Chapter 2
Our Conquest of Coevolution?

Counter-Collaborative Intuitions

If you doubt the prospect underlying all ethological breakthrough (interspecies mutualisms) consider the "the first study to reveal the adaptive nature of rhizobial cheating and to trace the evolutionary origins of uncooperative rhizobial mutants," from a critical study in May of 2010.[1] Or, in the same year, coral reef research that yielded a similarly spectral finding: "Molecular phylogenetic analyses have repeatedly recovered clades formed by colonial/zooxanthellate and solitary/azooxanthellate taxa, suggesting that coloniality and symbiosis were repeatedly acquired and/or lost throughout the history of the Scleractinia" corals.[2] Both scenarios invoke what has been characterized as *the* "Zone of Possible Agreement (ZOPA),"[3] in terms of human negotiation within a wide margin of latitudinal cross-species behavioral morphogenetic and neural differences and similarities. Our political, ethnic, and linguistic variations, routinely expressed in forms leading away from any shape of, or communion with the Others, is hard pressed to make empathy a realistic goal.

[1] J Evol Biol. 2010 May;23(5):1075–89. doi:10.1111/j.1420-9101.2010.01980.x. Epub 2010 Mar 24, "Origins of cheating and loss of symbiosis in wild Bradyrhizobium," Sachs JL, Ehinger MO, Simms EL. http://www.ncbi.nlm.nih.gov/pubmed/20345811, Accessed May 3, 2016.

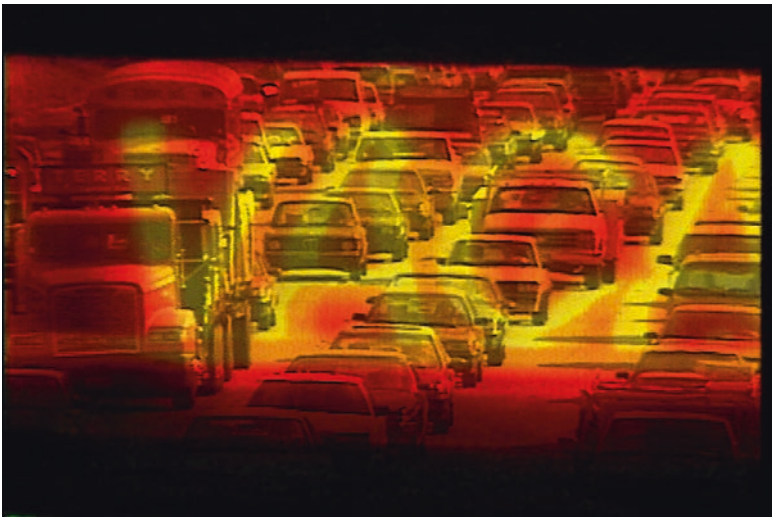
[2] "Repeated loss of coloniality and symbiosis in scleractinian corals," Marcos S. Barbeitosa, Sandra L. Romanob, and Howard R. Laskerc, Author Affiliations, CrossMark, http://www.pnas.org/content/107/26/11877.full, Accessed May 3, 2016.

[3] By Brad Spangler, June 2013, Original publication date June 2003; updated in June, 2013 by "Heidi Burgess," "Beyond Intractability," http://www.beyondintractability.org/essay/zopa, Accessed May 03, 2016.

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DOI 10.1007/978-3-319-45964-6_2

Fig. 2.1 "Los Angeles Traffic," Photo © M. C. Tobias



Nonetheless, we know that we have it in our genes, these willing connections in the polis of all animal and plant species; that open-air agora wherein communion has always occurred; where transactional benefits accrue to those willing to risk new strategies for survival.

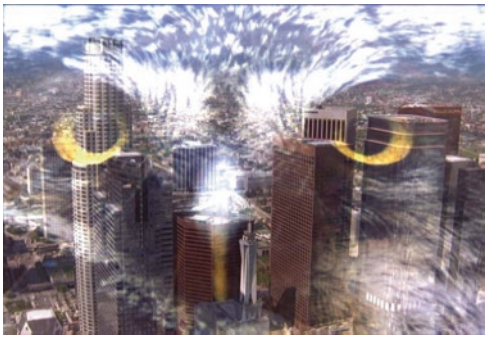
This leaves all that agreeable research into the nature of biological translation on an ambiguous tightrope: it is possible, but, thus far, the evidence supporting it is tenuous, no matter how many times we insist that our dog is our best friend. Indeed, one August 2015 PoochPerks.com poll of 1000 humans declared that 38 % of those surveyed preferred their dogs to their human partners. No one has ever managed within their finite lifetime to transcend all those continuing debates regarding the origins of altruism, caregiving, tenderness, kindness and the function of these special behavioral units within an evolutionary framework more accustomed to looking back than looking forward.

We have witnessed a veritable Renaissance with respect to the recent arguments affording quantifiability to empathy. We tend towards coherence in our individual choices. A life spent cohesively is a worthy goal that easily argues in favor of a sphere of arrangements that have more purchase on the world than selfishness. Selfish gene theories are at once suspect because—and this is particularly true for species with family characteristics—no matter which organism-type is represented in which biological musical chair, there are common themes that are impossible to overlook. Empathy, in all her spheres of transitivity, gives vertebrates a good name because we see the principles of mutual aid universally represented. If we empower our observations with a bias favoring all unicellular and multicellular behaviorism, then the distribution of noble causes, of virtue, of gentleness is autonomous, dependent upon no deep-dwelling rules, but mathematically a given. Free and unburdened to express itself.

This algebraic accumulation of numbers equivalent to behavioral functions of some intangible, immutable Good, is empirically proof-positive; it has persuaded

social norms within every known organism, even in those that have overtaken the facile hope of redemption.

Fig. 2.2 "Eyes Over Los Angeles," Photo © M. C. Tobias



The Zoological Gaze

We are saying several things here. First, empathy is as solid a pillar of zoology as hydrogen is for the Periodic Chart, inchoate; making our alleged conquest of coevolution all the more unlikely a scenario. Second, it should follow that the expression of this lasting hope for life on Earth in her most ubiquitous, salubrious, tangentially forbearing and magnanimous aspects, is co-emergent with the increasingly trained lenses that peer longingly out windows into forests, across meadows, towards mountain and rivers. Some philosophers have likened this zoological gaze as the most holy of sutras. It is not rooted to any particular religious orientation or genome. Our nostalgic handshakes with ancestors grants every cemetery a mirror image of our collective predisposition to want, to recognize, to partake of the biological benefits that devolve to all those individuals and their populations that actually chew the cud of kindness. Stewardship transforms the contemporary visions of art, of nature, of all of our lives going forward.

Unlike the fresh water guppies above referenced, our feelings and choices have not given way to anything remotely Darwinian, not since we diverged from earlier Hominini taxa, except in the seriously flawed and erroneously attributed social Darwinian, survivalist paradigmatics.

While capuchin-like fossils have been discovered in North America, near to the Isthmus of Panama[4] (a species, at least in what is today's Brazil's Serra da Capivara National Park that has been using tools for at least "700 years") and at least five other Genera of primates have been found in North America, the oldest, *Purgatorius*, dating to nearly 65 million years at what is today called Purgatorius (*P. unio* and *P. cera-*

[4] "First North American Monkey Fossils Are Found in Panama Canal Excavation," Published: April 20, 2016. Released by Smithsonian Tropical Research Institute, http://www.sciencenewsline.com/summary/2016042020520063.html, Accessed April 26th, 2016.

tops), unearthed in 1995 at what is known as the Hell Creek Formation in Montana,[5] our recent, non-arboreal ways in the last 200,000 years worldwide have outsmarted the union of different Hominini, extirpating every other species in our Genus, despite genetic vestiges, and—for a time—apparently viable hybridizations, such as between *Homo sapiens* and *Homo neanderthalensis*. There have been any number of theories to try and grasp what it was about us that succeeded in wiping out the other six Homo subspecies—*erectus* (the most successful, having survived for over 2-million years, until about the time of the Toba supervolcano, approximately 65–70,000 years ago; and the one ancestral member of our clade who allegedly invented fire); *foresiensis*, *habilis*, *heidelbergensis*, *naledi*, and *neanderthalensis*.

It is quite likely *erectus* did *not* discover fire, only how to transport it in the manner of numerous bird species—raptors in Australia, for example—that have been doing so, most likely, for millions of years.[6]

Our present status as dominant is entirely lodged on the nebulous basis of the countless and severe destructions we have evinced. No species can outrun its shadow, even if it has conquered coevolutionary dependencies, for the time being. What, precisely, would *H. sapiens* have accomplished in bypassing symbiosis, mutualism, interdependency? The answer is unambiguous: suicide. The approximately one million known suicides per year[7] corresponds to the low estimate for the global human population at the dawn of agriculture approximately 10,000 years ago.[8] By today's demographic comparisons (with nearly 7.4 billion and counting) a million suicides per year, or approximately 114 per hour, or fewer than two per minute, does not trend statistically as anything other than a nearly zero-based anomaly. The rate of metastasis, of the vast varieties of binary fission, sexual and asexual reproduction, render human self-destruction almost meaningless, except for one telling fact: the biography of each individual, and all those who were connected somehow to that person and his or her nearly 25,000 protein coding genes.

In other words, each suicide underscores that story of our connections, and the greater tale of our odyssey, which is a combined storyline involving all of the tens-of-billions of people who have lived and died in just the past 200,000 years; each one connected to other species, whether they knew, acknowledged, or cared about that fact. Biorealism has been employed as an expression and a movement by some architects, but in ethological terms, our biorealistic situation makes our connections to other species a profound given. And, curiously, architecturally so. We cohabit a sphere of biographies whose stories we actually depend upon for our own survival. The more poetic, mysterious, alluring, aesthetically pleasing, it appears the more

[5] "Five Early Primates You Should Know," By Erin Wayman, Smithsonian.com, October 31, 2012, Accessed April 26, 2016. For capuchin tool use, see "These Monkeys Have Used Tools for 700 Years," by Brandon Keim, Conservation Magazine, July 13, 2016, Utilizing data from Haslam et al., "Pre-Columbian monkey tools," Current Biology, 2016. doi:10.1016/cub.2016.05.046).

[6] See "Ornithogenic Fire: Raptors as Propagators of Fire in the Australian Savanna," by Robert A. Gosford and Mark Bon, p. 32, 2015. Raptor Research Foundation, Annual Meeting, Nov. 4–8, Sacramento, CA, http://www.raptorresearchfoundation.org/wpcontent/uploads/2015/11/2015_conference_program.pdf, Accessed April 26, 2016.

[7] See http://www.medicalnewstoday.com/articles/234219.php, Accessed May 15, 2016.

[8] Luc-Normand Tellier (2009). Urban world history: an economic and geographical perspective. Via Google Books. p. 26, Accessed May 15, 2016.

likely our survival is. Great art is biologically motivated and orchestrated, like great empathy. Mahavira, Buddha, Christ, St. Francis, and Gandhi were not anomalies. The impulses are universal.

Fig. 2.3 "A Thai Buddha," Photo © M. C. Tobias



Most critically, however profound those connections, they are contradicted second-by-second as the vast swathes of our anger is spent in so many death tolls among the Others; Holocausts that cumulatively indict the word "hope". This is beyond tragedy, because so many of us want to be hopeful; are clued in daily to a heroism of daily life, as Carl Jung referenced that unheralded and cumulative potential within us. Biorealism leaves us exhausted philosophically. We fail to account for our actions in the sphere of plant and animal interrelatedness. We are isolated, alone, yet to the brim with all that surrounds us, in every meaningful sense.

Fig. 2.4 "Man and Donkey," Painting by New Zealand Artist John Holmwood, 1973, Private Collection, Photo by J. G. Morrison



Biorealism, Species Extinctions, and Carrying Capacity

When ecologists speak of carrying capacity, or "the Netherlands Fallacy" (human populations, regardless of nation, flag, region, or city, which are totally dependent upon trade beyond borders) the number of planet Earths needed to provide and sustain the magnitude of our current consumptive pattern of resources, within the I = PAT equivalency (e.g., the aggregation of megacities—those in excess of ten million human residents) represents an immoral and implausible multiple of the present state of the Earth's finite resources, as captured in every economic system, ultimately.

Fig. 2.5 "Baby Dolls, Downtown Mexico City," Photo © M. C. Tobias



Most importantly, they are not *our* resources. The very word, resources, resourdre "to rally, raise again," from Latin resurgere "rise again," dates to the Old French usage of the term to connote the resurgence of a country's in situ resurgere, revival, the entire country's wealth, a definition first employed in 1779.[9] But it is most elegantly applied in the case of being resourceful, not in exploiting resources. Hence, it is clear that we are, in essence, something altogether new and ungainly on this planet, in this form. Short of a Chicxulub impact-like event, which triggered the last major extinction crisis (the K-T), Earth has never witnessed a species emerging so rapidly, so aggressively with impact results so deadly and fully global. Ten trillion ants, by comparison, are a picnic.

Do such demonic testimonies from science bode of some total undoing of our capacity for empathy, not only with guppies and owlet moths but amid the entire

[9] **Online Etymology Dictionary**, **© 2001–2016 Douglas Harper**, www.etymonline.com/index.php?item=resource, Accessed May 5, 2016.

whorl of biodiversity still managed by the rubrics of accelerated or decelerated evolutionary pathways? It is guesswork but not an impossibility. Even as we continue to ignore well over 700 million hungry humans, and a billion + micronutrient deficiency cases (biographies).

Usually, human guesses have been utterly out of tune with what the world needs. It is estimated that nearly 107 billion individual *Homo sapiens* have come and gone since our first generation, which occurred approximately 200,000 years ago (although other researchers have suggested 135,000 years ago).[10] At least 98 % of the estimated eight billion other vertebrate and mostly invertebrate and floristic species—each numbering between several thousand and several billion individuals, since the origins of life (abiogenesis, nearly 4.1 billion years ago),[11] have also gone extinct, and that this is just the way it is here on Earth. But that does not currently concern the trillions of ants, nor would it have bothered the now extinct Rocky Mountain Grasshopper (*Melanoplus spretus*), a single swarm of which, from 1873 to 1875 is said to have spread from the Mid-West to the East Coast, numbering at least 12–13 trillion individuals, giving it the status as one of the most numerous single species in the history of biology, and one whose fate was actually sealed because of plains irrigation and plowing systems of agriculture and the ruination of those stable soil nesting sites in which each female grasshoppers laid her hundreds of egg cases.[12] A similar situation can be deciphered in the case of the Ohlone beetle whose future is quietly being obfuscated by mountain bikers riding herd upon the beetles' larvae. Our pleasure, the world's despair.

All of the numbers that accompany these hour-by-hour exterminations form their own chilling calculus we prefer to ignore, although anomalies might hold more than a little interest in the full mathematical modeling of biomes across Earth, with target vortices where genetic drift and/or distribution confront barriers. Those ecological edges are where we are most likely to recognize new biological success stories. Speciation, primarily a function of barriers of population distribution, is exponentially enhanced beyond any easily understandable model when the rise and fall of species has become headlines; the life and death of populations and individuals, and of a deep biological veering away from stability, entirely driven by human machinations coming into drastic focus.[13]

Those "headlines" are rife with stressors undermining carrying capacity, inflictive flux, boom-and-bust, the proliferation of withering taxons, 63 million dead trees in California's High Sierras during the Summer of 2016. We can sense the majesty of these seemingly vague mathematics as they apply to biochemistry and our own

[10] The Dead Outnumber the Living (Infographic), by Live Science Staff, February 07, 2012, www.livescience.com/18336-human-population-dead-living-infographic.html. Accessed February 14, 2016.

[11] Elizabeth A. Bell. "Potentially biogenic carbon preserved in a 4.1 billion-year-old zircon". Accessed April 26, 2016.

[12] Lockwood, Jeffrey A. (2004). **Locust: the Devastating Rise and Mysterious Disappearance of the Insect that Shaped the American Frontier**, (1st ed.). New York: Basic Books. ISBN 0-7382-0894-9. Accessed March 10, 2016.

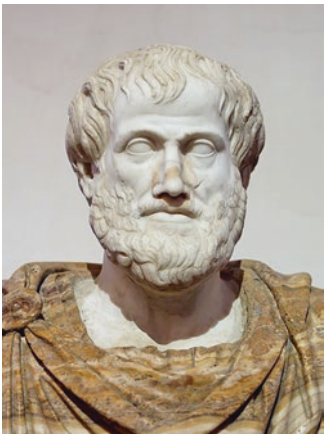
[13] See http://water.usgs.gov/edu/ph.html, Accessed May 6, 2016.

personal lives against sweeping backdrops, as far as can be gleaned and contemplated in a work as impressive as Rembrandt's "Aristotle Contemplating the Bust of Homer" (1653, in the New York Metropolitan Museum of Art).[14]

This unique portrait draws our attention to the orbit of two men, both myths in their own time; two individuals separated by what some have termed *notional ekphrasis*. By that we mean the power of art to illuminate; inviting consideration of the revelatory echoes and contradictions inherent to being mortal, as in W. H. Auden's poem 'Musee des Beaux Arts (1940)'. "Without imagination there would be no science."[15]

History prefers the notion of Aristotle in contemplation; of the exiled philosopher/scientist dying in his ancestral home, in his early 60s, alone and haunted.

Fig. 2.6 "Bust of Aristotle," © Wikipedia Commons



And we think of Homer (whose burial site has never been ascertained, three Greek island municipalities all claiming possession of it—we searched for it once in a gully, swarming with bees, on the north end of Ios) invested with all the emotion of great Greek dramatists. This painting has perpetually endowed its two mythic personages with a solemn sense of order in the world, the commiseration that lends sanctuary to opposing poignancies of life and death,[16] condensed by inference and precision into a densely scattered vision whose biological corollaries meet speciation head-on.

Humans are not one thing: we are evolving, remembering, keeping tabs, deciphering code, generating ideals, and dying out. Rembrandt's act of communication, as Simon Schama brilliantly articulates in his **Rembrandt's Eyes**[17] portrays each and every one of us fixated for an instant in the throes of coevolution.

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[14] See http://metmuseum.org/art/collection/search/437394, Accessed May 6, 2016, http://metmuseum.org/art/collection/search/437394Accessed May 6, 2016.

[15] See http://sianprior.com/2015/04/notional-ekphrasis-what-even-is-it/, Accessed May 6, 2016.

[16] See Joseph Newton Hallock, **The Christian life: For devotional reading and family worship**, Catskill, New York, 1892.

[17] See Alfred Knopf, New York, 1999.

If the painting, ultimately, enshrines a "who's who?" it is little removed from the taxonomist's dilemma in general: All of history is mere gossip, said Dante. And natural history even more so. Aristotle and Homer, who in their respective worlds were contemporaries of both the Dodo and Great Auk, had they but known what was to come might have portrayed Helen of Troy, or philosophy's most cherished First Principles, dressed in most colorful feathers. While a great artist revives legends and life based upon what he/she knows, or imagines to be, nature accomplishes it in totality every nanosecond, giving loft to the many truths of biological reincarnation in the guise of normal ecological interplay. We continue to populate at a pace which suggests we believe we are on to something; that in our perpetuations each generation, with greater and greater population sizes hotel chains for gene expression-knows something *we* don't know.

That constitutes a bit of a thriller, and one quite clouded with careening uncertainty.

The Sorites "Paradox of the Heap" in a World of Fuzzy Logic[18]

There is some evidence to indicate that *M. spretus* has a solitary phase, which means it could return, even though its official extinction was declared in 2014.[19] *M. spretus* loved the taste of wheat, was magnificently well-distributed and of a highly social nature. One swarm was estimated to measure the size, approximately, of all of California. Today's living counterparts might be likened to the 81 species of long-lived (10 years) Arthropod subphylum, crustacean krill, the most prominent being those individual members of the astonishingly widespread Euphausiidae family, whose herbivorous sons, daughters and cousins, in the case of the Antarctic *Euphausia superba* species, can weigh collectively nearly 380 million tons[20] and are visible from space, under the right conditions and lens power. Yet, for all their magnificence, indeed, as gorgeous and survival oriented as any species (they exhibit massively honed escape strategies and speed from predators) krill are subject to daily massacres by an unlikely, nonmarine mammal competitor. Humans kill approximately 200 tons of krill each year (down from 520,000 tons in 1983),[21] unloading enormous stress upon the available food supply for the less than 1 % of the remaining blue whales (*Balaenoptera musculus*

[18] See Barker, C. (2009). "Vagueness". In Allan, Keith. Concise Encyclopedia of Semantics. Elsevier. *p. 1037.* ISBN 978-0-08-095968-9, Accessed April 29, 2016; http://www.sciencedirect.com/science/article/pii/B008044854201083X, Accessed May 7, 2016.

[19] Hochkirch, A. (2014). "Melanoplus spretus". IUCN Red List of Threatened Species. Version 2014.3. International Union for Conservation of Nature. Accessed March 10, 2016.

[20] A. Atkinson, V. Siegel, E.A. Pakhomov, M.J. Jessopp, and V. Loeb (2009). "A re-appraisal of the total biomass and annual production of Antarctic krill" (PDF). Deep-Sea Research I56: 727–740. Accessed March 13, 2016.

[21] See http://www.coolantarctica.com/Antarctica%20fact%20file/science/threats_fishing.php, Accessed March 14, 2016.

intermedia) in Antarctica. Their populations plummeted from probably more than 300,000 amazing individuals to fewer than 400, and are slowly making a comeback today, it is hoped.[22] However, determining a precise number of Antarctic Blue Whales is thus far not possible. The technology for satellite tagging is cumbersome and time-consuming.[23]

But if it is sociality, culture, and numerical superlatives that one examines in an endeavor to establish a kind of biological defuzzification, the Milo of Croton of *H. sapiens* when it comes to one species' claims to global dominance, not even krill come close to the recently discovered virus, alleged to be the most multitudinous of all living beings, namely, HTVC01P. "*Pelagibacter ubique* is often cited as the most common organism ever: it's a third of all the single-celled organisms in the ocean." But scientists recently discovered four parasites that *eat P. ubique*, and one of them has the highest numbers of all, that being the virus called HTVC01P, according to researchers at Oregon State University.[24] Viruses also inhabit a kind of capitalistic biological world: there are headstrong winds, competitors, such as *Prochlorococcus* which has been found to be abundant in the euphotic zone of the world's tropical oceans and some argue may indeed be more plentiful, even, than HTV with a global yearly abundance calculated at between 2.8 and 3.0 octillion (~10-to-the-27th) individuals.[25]

A single human body, on average, as extrapolated from the one nanogram per cell weight, contains between 34 trillion and 70 trillion cells (astonishingly disparate estimates). What most surprises the author of the paper examining such numbers, Carl Zimmer, is that so many trillions of cells figured out how to cooperate for, on average, 70, 80, 90 years, to nurture a microbial world called a functioning mammal, in this case, a bipedal primate known as a human being.[26]

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[22] Circumpolar Diversity and Geographic Differentiation of mtDNA in the Critically Endangered Antarctic Blue Whale (Balaenoptera musculus intermedia), Angela L. Sremba, Brittany Hancock-Hanser, Trevor A. Branch, Rick L. LeDuc, C. Scott Baker, PLOS, Published: March 7, 2012, doi:10.1371/journal.pone.0032579, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0032579, Accessed March 14, 2016.

[23] Reuters, Wed Mar 27, 2013 "Tagging, satellite tracking reveals mystery of blue whales," by Pauline Askin. www.reuters.com/article/us-australia-antarctic-whales-idUSBRE92Q02M20130327, Accessed March 14, 2016.

[24] See http://www.smithsonianmag.com/smart-news/guess-what-the-most-abundant-organism-on-Earth-is-19254662/#PeOIKze7vtJ7YWSL.99; http://www.smithsonianmag.com/smart-news/guess-what-the-most-abundant-organism-on-Earth-is-19254662/?no-ist. Accessed February 19, 2016.

[25] G. Rocap, F. W. Larimer, J. Lamerdin, S. Malfatti, P. Chain, N. A. Ahlgren, A. Arellano, M. Coleman, L. Hauser, W. R. Hess, Z. I. Johnson, M. Land, D. Lindell, A. F. Post, W. Regala, M. Shah, S. L. Shaw, C. Steglich, M. B. Sullivan, C. S. Ting, A. Tolonen, E. A. Webb, E. R. Zinser & S. W. Chisholm (2003). "Genome divergence in two Prochlorococcus ecotypes reflects oceanic niche differentiation". Nature 424(6952): 1042–1047. doi:10.1038/nature01947. PMID 12917642.

[26] "How Many Cells Are In Your Body?" by Carl Zimmer, The Loom, National Geographic website, http://phenomena.nationalgeographic.com/2013/10/23/how-many-cells-are-in-your-body/, 10/23/2013. Accessed January 20, 2016.

Fig. 2.7 "Young Woman Among Sikkimese Mountain Tribe," Photo © M. C. Tobias



There are other ways to consider big species considerations by focusing on ring related collations of life, or *Rassenkreis*[27] that would not only include the aforementioned viruses and bacteria, but also those relational species marked by their ranges. Species like the Greenish Leaf Warbler (*Phylloscopus trochiloides*) whose life cycle takes them from Europe to Nepal to Siberia via the Tibetan plateau. The known 66 species of the Phylloscopidae family literally form a kind of ring of associations, genetically connected around vast geographical regions, with no referenda ever threatening a biological Brexit. Even more pronounced and earlier studied are the 28 species members of the gulls, or Laurus Genus, circumpolar, their family, the Laridae, geographically discernible at New Jersey urban landfills and atop icebergs floating in the North Atlantic. The Ploceidae family throughout Africa, including the Red-billed Quelea, *Quelea quelea*[28] is another bird species that would rank at the continental ring level of biospheric resiliency and inexplicable success, as least for now.

And, of course, one of the most commonly experienced Rassenkreis species in North America is the Aspen tree, *Populus tremuloides* whose root systems are millennia's old, and which all descend from a single seed, making them the ultimate clonal colonists. When the western tent caterpillar (*Malacosoma californicum*) goes into 1 or 2 years of frenzied leaf consumption, as is currently taking place across large swathes of the Rockies, notably throughout portions of the Sangre De Cristo mountains of the 1.6 million acre Santa Fe National Forest (New Mexico), it is this very colonial system that more often than not provides the Aspen their defense against insect predators. Safety in large numbers.

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[27] Brown, Rob. ""Same Species" vs. "Interfertile": concise wording can avoid confusion when discussing evolution."

[28] Arnaiz-Villena, A; Ruiz-del-Valle V; Gomez-Prieto P; Reguera R; Parga-Lozano C; Serrano-Vela I (2009). "Estrildinae Finches (Aves, Passeriformes) from Africa, South Asia and Australia: a Molecular Phylogeographic Study" (PDF). The Open Ornithology Journal 2: 29–36. doi:10.2174/1874453200902010029.

Fig. 2.8 "Clonal Aspen Complex, *Populus tremuloides*, Sangre De Christo Mountains, Northern New Mexico," Photo © M. C. Tobias



But this theory has not worked for bovines, or sheep, turkeys, or pigs, when up against our species; while, conversely, nearly 7.4 billion *H. sapiens* thus far have found safety nets—at the species-entire level—even if distinct populations teeter, or disappear entirely; and individuals are capable of, and vulnerable to enormous and/or permanent harm.

Species like the vast interconnected quaking Aspen, particularly at the golden heights of autumn, convey great beauty and hope, both in geographical and numeric terms. Their fuzzy logic dissipates on the cusp of a different set of mathematical confirmations. Nonetheless, those survival stratagem, so different from that of the nearly 650 species of primate who typically live in communities whose populations rarely exceed 150 individuals, offer no easy predictability with respect to biological procedures or prospects for survival, as was thoroughly explored in Ernst Mayr's classic study of modern evolutionary synthesis, his book **Systematics and the Origins of Species**.[29] What is problematic about assertions regarding relational species is the algebra that relies upon variables, if/then suppositions and infinite-valued logic. In other words, uncertainty in every aspect of scientific reasoning and proof. Mathematic models, whether applied to genetics, systematics, or any predicate, cannot be refined beyond fringes; obtuse membership rules, compromised probability specifics. Anything is possible within the fuzzy détentes guiding biological theory when big numbers, big history, big ideas and ideals are involved.

[29] Columbia University Press, New York, 1942; See http://www.nasonline.org/programs/sackler-colloquia/completed_colloquia/systematics-and-the-origin-of-species-on-ernst-mayrs-100th-anniversary.html, Accessed April 29, 2016.

Contradictory Breaking Points

All of biology, physics, and chemistry hinges in great measure upon such numbers as have been flying back and forth, thus far. The challenge in tracking such multitudes, at whatever scale, is that our definitions of a species, of their linguistic and other behavioral norms are realms for philosophy and morals, not mathematics, which provide a different kind of window on what's going on, namely, expansiveness and population dynamism, without judgment; indeed, absent any qualitative analysis whatsoever. In a neutral world of such numbers, all is lost when morality enters into proposed equations that will translate into human common sense, politics, economics, public opinion, and legislation.

The more numeric specificity science grants evolution and coevolution—the number of genes an organism possesses, for example—the greater likelihood of error; of totally misreading that specifically targeted 'reality,' and the larger, more frustratingly irremediable gulf separating human cultures from animal and plant cultures. Cultural schisms are at the heart of anthrozoology's mission to rectify and remedy.

Our knowledge bases, when multiplied, are incapable of substantiation. By scoring and accumulating, negating and positing, we have virtually tainted all translations; undermined tandem possibilities with the Others; worked hard to sabotage all competition among Other-than-humans; proscribed the moods, largesse and methodologies that might yet ensure a reciprocity that is fundamentally the precursor to our own survival. We simply don't have a clue how to make the closing of this abyss happen in ways that work for both parties to the negotiation.

Because we have for so many thousands of years endeavored to isolate ourselves, buttress our strongholds, keep the Others out (aside from the sporadic vogue for Corgies, pet Persian cheetahs, raptors of the Arabian Peninsula, chocolate point Siamese, Pekinese, etc.) we have undermined our possibilities for communion. This is tragic, deeply depressing, and real. Breaking bonds with biophilia, walking from the table of ethological discourse, melting the North and South poles, raining an atrocious toxicology upon all other life forms is our continuing legacy. Unlike the biotic components essential to any community of life forms, as described at many levels heretofore, our species has gone out on a limb like no other, attempting to do it all alone.[30]

Stranger, and more awkwardly still, we have translated our aloneness into biological success, as we have done with our species' TFRs, or, Total Fertility Rates;[31]

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[30] For but one example out of thousands, see, Plant Ecology Vol. 165, No. 2, 2003 Distribution, Specie…http://www.jstor.org/action/showPublication?journalCode=plantecology, "Distribution, Species Diversity and Life-Form Spectra of Plant Communities along an Altitudinal Gradient in the Northern Slopes of Qilianshan Mountains, Gansu, China," Guohong Wang, Guangsheng Zhou, Limin Yang, and Zhenqing Li, *Plant Ecology,* Vol. 165, No. 2 (2003), pp. 169–181, Published by: Springer, Stable URL: http://www.jstor.org/stable/20146379, Page Count: 13, http://www.jstor.org/stable/20146379?seq=1#page_scan_tab_contents, Accessed May 9, 2016.

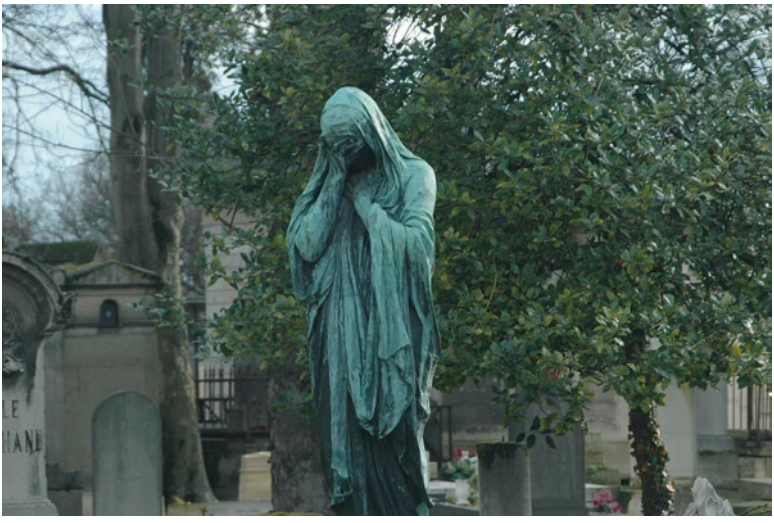
[31] See The Population Reference Bureau data sets, http://www.prb.org/Search.aspx?search=TFR, Accessed June 17, 2016.

urging our demographic madness to the summit of a population Mount Everest, an ecological chasm, in other words, containing sooner than later probably ten-billion individuals or more who will be living in absence of the slightest consideration of the many consequences of their destructive aggregations. Every single indicator of such delusional triumph is trapped by irreconcilable data sets condemning us, and rightly so, to what is cumulatively a clear and present proclivity for outright ecocide. But this is the same edge known as biological suicide. That transcends in its cause of nullity the most fragile and telling of ecological boundaries, namely, habitat and population levels. In other species we find this same edge of death-throes in genetic bottlenecks that correspond with massive extinctions, die-offs, all of the concerted destruction whose outlines clearly illuminate the Anthropocene.

Is such self-destructive behavior at the population level simply a matter of mass stupidity? Morbidity? Insanity? It is, however described, a clinical crisis that no one is taking seriously enough.

H. sapiens' isolationism is an indicator of species-wide planetary failure, our most self-damning indictment and the one most likely to ensure our extinction as a species. The successor hominidae, if there is one, will endeavor desperately to eke out survival in spite of evolution, having diverged entirely from any sustainable biospheric conditions of their own making. Such a future is a conditional that can be projected at this time. Our attempt to overthrow evolution by causing our own nature to prevail above all others mirrors precisely the global problematique: we have turned our back on the mirror of ourselves and waged war against the Earth. Only a Fool of a Species would think to do that. Are we clinically suicidal? It is worse than that. We are a species governed by serial killing as the most obvious through-story of our history.

Fig. 2.9 "From Cimetière du Père Lachaise," Photo © M. C. Tobias



Even the geographic expansionism of our restless selves eludes any other explanation or clarity. We may *think* that we understand a continent, a shoreline, a forest. But, as with the classic case of the famed Heraclitus of Ephesus (535 BC–475 BC), who wrote, "δὶς ἐς τὸν αὐτὸν ποταμὸν οὐκ ἂν ἐμβαίης, You could not step twice into the same river," as remembered by Plato in his **Cratylus**, 402a.,[32] the investiture corresponding to our having laid claim to all six (some say seven) continents, demonstrates that we cannot stop ourselves. Topophilia (as denominated by geographer Yu Fu Tuan) has transmogrified into topocide. The talk of restraint is reserved for poetry and ethical literature but does not hold a candle to the darkness of human multitudes struggling within their miniature mortal coils of habitation.

A heap of a billion grains of sand is still a heap plus-or-minus one, two, even two million grains. One plus one, in other words, does not equal two, a discussion about which will be taken up at the end of this book. In any outdoor ethical discourse, for one plus one to equal zero, or worse, is writ large on too many emergent epitaphs of our fellow species to be ignored any longer.

The Metabolic Truths of Biological De-Constructions

The point is that such big numbers may mean little to us, other than the vague consolation—as gleaned from the conglomerations of an Anselm Kiefer, the stark bifurcations of a Mark Rothko or photographic montages, blurred and self-indulgent that mark those countless, often illuminating experiments performed on the world by a Gerhardt Richter—that when we die as a species, all that other calculus of strangers will more than likely still be doing their grand metabolic, life-fostering work out in the forests, the meadows, the prairies, mangroves, neo-tropics, and oceans, at least some of them will. Jacques Cousteau raised a generation on this belief system, just as Disney enterprises rallied on behalf of painted deserts, scorpions, Pinocchio, Lion Kings and—eventually, along with other corporate stewards such as Pixar, the favoring of populist sharks, penguins, parrots, and lemurs.

But there is more to it than that. Forgetting these astronomical-sized biological numerics, beneath, or outside Darwin's umbrella—that paradigm which all but assures the supremacy at some point, of mutations—our problem is also a philosophical and moral prospect, indeed, an opportunity if you are up to concession: to reconcile our apparently compulsive need to exploit with an attitudinal change at once aesthetically satisfying and mutualistic in terms of the Others—the other species still left on the planet. This takes courage, principally because you are likely to be alone in Sussex, overlooking a pond, engaged in quiet commiseration with what your neighbors take to be pests and weeds. That would be, perhaps, for starters.

Regardless of your age of retirement from the hubbub of nosey neighbors, it would indeed be helpful to understand how to forego exploitation, without having

[32] **Stanford Encyclopedia of Philosophy**, http://plato.stanford.edu/entries/plato-cratylus/, Accessed April 29, 2016.

to sneak about throwing walnuts to squirrels and chunks of seven-grain bread to the rabbits, and mustelids. And to be stuffing your suet boxes, other hidden peanut caches, cookie stashes, nut castles and chopped tofu habitats for other-than-humanity without behaving like a thief in the dark; and in as many configurations and positive outcome scenarios as possible. The patron of these humble gifts to your true neighbors, the other animal species, is, of course, Prince Charles—a true Prince, as far as can be determined; and others of his ilk, like Bridget Bardot, Michael Aufhauser, and Reinhardt Brandauer. Dr. Biruté Mary Galdikas, Linda Tucker, Pramoda and Gurudev Chitrabhanuji, Dr. Marc Bekoff, Ingrid Newkirk, Dr. Paul Waldau, Dr. Jane Goodall. Shelley, one can be sure, did not stint when it came to feeding birds. Nor did Petrarch. Schakleton, Milton, Dante, Sannazaro, Da Vinci, Einstein, Schweitzer, Beethoven, or Monteverdi, Bernardt de Ventadorn, Dürer and the earlier Martin Schongaüer of Colmar, as well as the subsequent engraving family dynasties like the de Passe's and Wierx's and Sadelers. Vivaldi or Mozart. They have all revered life. It is what makes humanity humanity.

The Blue Whale Question?

Had we driven the Blue Whale to extinction—which was nearly a fact, what could we have possibly learned from that tragedy? How could it have helped the Earth? Are we learning lessons, or ignoring them? Do we even believe that our species could be imperiled as was the Blue Whale? Is there a critical mass of humans who even care whether we go extinct? The average Blue Whale weighs 200 tons, a human 62 kg or 136.687 lb. The African bush elephant (*Loxodonta africana*), of which there are thought, possibly, to be four subspecies, the largest of the males weighing over 13,000 pounds, are the Earth's terrestrial equivalent of the Blue Whale (excluding Sequoia and Redwoods, of course), and today we are watching their populations being decimated. The IUCN has downgraded their conservation status from Endangered to merely Vulnerable[33] based on the fact of the animal's widespread ranges across much of Africa, which translates into huge gaps in analysis or the infrastructure to reliably ascertain from region to region, year to year, their number. Tracking, as with Blue Whales, is difficult.[34] And for conservationists, not to mention the elephants themselves, this is acutely frustrating. If there is a Devil in such statistics it is the combinatorial power of poverty, poaching, the human population explosion, and elephant habitat loss. All four of these dilemmas should be soluble, and education through communication is key.

Anthrozoology is very much about communicating: people to people; but as importantly, the willingness of people to *listen* to elephants and Blue Whales. It was Scott McVay, in his seminal investigation of the whaling industry for Scientific

[33] See http://www.iucnredlist.org/details/12392/0, Accessed March 14, 2016.

[34] See http://www.globefoundation.org/projects/about-elephant-tracking-and-collaring/, Accessed March 14, 2016.

American, who first exposed the true horror and near extinction levels being faced by whales everywhere.[35]

These concerns and conjectures reverberate amid a flood of numbers, admittedly. And there are good reasons for ascribing some importance to data. A Blue Whale consumes some 40 million individual krill every day. How is it a small primate, humans, were able in the space of two centuries to virtually extinguish the Blue Whale, and why? And what has our inglorious intercession done by so depleting those numbers, each one of which—a point we must drive home insistently—is a living individual comprised of great importance in the overall scheme of life? Otherwise, and in spite of the insistence, all these numbers are a meaningless blur, to be permanently shelved, ignored, and by logical inference, forgotten.

Does "forgotten" merit consideration? Is there some kind of planetary reconciliatory gesture on our part, within this vast numbers game, that is feasible? One that would go so far as to promote, somehow, our making friends not only with whales and elephants and grasshoppers but with antibiotics, with bacteria and viruses, to the extent possible? At least not mindfully accelerating their mutations by flushing other species with antibiotics, or applying many of the bars of soap that are normally (and legally) manufactured to our own bodies? Should the loss of antibiotic resistance truly worry us as much as the accelerating loss of Bengal tigers (*Panthera tigris tigris*) or Black (hook-lipped) Rhinos (*Diceros bicornis*)? Even the southern-white rhino (*Ceratotherium simum simum*) sub-species in Africa numbers fewer than 20,500 individuals in the wild.

Fig. 2.10 "Southern-White Rhino Family, South Africa," Photo © M. C. Tobias



[35] "The Last of the Great Whales," Scott McVay, Scientific American, August 1 1966, http://www.scientificamerican.com/article/the-last-of-the-great-whales/, Accessed June 1, 2016.

Post-Holocene Histories

Anthrozoology is that broader science of orientation which prescribes a basic public policy that comports with primordial ethics: every living being wants to survive. We have repeated this, and will do so again. What we feel, and think and do with respect to the Others, all of the Others, is also what we do to ourselves. It all matters deeply. The Anthropocene is that geological period of time, post-Holocene, now upon us, singularly characterized by the catalyst of all those activities conceived and empowered by humanity, directly and indirectly alike. That impact is the history of environmentalism, but it also reigns in the problem we face today at an unprecedented convergence and convolution of crises which the Anthropocene illustrates.

Could Darwin's umbrella be changed radically? The notion of altering human evolution is not a new concept. Just recently, with respect to the capacity to "edit genetic mistakes" (read: "cystic fibrosis, muscular dystrophy and even HIV and cancer") the concept emerged: "We're talking about something that would affect human evolution," said UC-Berkeley geneticist Jennifer Doudna, in an interview with CBS News.[36]

We are only too aware of the fact that our very tenuous relationship with the natural world is predicated upon our own impact upon that world. Certainly our species' relationship with the Boll Weevil (*Anthonomus grandis*) is one of the great case studies in ecological gratification backfiring. Commencing with its entry from Mexico in 1892, much of the cotton production—itself hugely destructive to the environment—was impeded by the beetle's robust feeding frenzy. The blame goes strictly to the cotton growing throughout the southeastern USA, a practice that resulted in vast losses of biodiversity. By 1915, in the state of Georgia, the beetle's love affair with cotton had devastated croplands by nearly 50 %, within less than a decade, resulting in what historians call the "great migration"; farmers put out of business and moving to where jobs might be found in the northern states.[37] Following WWII, farmers were back in business massively spraying pesticides like DDT to control the beetles, thus amplifying one ecological disaster (loss of habitat, extinctions, and soil erosion—more than half-a-foot of soil depth in every field)[38] with an outbreak of toxicants, prior to the revelations of the scientific community, largely driven by the publication, of course, of **Silent Spring** (1962) by Rachel Carson.[39]

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[36] "Could revolutionary gene-editing technology end cancer?" CBS News, November 30, 2015, http://www.cbsnews.com/news/crispr-jennifer-doudna-gene-editing-technology-diseases-dangers-ethics/, Accessed March 4, 2016.

[37] "Business and Economy," Original entry by Phillip M. Roberts, University of Georgia, 05/18/2004, http://www.georgiaencyclopedia.org/articles/business-economy/boll-weevil, Accessed March 31, 2016.

[38] See "Environmental History of Georgia: Overview," by Leslie Edwards, 05/25/2004,http://www.georgiaencyclopedia.org/articles/geography-environment/environmental-history-georgia-overview, Accessed March 31, 2016.

[39] See "How 'Silent Spring' Ignited the Environmental Movement," By Eliza Griswold, September 21, 2012, The New York Times Magazine, http://www.nytimes.com/2012/09/23/magazine/how-

When we speak about humans tampering with evolution, the history of the state of Georgia is certainly quintessentially all about human intervention and destruction, unabated from the earliest Mississippian culture fire-alterations for early agriculture between AD 800 and 1600; and subsequent mass extermination by colonizing Europeans of fur bearing animals, then longleaf pine forests, along with the rice and cotton cultivation crazes, subsidized by slavery, all echoing a human pattern that has been several thousand years in the works.

But then we must add the interbreeding and artificial selection of (in essence, genomic qualities) that would be favorable to those plants we prize, and to the domestication of animals we can utilize and who can optimize benefits to themselves by associating with our species. In the case of canines, geneticists at UCLA have now discovered that such domestication can cause predictably far higher mutational problems (some 115 possible mutation types for over-bred dogs) by comparison, for example, with genome studies of wolves in Tibet, or on Isle Royal in Michigan.[40]

silent-spring-ignited-the-environmental-movement.html?_r=0, Accessed June 17, 2016.

[40] "The domestication of dogs has caused harmful genetic changes, study finds," by Peter Dockrill, 23 Dec 2015, Alert, http://www.sciencealert.com/the-domestication-of-dogs-has-caused-harmful-genetic-changes-study-finds. Accessed February 27, 2016.

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