ought to include, among other matters, the news that we do not understand a flea, much less the making of a thought. We can get there someday if we keep at it, but we are nowhere near and there are mountains and centuries of work still to be done.

One major question needing to be examined is the general attitude of nature. A century ago there was a consensus about this: nature was read in tooth and claw; evolution was a record of open warfare among competing species; the fittest were the strongest aggressors, and so forth. Now it begins to look different. The tiniest and most fragile of organisms dominate the life of the earth. The chloroplasts inside the cells of plants, which turn solar energy into food and supply the oxygen for breathing, are the descendants of ancient, blue-green algae living now as permanent lodgers within the cells of what we like to call "higher forms." And the mitochondria of all nucleated cells which serve as engines for all the functions of life are the progeny of bacteria which took to living as cells inside cells long ago.

The urge to form partnerships, to link up in collaborated arrangements is perhaps the oldest, strongest, and most fundamental force in nature.

There are no solitary, free-living creatures. Every form of life is dependent on other forms. The great successes in evolution, the mutants who have, so to speak, "made it" have done so by fitting in with and sustaining the rest of life. Up to now we might be counted among the brilliant successes, but we are flashy and somewhat unstable, and we should go warily into the future looking for ways to be more useful, listening more carefully for the signals, watching our step, and having an eye out for partners.

Partnerships have to have a certain steadiness and predictability to survive for any length of time. You can't have linkages between creatures that have nothing at all to offer to each other, and partners have to be equipped with accurate information about the identity of each other. There must exist, in short, an information system capable of emitting signals indicating usefulness. You can see this sort of system still conspicuously at work in the life of the sea. There are no unattached, isolated, animals. Creatures live on each other, next to each other, inside the same carapaces and, most commonly of all, inside each other. The emergence of mitochondria and chloroplasts as organelles is only one example, perhaps the earliest and most spectacular.



The greatest single invention of nature to date was surely the invention of the molecule of DNA. We have had it from the very beginning, built into the first cell to emerge, membranes and all, somewhere in the soupy water of a cooling planet, three thousand million years or so ago. All of today's DNA, strung through all the cells of the earth, is simply an extension and elaboration of that first molecule. In the fundamental sense we cannot claim to have made progress since the method used for growth and replication is essentially unchanged.

But we have made progress in all kinds of other ways. Although it is out of fashion today to talk of progress in evolution, if you use that word to mean anything like improvement, implying some sort of value judgment beyond the reach of science, I cannot think of a better term to describe what has happened. After all, to have come all the way from a system of life possessing only one kind of primitive microbial cell, living out colorless lives in hummocks of algal mats, to what we see around us today — this place, and the city of Paris, and the state of Iowa, and Woods Hole, and that succession of travertine-lined waterfalls and lakes like flights of great stairs in Plevlja in Yugoslavia, and the horse chestnut tree in my backyard, and the columns of neurons arranged in modules in the cerebral cortex of human beings — this *has* to represent improvement. We have come a long way on that old molecule.

To err is human, we say, but we don't like the idea much and it is harder still to accept the fact that erring is biological as well. We prefer sticking to the point and insuring ourselves against change. But there it is: we are here by the purest chance, and by mistake at that. Somewhere along the line nucleatides were edged apart to let new ones in. Maybe viruses moved in carrying bits of other foreign genomes; radiation from the sun or from outer space caused tiny cracks in the molecule, and humanity was invented.

And maybe, given the fundamental instability of the molecule, it had to turn out this way. After all, if you have a mechanism designed to keep changing the ways of living; and if all the new forms have to fit together as they plainly do with symbiotic living all over the place; and if every improvised new gene representing an embellishment in an individual is likely to be selected for the species if it turns out to be useful for others; and if you have enough time, maybe the system is simply bound to develop brains sooner or later — and awareness. Biology needs a better word than error for the driving force in evolution. Or perhaps error will do when you remember that it came from an old Indo-European root meaning to wander about looking for something.

I cannot make my peace with the randomness doctrine. I cannot abide the notion of purposelessness and blind chance in nature, and yet I do not know what to put in its place for the quieting of my mind. It is absurd to say that a place like this place is absurd when it contains in front of our eyes so many billions of different forms of life, each one in its way absolutely perfect, and all linked together to form what would surely seem to an outsider to be a huge spherical organism.

We talk, some of us anyway, about the absurdity of the human situation, but we do this because we do not know how we fit in or what we are for. Some people believe we are in trouble because of science and that we ought to stop doing science and go back to living in nature, with nature, and contemplating nature. It is too late for us to do this. Too late by several hundred years and there are now too many of us here — four billion already with the likelihood of doubling that population and doubling it again within the lifetime of some of the people here.

What I would like to know most about the developing earth is: does it already have a mind, or will it sometime gain a mind and are we a part of that? Are we a tissue for the earth's awareness? I like this thought, even though I cannot take it anywhere, and I must say it embarrasses me. I have that nagging hunch that it is a presumption, a piece of ultimate hubris. A single insect may have only two thoughts, maybe three, but there are a lot of

insects. The million blind and almost mindless termites in a hill make up in their collective life an intelligence, a kind of brain now capable of building endless vaulted chambers and turning perfect arches, thinking all the way. I would like to know what whales are thinking about or dolphins, but if I were hoping to find out how intercommunication really works on this planet I would study beetles.

I'm willing to predict that there is one central, universal, aspect of human behavior genetically set by our very nature, biologically governed, driving each of us along. Depending on how one looks at it, it can be defined as the urge to be useful. This urge drives society along, sets our behavior as individuals and in groups, invents all our myths, writes our poetry, composes our music. This is why it is so hard being a juvenile species, still milling around in groups, trying to construct a civilization that will last. Being useful is easy for an ant. You just wait for the right chemical signal at the right stage in the construction of the hill and then you go looking for a twig of exactly the right size for that stage and carry it back up the flank of the hill and put it in place and then you go and do that thing again. An ant can dine out on his usefulness all his life and never get it wrong.

It is a different problem for us, carrying such risks of doing it wrong, getting the wrong twig, losing the hill, not even recognizing yet the outline of the hill. We are beset by strings of DNA, immense arrays of genes, instructing each of us to be helpful, impelling us to try our whole lives to be useful, but never telling us how. The instructions are not coded out in anything like an operator's manual. We have to make guesses all the time.

The difficulty is increased when groups of us are set to work together. I have seen and sat on numberless committees, not one of which intended anything other than great usefulness, and most of them ended up getting everything wrong — most of them useless. Larger collections of us, cities for instance, hardly ever get anything right. And of course there is the modern nation — probably the most stupefying example of biological error since the age of the great reptiles. Wrong at every turn and always felicitating itself loudly on its great usefulness.

It is a biological problem, as much so as a coral reef or a rain forest, but such things as happen to human nations, error piled on error, could never happen in a school of fish. It is, when you think about it, a humiliation. But then "humble" and "human" are cognate words, both derived from an old root meaning, simply, "earth." We are smarter than the fish, but their instructions come along in their eggs; ours we are obliged to figure out and we are, in this respect, slow learners and error-prone. We have come a long way but we may have, with a bit of luck, a much longer way to go. ■

This article by Dr. Lewis Thomas was the address at Trinity's 154th Commencement in June. Dr. Thomas, chancellor of the Memorial Sloan-Kettering Cancer Center in New York, is both a scientist and humanist. He has been honored for his work in immunology and pathology, and his book, *Lives of a Cell*, received the 1975 National Book Award. A sequel, *The Medusa and the Snail*, was published last year.