❖ *An illustration by Peter de Seve*

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❖ *'Storm over the Amazon:*
An excerpt from the book 'The Diversity of Life' by E.O. Wilson

E.O. Wilson, the biologist, naturalist and scholar in the field of evolution and ecology passed away on 26 December 2021. The various descriptions by which he was called during his lifetime give us some idea about his colossal stature and contributions: 'the modern day Darwin' , 'the father of biodiversity', 'the father of biodiversity'' 'THE ant man' – just to name a few.
In the following excerpt, we can get glimpses of the astounding range of capacities and perspectives of this great master – a naturalist with incredible expertise in all kinds of life forms, a deep and reflective scholar of ecology, a very wise philosopher of human life and it's place in the universe, a brilliant writer and an incredibly perceptive and sensitive human being.

The moon was down, and only starlight etched the tops of the trees. It was August in the dry season. The air had cooled enough to make the humidity pleasant, in the tropical manner, as much a state of mind as a physical sensation. The storm I guessed was about an hour away. I thought of walking back into the forest with my headlamp to hunt for new treasures, but was too tired from the day's work. Anchored again to my chair, forced into myself, I welcomed a meteor's streak and the occasional courtship flash of luminescent click beetles among the nearby but unseen shrubs. Even the passage of a jetliner 10,000 meters up, a regular event each night around ten o'clock, I awaited with pleasure. A week in the rain forest had transformed its distant rumble from an urban irritant into a comforting sign of the continuance of my own species. But I was glad to be alone. The discipline of the dark envelope summoned fresh images from the forest of how real organisms look and act. I needed to concentrate for only a second and they came alive as eidetic images, behind closed eyelids, moving across fallen leaves and decaying humus. I sorted the memories this way and that in hope of stumbling on some pattern not obedient to abstract theory of textbooks. I would have been happy with *any* pattern. The best of science doesn't consist of mathematical models and experiments, as textbooks make it seem. Those come later. It springs fresh from a more primitive mode of thought, wherein the hunter's mind weaves ideas from old facts and fresh metaphors and the scrambled crazy images of things recently seen. To move forward is to concoct new patterns of thought, which in turn dictate the design of the models and experiments. Easy to say, di□cult to achieve. The subject fully engaged that night, the reason for this research trip to the Brazilian Amazon, had in fact become an obsession and, like all obsessions, very likely a dead end. It was the kind of favorite puzzle that keeps forcing its way back because its very intractability makes it perversely pleasant, like an overly familiar melody intruding into the relaxed mind because it loves you and will not leave you. I hoped that some new image might propel me past the jaded puzzle to the other side, to ideas strange and compelling.

Bear with me for a moment while I explain this bit of personal esoterica; I am approaching the subject of central interest. Some kinds of plants and animals are dominant, proliferating new species and spreading over large parts of the world. Others are driven back until they become rare and threatened by extinction. Is there a single formula for this biogeographic difference, for all kinds of organisms? The process, if articulated, would be a law or at least a principle of dynastic succession in evolution. I was intrigued by the circumstance that social insects, the group on which I have spent most of my life, are among the most abundant of all organisms. And among the social insects, the dominant subgroup is the ants. They range 20,000 or more species strong from the Arctic Circle to the tip of South America. In the Amazon rain forest they compose more than 10 percent of the biomass of all animals. This means that if you were to collect, dry out, and weigh every animal in a piece of forest, from monkeys and birds down to mites and roundworms, at least 10 percent would consist of these insects alone. Ants make up almost half of the insect biomass overall and 70 percent of the individual insects found in the treetops. They are only slightly less abundant in grasslands, deserts, and temperate forests throughout the rest of the world. It seemed to me that night, as it has to others in varying degrees of persuasion many times before, that the prevalence of ants must have something to do with their advanced colonial organization. A colony is a superorganism, an assembly of workers so tightly knit around the mother queen as to act like a single, well coordinated entity. A wasp or other solitary insect encountering a worker ant on its nest faces more than

just another insect. It faces the worker and all her sisters, united by instinct to protect the queen, seize control of territory, and further the growth of the colony. Workers are little kamikazes, prepared—eager—to die in order to defend the nest or gain control of a food source. Their deaths matter no more to the colony than the loss of hair or a claw tip might to a solitary animal. There is another way to look at an ant colony. Workers foraging around their nest are not merely insects searching for food. They are a living web cast out by the superorganism, ready to congeal over rich food or shrink back from the most formidable enemies. Superorganisms can control and dominate the ground and treetops in competition with ordinary, solitary organisms, and that is surely why ants live everywhere in such great numbers.

I heard around me the Greek chorus of training and caution: *How can you prove that is the reason for their dominance? Isn't the connection just another shaky conclusion that because two events occur together, one causes the other? Something else entirely different might have caused both. Think about it—greater individual fighting ability? Sharper senses? What?*

Such is the dilemma of evolutionary biology. We have problems to solve, we have clear answers—too many clear answers. The di□cult part is picking out the right answer. The isolated mind moves in slow circles and breakouts are rare. Solitude is better for weeding out ideas than for creating them. Genius is the summed production of the many with the names of the few attached for easy recall, unfairly so to other scientists. My mind drifted into the hourless night, no port of call yet chosen.

The storm grew until sheet lightning spread across the western sky. The thunderhead reared up like a top heavy monster in slow motion, tilted forward, blotting out the stars. The forest erupted in a simulation of violent life. Lightning bolts broke to the front and then closer, to the right and left, 10,000 volts dropping along an ionizing path at 800 kilometers an hour, kicking a counter surge skyward ten times faster, back and forth in a split second, the whole perceived as a single flash and crack of sound. The wind freshened, and rain came stalking through the forest. In the midst of chaos something to the side caught my attention. The lightning bolts were acting like strobe flashes to illuminate the wall of the rain forest. At intervals I glimpsed the storied structure: top canopy 30 meters o_ the ground, middle trees spread raggedly below that, and a lowermost scattering of shrubs and small trees. The forest was framed for a few moments in this theatrical setting. Its image turned surreal, projected into the unbounded wildness of the human imagination, thrown back in time 10,000 years. Somewhere close I knew spear-nosed bats flew through the tree crowns in search of fruit, palm vipers coiled in ambush in the roots of orchids, jaguars walked the river's edge; around them eight hundred species of trees stood, more than are native to all of North America; and a thousand species of butterflies, 6 percent of the entire world fauna, waited for the dawn. About the orchids of that place we knew very little. About flies and beetles almost nothing, fungi nothing, most kinds of organisms nothing. Five thousand kinds of bacteria might be found in a pinch of soil, and about them we knew absolutely nothing. This was wilderness in the sixteenth-century sense, as it must have formed in the minds of the Portuguese explorers, its interior still largely unexplored and filled with strange, myth engendering plants and animals. From such a place the pious naturalist would send long respectful letters to royal patrons about the wonders of the new world a testament to the glory of God. And I thought: there is still time to see this land in such a manner.

The unsolved mysteries of the rain forest are formless and seductive. They are like unnamed islands hidden in the blank spaces of old maps, like dark shapes glimpsed descending the far wall of a reef into the abyss. They draw us forward and stir strange apprehensions. The unknown and prodigious are drugs to the scientific imagination, stirring insatiable hunger with a single taste. In our hearts we hope we will never discover everything. We pray there will always be a world like this one at whose edge I sat in darkness. The rain forest in its richness is one of the last repositories on earth of that timeless dream. That is why I keep going back to the forests forty years after I began, when I flew down to Cuba, a graduate student caught up in the idea of the "big" tropics, free at last to look for something hidden, as Kipling had urged, something lost behind the Ranges. The chances are high, in fact certain, of finding a new species or phenomenon within days or, if you work hard, hours after arrival. The hunt is also on for rare species already discovered but still effectively unknown —represented by one or two specimens placed in a museum drawer fifty or a hundred years ago,

left with nothing but a locality and a habitat note handwritten on a tiny label ("Santarém, Brazil, nest on side of tree in swamp forest"). Unfold the still yellowing piece of paper and a long-dead biologist speaks: I was there, I found this, now you know, now move on. There is still more to the study of biological richness. It is a microcosm of scientific exploration as a whole, refracting hands-on experience onto a higher plane of abstraction. We search in and around a subject for a concept, a pattern, that imposes order. We look for a way of speaking about the rough unmapped terrain, even just a name or a phrase that calls attention to the object of our attention. We hope to be the first to make a connection. Our goal is to capture and label a process, perhaps a chemical reaction or behavior pattern driving an ecological change, a new way of classifying energy flow, or a relation between predator and prey that preserves them both, almost anything at all. We will settle for just one good question that starts people thinking and talking: Why are there so many species? Why have mammals evolved more quickly than reptiles? Why do birds sing at dawn? These whispering denizens of the mind are sensed but rarely seen. They rustle the foliage, leave behind a pug mark , filling with water and a scent, excite us for an instant and vanish. Most ideas are waking dreams that fade to an emotional residue. A first-rate scientist can hope to capture and express only several in a lifetime. No one has learned how to invent with any consistent success the equations and phrases of science, no one has captured the meta formula of scientific research. The conversion is an art aided by a stroke of luck in minds set to receive them. We hunt outward and we hunt inward, and the value of the quarry on one side of that mental barrier is commensurate with the value of the quarry on the other side. Of this dual quality the great chemist Berzelius wrote in 1818 and for all time:

'All our theory is but a means of consistently conceptualizing the inward processes of phenomena, and it is presumable and adequate when all scientifically known facts can be deduced from it. This mode of conceptualization can equally well be false and, unfortunately, presumably is so frequently. Even though, at a certain period in the development of science, it may match the purpose just as well as a true theory. Experience is augmented, facts appear which do not agree with it, and one is forced to go in search of a new mode of conceptualization within which these facts can also be accommodated; and in this manner, no doubt, modes of conceptualization will be altered from age to age, as experience is broadened, and the complete truth may perhaps never be attained'

The storm arrived, racing from the forest's edge, turning from scattered splashing drops into sheets of water driven by gusts of wind. It forced me back to the shelter of the corrugated iron roof of the open-air living quarters, where I sat and waited with the *mateiros*. The men stripped o_ their clothing and walked out into the open, soaping and rinsing themselves in the torrential rain, laughing and singing. In bizarre counterpoint, leptodactylid frogs struck up a loud and monotonous honking on the forest floor close by. They were all around us. I wondered where they had been during the day. I had never encountered a single one while sifting through the vegetation and rotting debris on sunny days, in habitats they are supposed to prefer. Farther out, a kilometer or two away, a troop of red howler monkeys chimed in, their chorus one of the strangest sounds to be heard in all of nature, as enthralling in its way as the songs of humpback whales. A male opened with an accelerating series of deep grunts expanding into prolonged roars and was then joined by the higher-pitched calls of the females. This far away, filtered through dense foliage, the full chorus was machine-like: deep, droning, metallic. Such rain time calls are usually territorial advertisements, the means by which the animals space themselves out and control enough land to forage and breed. For me they were a celebration of the forest's vitality: *Rejoice! The powers of nature are within our compass, the storm is part of our biology!* For that is the way of the nonhuman world. The greatest powers of the physical environment slam into the resilient forces of life, and nothing much happens.

For a very long time, 150 million years, the species within the rain forest evolved to absorb precisely this form and magnitude of violence. They encoded the predictable occurrence of nature's storms in the letters of their genes. Animals and plants have come to use heavy rains and floods routinely to time episodes in their life cycle. They threaten rivals, mate, hunt prey, lay eggs in new water pools, and dig shelters in the rain softened earth. On a larger scale, the storms drive change in the whole structure of the forest. The natural dynamism raises the diversity of life by means of local destruction and regeneration. Somewhere a large horizontal tree limb is weak and vulnerable, covered by a dense garden of orchids, bromeliads, and other kinds of plants that grow on trees. The rain fills up the cavities enclosed by the axil sheaths of the epiphytes and soaks the humus and clotted dust around their roots. After years of growth the weight

has become nearly unsupportable. A gust of wind whips through or lightning strikes the tree trunk, and the limb breaks and plummets down, clearing a path to the ground. Elsewhere the crown of a giant tree emergent above the rest catches the wind and the tree sways above the rain-soaked soil. The shallow roots cannot hold, and the entire tree keels over. Its trunk and canopy arc downward like a blunt ax, shearing through smaller trees and burying understory bushes and herbs. Thick lianas coiled through the limbs are pulled along. Those that stretch to other trees act as hawsers to drag down still more vegetation. The massive root system heaves up to create an instant mound of bare soil. At yet another site, close to the river's edge, the rising water cuts under an overhanging bank to the critical level of gravity, and a 20-meter front collapses. Behind it a small section of forest floor slides down, toppling trees and burying low vegetation. Such events of minor violence open gaps in the forest. The sky clears again and sunlight floods the ground. The surface temperature rises and the humidity falls. The soil and ground litter dries out and warms up still more, creating a new environment for animals, fungi, and microorganisms of a different kind from those in the dark forest interior. In the following months pioneer plant species take seed. They are very different from the young shade-loving saplings and understory shrubs of the prevailing old-stand forest. Fast-growing, small in stature, and short-lived, they form a single canopy that matures far below the upper crowns of the older trees all around. Their tissue is soft and vulnerable to herbivores. The palmate-leaved trees of the genus *Cecropia*, one of the gap-filling specialists of Central and South America, harbor vicious ants in hollow internodes of the trunk. These insects, bearing the appropriate scientific name *Azteca*, live in symbiosis with their hosts, protecting them from all predators except sloths and a few other herbivores specialized to feed on *Cecropia*. The symbionts live among new assemblages of species not found in the mature forest. All around the second-growth vegetation, the fallen trees and branches rot and crumble, offering hiding places and food to a vast array of basidiomycete fungi, slime molds, ponerine ants, scolytid beetles, bark lice, earwigs, embiopteran web spinners, zorapterans, entomobryomorph springtails, japygid diplurans, schizomid arachnids, pseudoscorpions, real scorpions, and other forms that live mostly or exclusively in this habitat. They add thousands of species to the diversity of the primary forest. Climb into the tangle of fallen vegetation, tear away pieces of rotting bark, roll over logs, and you will see these creatures teeming everywhere. As the pioneer vegetation grows denser, the deepening shade and higher humidity again favor old-forest species, and their saplings sprout and grow. Within a hundred years the gap specialists will be phased out by competition for light, and the tall storied forest will close completely over. In the succession, pioneer species are the sprinters, old-forest species the long-distance runners. The violent changes and a clearing of space bring all the species briefly to the same starting line. The sprinters dash ahead, but the prolonged race goes to the marathoners. Together the two classes of specialists create a complex mosaic of vegetation types across the forest which, by regular tree falls and landslides, is forever changing. If square kilometers of space are mapped over decades of time, the mosaic turns into a riotous kaleidoscope whose patterns come and go and come again. A new marathon is always beginning somewhere in the forest. The percentages of successional vegetation types are consequently more or less in a steady state, from earliest pioneer species through various mixes of pioneer and deep-forest trees to stands of the most mature physiognomy. Walk randomly on any given day for one or two kilometers through the forest, and you will cut through many of these successional stages and sense the diversity sustained by the passage of storms and the fall of forest giants. It is diversity by which life builds and saturates the rain forest. And diversity has carried life beyond, to the harshest environments on earth. Rich assemblages of animals swarm in the shallow bays of Antarctica, the coldest marine habitats on earth. Perch-like notothenioid fishes swim there in temperatures just above the freezing point of salt water but cold enough to turn ordinary blood to ice, because they are able to generate glycopeptides in their tissues as antifreeze and thrive where other fish cannot go. Around them flock dense populations of active brittlestars, krill, and other invertebrate animals, each with protective devices of its own.

In a radically different setting, the deep unlighted zone of caves around the world, blind white springtails, mites, and beetles feed on fungi and bacteria growing on rotting vegetable matter washed down through ground water. They are eaten in turn by blind white beetles and spiders also specialized for life in perpetual darkness.

Some of the harshest deserts of the world are home to unique ensembles of insects, lizards, and flowering plants. In the Namib of southwestern Africa, beetles use leg tips expanded into oarlike sandshoes to swim down through the shifting dunes in search of dried vegetable matter. Others, the swiftest runners of the insect world, race over the baking hot surface on bizarre stilt legs. Archaebacteria, one-celled microorganisms so different from ordinary bacteria as to be

candidates for a separate kingdom of life, occupy the boiling water of mineral hot springs and volcanic vents in the deep sea. The species composing the newly discovered genus *Methanopyrus* grow in boiling vents at the bottom of the Mediterranean Sea in temperatures up to 110°C. Life is too well adapted in such places, out to the edge of the physical envelope where biochemistry falters, and too diverse to be broken by storms and other ordinary vagaries of nature.

But diversity, the property that makes resilience possible, is vulnerable to blows that are greater than natural perturbations. It can be eroded away fragment by fragment, and irreversibly so if the abnormal stress is unrelieved. This vulnerability stems from life's composition as swarms of species of limited geographical distribution. Every habitat, from Brazilian rain forest to Antarctic bay to thermal vent, harbors a unique combination of plants and animals. Each kind of plant and animal living there is linked in the food web to only a small part of the other species. Eliminate one species, and another increases in number to take its place. Eliminate a great many species, and the local ecosystem starts to decay visibly. Productivity drops as the channels of the nutrient cycles are clogged. More of the biomass is sequestered in the form of dead vegetation and slowly metabolizing, oxygen-starved mud, or is simply washed away. Less competent pollinators take over as the best-adapted bees, moths, birds, bats, and other specialists drop out. Fewer seeds fall, fewer seedlings sprout. Herbivores decline, and their predators die away in close concert. In an eroding ecosystem life goes on, and it may look superficially the same. There are always species able to recolonize the impoverished area and exploit the stagnant resources, however clumsily accomplished. Given enough time, a new combination of species—a reconstituted fauna and flora—will reinvest the habitat in a way that transports energy and materials somewhat more efficiently. The atmosphere they generate and the composition of the soil they enrich will resemble those found in comparable habitats in other parts of the world, since the species are adapted to penetrate and reinvigorate just such degenerate systems. They do so because they gain more energy and materials and leave more offspring. But the restorative power of the fauna and flora of the world as a whole depends on the existence of enough species to play that special role. They too can slide into the red zone of endangered species.

Biological diversity—"biodiversity" in the new parlance—is the key to the maintenance of the world as we know it. Life in a local site struck down by a passing storm springs back quickly because enough diversity still exists. Opportunistic species evolved for just such an occasion rush in to fill the spaces. They entrain the succession that circles back to something resembling the original state of the environment. This is the assembly of life that took a billion years to evolve. It has eaten the storms—folded them into its genes—and created the world that created us. It holds the world steady. When I rose at dawn the next morning, Fazenda Dimona had not changed in any obvious way from the day before. The same high trees stood like a fortress along the forest's edge; the same profusion of birds and insects foraged through the canopy and understory in precise individual timetables. All this seemed timeless, immutable, and its very strength posed the question: how much force does it take to break the crucible of evolution?

A Personal Note about this excerpt: *Last week when I read about the death of E.O. Wilson, I remembered the time and place where I was introduced to this man and his work. It was around 1994-95, when Dr. Milind Watve used to host a group of students and a few professionals interested in world of ecology and science at his home on every Wednesday evening – a forum that was named as 'Katta'. I vividly remember the copy of this E O Wilson book that Watve Sir had -it's cover had a beautiful, haunting bluish green image- showing a think, moist evergreen forest. I also remember getting blown away by this writing from first chapter of the book 'Storm over the Amazon'. Sharing this excerpt with all of you is my very small tribute to E.O. Wilson.*

While thinking about this I also realized that I have never properly expressed my gratitude for Watve Sir for all that I have learnt and gained from him. I started going to 'Katta' due to my interest in wild-life – but even before I realized , Sir had opened this whole wide vista of ecology and evolution for all us , introduced us to the true scientific mindset and the beauty of interdisciplinary thinking. I think the time spent with Sir and at the Katta , studying and discussing wide range

of subjects – from natural history to human consciousness helped me discover the subject that I was most deeply interested in – study of human behavior. That self-discovery has shaped and continues to shape my professional journey. I think one meaningful way I can describe what I gained from Sir is to just list few of the authors that I studied, due to quest that Sir ignited – Richard Dawkins, Matt Ridley, Douglas Hofstadter, Daniel Dennett, Steven Pinker, David Buss, EO Wilson, Richard Leakey, Robert Sapolsky.
Thank you so very much Sir!!!

❖ *A Dream of Trees*

https://www.youtube.com/watch?v=biazSyLYsEY&list=PLNu8fjB6zFAM_eHkVFJX_9YpOIQrt3VSt&index=35

A Dream of Trees, a film by Evanescence Studios, tells the story of the ecological restoration of degraded tropical rainforests in the Annamalai Hills of the Western Ghats, India.

Tropical rainforests are complex ecosystems, home to numerous plants and animals that are intricately connected to each other. The film follows the work of two scientists of the Nature Conservation Foundation, Divya Mudappa and TR Shankar Raman, from 2001, as they work with their team to restore degraded patches of rainforest in the Anamalai Hills in partnership with tea and coffee plantation companies. It speaks of the extraordinary values of rainforests and how restoration helps revive forests, bring back wildlife and pull carbon down from the atmosphere in a time of climate crisis.

An instructive story of challenge, limitation, and hope, A Dream of Trees is also an inspiring tale of restoration, of reviving the connections between plants and animals, and between people and rainforests in a shared landscape. (From https://www.natureinfocus.in/environment/a-dream-of-trees)

About 'Treasures'

It's a compilation that I put together every once in a while, of things that I have found to be beautiful and meaningful.
Do share it with others who you think will enjoy it.

Drop me an email (shaileshdesh@gmail.com) if you want to add someone to the circulation list.

For older editions (From January 2012): http://shaileshdeshpande.in/treasures/