HUXLEY

When Thomas Huxley first heard Darwin's theory of evolution he remarked, *"How extremely stupid not to have thought of that."*

One of the advantages of getting very old is that you have ample opportunity to notice how extremely stupid you have been in the past. As an example: Although I am not a Sanskrit scholar by any stretch of the imagination, I have been exposed to Sanskrit over most of the past century, yet I never noticed that Einstein's famous equation (E = m) was built into that language several thousand years ago.

Although the concept of energy did not arise in European physics till 1845 with Thomas Young's definition of what we now call kinetic energy, it was known to those older physicists in India at least several thousand years earlier. And they had two words for energy, *Shakti* and *Prana.* If the whole Universe is seen as energy, their word is *Shakti*, but if the usual discrimination is made between what we call mass and what we call energy, then their word for energy is *Prana*. Now as soon as you put these two notions together, you have E = m. But I was way too stupid to think of all that back then.

And another thing: We were all taught that Einstein's equation meant that matter could be *converted* to energy and that energy could be *converted* to matter, but that equation would be E + m = K, that is, the *sum* of mass and energy is constant. But Einstein's equation says that *what we call mass is just potential energy.* How extremely stupid I was not to have thought of that.

Although I was always clever about geometry, I failed to notice that Einstein's 1905 geometry ruled out the existence of photons. In his four dimensional geometry, space and time come in as a pair of opposites so that the total space-time separation between the emission and absorption events of a single photon is zero. If x is the space between the emission and absorption events of a photon and t is the time, and if S is the space-time separation between them, then his equation reads $S^2 = x^2 - t^2$, and since, for photons, x and t are always equal, the total separation between the emission and absorption events of a photon is always zero. That's why no one ever saw a photon in transit.

When Thomas Young did the double-slit experiment in 1802, he invented the wave theory of light to explain the diffraction pattern that he saw. But the emission and absorption events of his waves are adjacent in space-time. And it is for the space component of the adjacency that both slits are open. As Niels Bohr pointed out, even electrons don't have trajectories. And, once again, how extremely stupid for all of us not to have thought of that.

When I was younger, I took for granted that wet air was denser than dry air. But it's not. The molecular weight of oxygen is 32 and the molecular weight of nitrogen is 28, so, since the molecular weight of water is only 18, and since we have the same number of molecules in the same volume of gas at the same temperature and pressure, wet air is less dense than dry air because the water molecule is lighter than the majority of molecules that make up our atmosphere. That's why we have hurricanes.

When a large mass of wet air goes up, it cools off and the water vapor precipitates out as cloud or rain. But the heat of vaporization of water is 540 calories per gram, and all that heat comes out when the water vapor precipitates as cloud or rain. It is that extra heat that causes the cloud to go up, cool off and drop more rain. This process can continue till the cloud runs out of water. And it is the air coming in from below to replace the rising cloud that blows your house away. The hurricane doesn't bring the rain; the rain brings the hurricane. How stupid not to have noticed that when I was younger and trained as a chemist.

One would have thought, even before we sampled the Moon, that several astronomers would have figured out that the Moon would be covered with glass beads. That is because, in the absence of an atmosphere on the Moon, the vaporized stone from an asteroid impact would condense to spherical glass beads. Any kid could have figured it out. Why were we so stupid? It's mentioned in the earlier literature only once. And the gegenshein, of course, is from the glass beads that orbit the Sun.

I used to think that stars in the globular clusters and in the central bulge of our galaxy could have planets like Jupiter and Saturn, made of the lighter elements, but couldn't have planets like the Earth and Mars, made of iron and rock, because the heavier elements were not available then. But now I see that they couldn't have planets at all because they lack the angular momentum required for planetary orbits. The angular momentum of those earlier stars would have been transferred through their spinning magnetic fields to the hovering layer, now called the halo. It is this angular momentum that flattens the hovering layer into a disc. Most of the angular momentum of the galactic cloud must surely wind up in the disc where stars like our Sun are born. I now suspect that planets will be found only in galactic discs. Why didn't I think of that earlier?

It appears to me now that atmospheric twisters are the observational evidence that galaxies are born in bunches. If galaxies were born alone they wouldn't spin. But if a galaxy is born in a cluster it could pick up angular momentum by passing another galaxy, especially a larger one. And stars that form in a spinning cloud would, themselves, have angular momentum which would be transferred by their spinning magnetic fields to the surrounding halo, to what I call the hovering layer. Then, if the hovering layer is spinning, it will tend to peel away from the axis of rotation, both north and south, and condense into a disc. It is surely in such spinning discs that stars like our Sun are born with

sufficient angular momentum to form planetary systems with spinning planets. It is the Coriolis effect on the winds blowing across the surface of a spinning planet that causes atmospheric twisters in galactic discs.

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"IN WHAT FURNACE WAS THY BRAIN?"

For hundreds of millions of years you have been bullied and pushed around, driven from the ocean to the rivers, from the rivers to the shallows, from the shallows to the swamps, and out on land. Always the species who were better adapted to the older environment stayed in the older environment. The faster fishes stayed in the sea. You are not descended from them. You are descended from a long line of misfits who were bullied and driven out. Always it was "Shape up or get out!" and you got out.

You were driven ashore on stumpy fins in the Devonian swamps, and you were driven underground in the Paleocene grass, and you were driven from the grass into the trees, by other descendents of those stumpy fins. And every change entailed millions of years of discomfort while you painfully built in your new genetic adjustments, not so much by the survival of those who succeeded as by the early demise of those who failed. The dinosaurs, with scaly feet, drove some of you underground. Those who couldn't adjust are gone. There in their burrows, in the sunny grass, the rodents, furry mammals much like you, but better adapted to the grass than you, drove you to the trees. Those who couldn't adjust went down.

There in the trees, through long and painful genetic readjustments you learned to swing from branch to branch. Those who failed were eaten by cats. Then, after many more millions of years, just when your arms could reach from side to side, came the dwindling of the forests by drought, twelve million years of drought. Those were better at swinging that you drove you to the ground, and you fled to the sea. You had four hands and no feet, and the grass was now no place for you. There were pack-hunting dogs and great, stalking cats. Those who didn't make it to the beach are gone.

In the safety of the terrifying breakers you were cradled in the sea, with hands instead of paddles and hands instead of feet, and there were millions of cold, wet, salty years before you even had the tears to cry. You were small and you were timid when you came from the green-roofed jungle with eyes accustomed to the dark, and there were millions of years of blinding brightness on the sunlit waves and beaches before you had the frown of your bewilderment, the furrowed brow of the thinker, and you wondered what it's all about.

The long pursuit has made you thoughtful. Every new adjustment entailed a genetic enlargement of the brain. It is the brain of a misfit, driven hither and yon to the refuge of new environments by those better adapted to the old. It is the brain of a shiftless outcast, living always in the discomfort of genetic maladjustment. It is the product of hundreds of millions of years of distress, the product of the vicissitudes of countless misfortunes encountered along the seemingly endless reaches of the immense journey. And your present form is

not the end. The journey lies as far ahead as behind. No, not so far, for now, for the first time, you can look behind to see how you have come. And now, for the first time, you can guess ahead to see how you should go.

In all that three hundred million years, no creature descended from the Snout thought of himself as descended from the Snout, that lumbering, Devonian fish with simple lungs and bubbles in his brain. In all that length of time, no creature thought that any creature would ever think to figure it out, to unscramble and decipher the account. You are the first species that ever investigated its own genetic past. You are the only creatures who are not fish who ever knew that they are not fish but that their ancestors were. You are the first creatures who ever lived on land but who knew that their ancestors lived in the sea.

And you are the first creatures who can look ahead to see where you are going. You are the first creatures who can understand that you got into this mess through an uncertainty and cannot possibly get out by transformation. Uncertainty is overcome by knowledge, not be transformation. You alone can understand that the journey has an end, which cannot possibly be reached by journeying.

Yours is the strength of the eternal underdog. You have been pushed and bullied and driven till you have mastered every environment on the face of the earth, and have the brain to comprehend the Universe beyond. Out of the endless vicissitudes of your misfortunes and your failures has come your strength, and your love for the underdog. Every unbiased observer among you roots for the underdog.

When you walk in the woods, the squirrels don't bring you their peanuts, but you carry peanuts for them. The gulls don't bring you their lunches, but you throw your lunches to them. And signs are required at every zoo to keep you from feeding the underdog. Out of the strength to save yourselves has come the strength to save others. You are Eiseley's Star Throwers. Hundreds of millions of years of distress have gone into that strength, and the salt of your eyes.

For hundreds of millions of years you have been bullied by the superior genetic technologies of better adapted species. You were hurt by the pincers of crabs, bled by the syringes of insects and killed by the syringes of snakes. You were scratched and torn by the talons and beaks of birds, crushed by the hoofs of mammals, tossed by their antlers and gored by their thorns. Losing the sea to the fins of faster fishes, long ago, and to the flukes of faster mammals, only yesterday, you came ashore again, only to be slashed by the fangs of cats, descended by another trail, another trial, from that same Devonian fish. Into every new habitat you came, you came lately. Everywhere you looked, there was someone ahead of you. Everything you could do, they could do better.

Every vicissitude of your misfortune had robbed you of some piece of genetic hardware which could have saved you in some niche, till, by the time you came, a second time, ashore, you had no fins, you had no flukes, you had no tusks, you had no claws, you had no hoofs, you had no fur. You were a ne'er-do-well's ne'er-do-well, protecting naked babies in the grass.

Without pincers, without syringe, without talons, without beak, and without wings you came ashore, with no trunk, no hoofs, no fangs, and no fur. But something else you had. Behind your furrowed brow you had a better brain. Every single blow of your misfortune, which drove you to another niche and robbed you of some piece of genetic technology, had hammered on its anvil some improvement in your brain till you had now the gleam of knowledge in your eye. At the cost of losing every piece of hard-won hardware, you have built the software behind your eyes. You have a brain to wonder and to understand.

And you have breasts to feed the growing brain of your helpless offspring. You have tools, and you have words to tell your offspring how to use them. You have fire to protect both your infant and your breasts from the bullying of furry beasts with fangs and claws and chattering teeth. Only in your nakedness have you lost your fear of fire, driven by the cold and by your terror of the hardware of other species. Your every misfortune you have turned to your account. Through the unfortunate necessity of prolonged parental care has come the growth of that brain that uses fire. Only through the prolonging of your youth has come your wisdom which began in the swamp, long ago, around those bubbles in your brain. You are the descendants of that ne'er-do-well, air-breathing fish, and the children of children who never grow up.

Now, for the first time, you have a software technology before which all the genetic hardware has gone down. Now, with non-genetic hardware, you out-swim the fish, you out-run the cats, you out-fly the birds, and you look down from the Moon and you smile. Just think what went into that smile.

You have been pushed and bullied till you can be pushed and bullied no more. Every time you went down before the onslaught of some piece of genetic hardware you have come back with some unexpected improvement in the software behind your eyes. Now, with your software technology and the use of non-genetic hardware, you, the eternal underdog, can bully any species that ever bullied you. But with your new-won strength has come the frown of your puzzlement, the salt of your tears, and your smile. Why should dog eat dog? Why should a species, once bullied, bully back against the species that bullied it? The furrowed brow has noticed and the salty eyes are wet. You are the underdog's underdog, and now that hand, once fin, once paw, lengthened for swinging in the trees, and flattened for swimming in the sea; now that hand, grown old, reaches out to touch, in consolation, those who, in the past, have bullied it. Was it not their bullying that made you what you are? You are the Star Thrower, throwing the broken starfish back into the sea. Save the condor! Save

the whales! Save the leopard! Save the shark! Save that menace of the seas against those whose fearful jaws you learned to clench your fist!

You are the only creatures who ever knew that the rest of the creatures are just like you. You are the only creatures to have figured it out, that you got into this plight through uncertainty and cannot possibly get out through a transformation. Knowledge is the key.

You are the first creatures to have figured out that the entire Universe is made out of hydrogen but that the hydrogen itself is an apparition. You are the first to see that your bodies, and every single terror that beset them in the past, arose by transformation from that primordial hydrogen. That colorless, odorless, tasteless, intergalactic gas which couldn't possibly have arisen by any transformation, but only by the appearance of pairs of opposites on an underlying entity – plus against minus; electricity against gravity; and space against time. Only on that identity rests your concern for other creatures.

That ancient, bullied hand still reaches out. That ancient, furrowed brow has understood, and now the strength of knowledge lights those salty eyes. The end is not far off, and, to one who sees beyond the transformations, the end is already within reach. The journey has been immense, and, in its immensity, it has yet to run, but the journey has an end which cannot possibly be reached by journeying.

IT'S ALIVE

Swami Ashokananda once blurted out, "It's alive. The whole Universe is alive." I didn't understand it then, but I can understand it now.

To begin with, what are the defining characteristics of a living organism? They are three. First, it must have a membrane between inside and outside, between self and not-self. Second, it must be able to direct a stream of negative entropy across this membrane from outside to inside. And finally, if the species is to survive, it must be able to replicate the inside.

So let's look at the Universe. To a first approximation the Universe consists of hydrogen falling together to stars which convert the gravitational energy to radiation and drive the cosmological expansion, because the radiation loses its energy to redshifting in the expansion. The redshifting drives the cosmic microwave background radiation, because radiation gets thermalized to 3^0K by going through the field of low mass particles near the observational border. And finally, through Heisenberg's Uncertainty Principle, the redshifting also drives the recycling of the hydrogen and the negative entropy from the border, because as the uncertainty in the momentum goes down the uncertainty in where the particles are goes up.

So we see that the expanding Universe, with its observational border, not only directs a stream of negative entropy upon itself, but also, by recycling, replicates the hydrogen which drives the stars.

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