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the very elements that we strive mightily, and so often unsuccessfully, to put into our own lives – intrinsically in nature. I see no evidence for Teilhard's noosphere, for Capra's California style of holism, for Sheldrake's morphic resonance. Gaia strikes me as a metaphor, not a mechanism. (Metaphors can be liberating and enlightening, but new scientific theories must supply new statements about causality. Gaia, to me, only seems to reformulate, in different terms, the basic conclusions long achieved by classically reductionist arguments of biogeochemical cycling theory.)

There are no shortcuts to moral insight. Nature is not intrinsically anything that can offer comfort or solace in human terms – if only because our species is such an insignificant latecomer in a world not constructed for us. So much the better. The answers to moral dilemmas are not lying out there, waiting to be discovered. They reside, like the kingdom of God, within us – the most difficult and inaccessible spot for any discovery or consensus.

belonging to the same species, which was considered by most Darwinists (though not always by Darwin himself) as the dominant characteristic of struggle for life, and the main factor of evolution.

What can we make of Kropotkin's argument today, and that of the entire Russian school represented by him? Were they just victims of cultural hope and intellectual conservatism? I don't think so. In fact, I would hold that Kropotkin's basic argument is correct. Struggle does occur in many modes, and some lead to cooperation among members of a species as the best pathway to advantage for individuals. If Kropotkin overemphasized mutual aid, most Darwinians in Western Europe had exaggerated competition just as strongly. If Kropotkin drew inappropriate hope for social reform from his concept of nature, other Darwinians had erred just as firmly (and for motives that most of us would now decry) in justifying imperial conquest, racism, and oppression of industrial workers as the harsh outcome of natural selection in the competitive mode.

I would fault Kropotkin only in two ways – one technical, the other general. He did commit a common conceptual error in failing to recognize that natural selection is an argument about advantages to individual organisms, however they may struggle. The result of struggle for existence may be cooperation rather than competition, but mutual aid must benefit individual organisms in Darwin's world of explanation. Kropotkin sometimes speaks of mutual aid as selected for the benefit of entire populations or species – a concept foreign to classic Darwinian logic (where organisms work, albeit unconsciously, for their own benefit in terms of genes passed to future generations). But Kropotkin also (and often) recognized that selection for mutual aid directly benefits each individual in its own struggle for personal success. Thus, if Kropotkin did not grasp the full implication of Darwin's basic argument, he did include the orthodox solution as his primary justification for mutual aid.

More generally, I like to apply a somewhat cynical rule of thumb in judging arguments about nature that also have overt social implications: When such claims imbue nature with just those properties that make us feel good or fuel our prejudices, be doubly suspicious. I am especially wary of arguments that find kindness, mutuality, synergism, harmony –

In late 1909, two great men corresponded across oceans, religions, generations, and races. Leo Tolstoy, sage of Christian nonviolence in his later years, wrote to the young Mohandas Gandhi, struggling for the rights of Indian settlers in South Africa:

God helps our dear brothers and co-workers in the Transvaal. The same struggle of the tender against the harsh, of meekness and love against pride and violence, is every year making itself more and more felt here among us also.

A year later, wearied by domestic strife, and unable to endure the contradiction of life in Christian poverty on a prosperous estate run with unwelcome income from his great novels (written before his religious conversion and published by his wife), Tolstoy fled by train for parts unknown and a simpler end to his waning days. He wrote to his wife:

My departure will distress you. I'm sorry about this, but do understand and believe that I couldn't do otherwise. My position in the house is becoming, or has become, unbearable. Apart from anything else, I can't live any longer in these conditions of luxury in which I have been living, and I'm doing what old men of my age commonly do: leaving this worldly life in order to live the last days of my life in peace and solitude.

But Tolstoy's final journey was both brief and unhappy. Less than a month later, cold and weary from numerous long rides on Russian trains in approaching winter, he contracted pneumonia and died at age eighty-two in the stationmaster's home at the railroad stop of Astapovo. Too weak to write, he dictated his last letter on November 1, 1910. Addressed to a son and daughter who did not share his views on Christian nonviolence, Tolstoy offered a last word of advice:

The views you have acquired about Darwinism, evolution, and the struggle for existence won't explain to you the meaning of your life and won't give you guidance in your actions, and a life without an explanation of its meaning and importance, and without the

unfailing guidance that stems from it is a pitiful existence. Think about it. I say it, probably on the eve of my death, because I love you.

Tolstoy's complaint has been the most common of all indictments against Darwin, from the publication of the *Origin of Species* in 1859 to now. Darwinism, the charge contends, undermines morality by claiming that success in nature can only be measured by victory in bloody battle – the “struggle for existence” or “survival of the fittest” to cite Darwin's own choice of mottoes. If we wish “meekness and love” to triumph over “pride and violence” (as Tolstoy wrote to Gandhi), then we must repudiate Darwin's vision of nature's way – as Tolstoy stated in a final plea to his errant children.

This charge against Darwin is unfair for two reasons. First, nature (no matter how cruel in human terms) provides no basis for our moral values. (Evolution might, at most, help to explain why we have moral feelings, but nature can never decide for us whether any particular action is right or wrong.) Second, Darwin's “struggle for existence” is an abstract metaphor, not an explicit statement about bloody battle. Reproductive success, the criterion of natural selection, works in many modes: Victory in battle may be one pathway, but cooperation, symbiosis, and mutual aid may also secure success in other times and contexts. In a famous passage, Darwin explained his concept of evolutionary struggle (*Origin of Species*, 1859, pp. 62–63):

I use this term in a large and metaphorical sense including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny. Two canine animals, in a time of dearth, may be truly said to struggle with each other which shall get food and live. But a plant on the edge of a desert is said to struggle for life against the drought. . . . As the mistletoe is disseminated by birds, its existence depends on birds; and it may metaphorically be said to struggle with other fruit-bearing plants, in order to tempt birds to devour and thus disseminate its seeds rather than those of other plants. In these

attributes of science, from obliging philosophers and sociologists, could weed out the feeling of human solidarity, deeply lodged in men's understanding and heart, because it has been nurtured by all our preceding evolution.

But the second reason is more enlightening, as a welcome empirical input from Kropotkin's own experience as a naturalist and an affirmation of Todes's intriguing thesis that the usual flow from ideology to interpretation of nature may sometimes be reversed, and that landscape can color social preference. As a young man, long before his conversion to political radicalism, Kropotkin spent five years in Siberia (1862–1866) just after Darwin published the *Origin of Species*. He went as a military officer, but his commission served as a convenient cover for his yearning to study the geology, geography, and zoology of Russia's vast interior. There, in the polar opposite to Darwin's tropical experiences, he dwelled in the environment least conducive to Malthus's vision. He observed a sparsely populated world, swept with frequent catastrophes that threatened the few species able to find a place in such bleakness. As a potential disciple of Darwin, he looked for competition, but rarely found any. Instead, he continually observed the benefits of mutual aid in coping with an exterior harshness that threatened all alike and could not be overcome by the analogues of warfare and boxing.

Kropotkin, in short, had a personal and empirical reason to look with favor upon cooperation as a natural force. He chose this theme as the opening paragraph for *Mutual Aid*:

Two aspects of animal life impressed me most during the journeys which I made in my youth in Eastern Siberia and Northern Manchuria. One of them was the extreme severity of the struggle for existence which most species of animals have to carry on against an inclement Nature; the enormous destruction of life which periodically results from natural agencies; and the consequent paucity of life over the vast territory which fell under my observation. And the other was, that even in those few spots where animal life teemed in abundance, I failed to find – although I was eagerly looking for it – that bitter struggle for the means of existence among animals

under the menace of otherwise succumbing in a world based upon mutual extermination.

Kropotkin did not deny the competitive form of struggle, but he argued that the cooperative style had been underemphasized and must balance or even predominate over competition in considering nature as a whole.

There is an immense amount of warfare and extermination going on amidst various species; there is, at the same time, as much, or perhaps even more, of mutual support, mutual aid, and mutual defense . . . Sociability is as much a law of nature as mutual struggle.

As Kropotkin cranked through his selected examples, and built up steam for his own preferences, he became more and more convinced that the cooperative style, leading to mutual aid, not only predominated in general but also characterized the most advanced creatures in any groups among insects, mammals among vertebrates. Mutual aid therefore becomes a more important principle than competition and slaughter:

If we . . . ask Nature: “who are the fittest: those who are continually at war with each other, or those who support one another?” we at once see that those animals which acquire habits of mutual aid are undoubtedly the fittest. They have more chances to survive, and they attain, in their respective classes, the highest development of intelligence and bodily organization.

If we ask why Kropotkin favored cooperation while most nineteenth-century Darwinians advocated competition as the predominant result of struggle in nature, two major reasons stand out. The first seems less interesting, as obvious under the slightly cynical but utterly realistic principle that true believers tend to read their social preferences into nature. Kropotkin, the anarchist who yearned to replace laws of central government with consensus of local communities, certainly hoped to locate a deep preference for mutual aid in the innermost evolutionary marrow of our being. Let mutual aid pervade nature and human cooperation becomes a simple instance of the law of life.

Neither the crushing powers of the centralized State nor the teachings of mutual hatred and pitiless struggle which came, adorned with the

several senses, which pass into each other, I use for convenience sake the general term of struggle for existence.

Yet, in another sense, Tolstoy’s complaint is not entirely unfounded. Darwin did present an encompassing, metaphorical definition of struggle, but his actual examples certainly favored bloody battle – “Nature, red in tooth and claw,” in a line from Tennyson so overquoted that it soon became a knee-jerk cliché for this view of life. Darwin based his theory of natural selection on the dismal view of Malthus that growth in population must outstrip food supply and lead to overt battle for dwindling resources. Moreover, Darwin maintained a limited but controlling view of ecology as a world stuffed full of competing species – so balanced and so crowded that a new form could only gain entry by literally pushing a former inhabitant out. Darwin expressed this view in a metaphor even more central to his general vision than the concept of struggle – the metaphor of the wedge. Nature, Darwin writes, is like a surface with 10,000 wedges hammered tightly in and filling all available space. A new species (represented as a wedge) can only gain entry into a community by driving itself into a tiny chink and forcing another wedge out. Success, in this vision, can only be achieved by direct takeover in overt competition.

Furthermore, Darwin’s own chief disciple, Thomas Henry Huxley, advanced this “gladiatorial” view of natural selection (his word) in a series of famous essays about ethics. Huxley maintained that the predominance of bloody battle defined nature’s way as nonmoral (not explicitly immoral, but surely unsuited as offering any guide to moral behavior).

From the point of view of the moralist the animal world is about on a level of a gladiator’s show. The creatures are fairly well treated, and set to fight – whereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given.

But Huxley then goes further. Any human society set up along these lines of nature will devolve into anarchy and misery – Hobbes’s brutal world of *bellum omnium contra omnes* (where *bellum* means “war,” not

beauty): the war of all against all. Therefore, the chief purpose of society must lie in mitigation of the struggle that defines nature's pathway. Study natural selection and do the opposite in human society:

But, in civilized society, the inevitable result of such obedience [to the law of bloody battle] is the re-establishment, in all its intensity, of that struggle for existence – the war of each against all – the mitigation or abolition of which was the chief end of social organization.

This apparent discordance between nature's way and any hope for human social decency has defined the major subject for debate about ethics and evolution ever since Darwin. Huxley's solution has won many supporters – nature is nasty and no guide to morality except, perhaps, as an indicator of what to avoid in human society. My own preference lies with a different solution based on taking Darwin's metaphorical view of struggle seriously (admittedly in the face of Darwin's own preference for gladiatorial examples) – nature is sometimes nasty, sometimes nice (really neither, since the human terms are so inappropriate). By presenting examples of all behaviors (under the metaphorical rubric of struggle), nature favors none and offers no guidelines. The facts of nature cannot provide moral guidance in any case.

But a third solution has been advocated by some thinkers who do wish to find a basis for morality in nature and evolution. Since few can detect much moral comfort in the gladiatorial interpretation, this third position must reformulate the way of nature. Darwin's words about the metaphorical character of struggle offer a promising starting point. One might argue that the gladiatorial examples have been over-sold and misrepresented as predominant. Perhaps cooperation and mutual aid are the more common results of struggle for existence. Perhaps communion rather than combat leads to greater reproductive success in most circumstances.

The most famous expression of this third solution may be found in *Mutual Aid*, published in 1902 by the Russian revolutionary anarchist Petr Kropotkin. (We must shed the old stereotype of anarchists as bearded bomb throwers furtively stalking about city streets at night. Kropotkin

snow, or pestilence. These forms of struggle between organism and environment are best waged by cooperation among members of the same species-by mutual aid. If the struggle for existence pits two lions against one zebra, then we shall witness a feline battle and an equine carnage. But if lions are struggling jointly against the harshness of an inanimate environment, then lighting will not remove the common enemy – while cooperation may overcome a peril beyond the power of any single individual to surmount.

Kropotkin therefore created a dichotomy within the general notion of struggle – two forms with opposite import: (1) organism against organism of the same species for limited resources, leading to competition; and (2) organism against environment, leading to cooperation.

No naturalist will doubt that the idea of a struggle for life carried on through organic nature is the greatest generalization of our century. Life is struggle; and in that struggle the fittest survive. But the answers to the questions “by which arms is the struggle chiefly carried on!” and “who are the fittest in the struggle!” will widely differ according to the importance given to the two different aspects of the struggle: the direct one, for food and safety among separate individuals, and the struggle which Darwin described as “metaphorical” – the struggle, very often collective, against adverse circumstances.

Darwin acknowledged that both forms existed, but his loyalty to Malthus and his vision of nature chock-full of species led him to emphasize the competitive aspect. Darwin's less sophisticated votaries then exalted the competitive view to near exclusivity, and heaped a social and moral meaning upon it as well.

They came to conceive of the animal world as a world of perpetual struggle among half-starved individuals, thirsting for one another's blood. They made modern literature resound with the war-cry of woe to the vanquished, as if it were the last word of modern biology. They raised the “pitiless” struggle for personal advantages to the height of a biological principle which man must submit to as well,

against body. An Englishman who had learned the ways of nature in the tropics was almost bound to view evolution differently from a Russian nurtured on tales of the Siberian wasteland.

For example, N. I. Danilevsky, an expert on fisheries and population dynamics, published a large, two-volume critique of Darwinism in 1885. He identified struggle for personal gain as the credo of a distinctly British “national type,” as contrasted with old Slavic values of collectivism. An English child, he writes, “boxes one on one, not in a group as we Russians like to spar.” Danilevsky viewed Darwinian competition as “a purely English doctrine” founded upon a line of British thought stretching from Hobbes through Adam Smith to Malthus. Natural selection, he wrote, is rooted in “the war of all against all, now termed the struggle for existence – Hobbes’ theory of politics; on competition – the economic theory of Adam Smith. . . . Malthus applied the very same principle to the problem of population. . . . Darwin extended both Malthus’ partial theory and the general theory of the political economists to the organic world.” (Quotes are from Todes’s article.)

When we turn to Kropotkin’s *Mutual Aid* in the light of Todes’s discoveries about Russian evolutionary thought, we must reverse the traditional view and interpret this work as mainstream Russian criticism, not personal crankiness. The central logic of Kropotkin’s argument is simple, straightforward, and largely cogent.

Kropotkin begins by acknowledging that struggle plays a central role in the lives of organisms and also provides the chief impetus for their evolution. But Kropotkin holds that struggle must not be viewed as a unitary phenomenon. It must be divided into two fundamentally different forms with contrary evolutionary meanings. We must recognize, first of all, the struggle of organism against organism for limited resources – the theme that Malthus imparted to Darwin and that Huxley described as gladiatorial. This form of direct struggle does lead to competition for personal benefit.

But a second form of struggle – the style that Darwin called metaphorical – pits organism against the harshness of surrounding physical environments, not against other members of the same species. Organisms must struggle to keep warm, to survive the sudden and unpredictable dangers of fire and storm, to persevere through harsh periods of drought,

was a genial man, almost saintly according to some, who promoted a vision of small communities setting their own standards by consensus for the benefit of all, thereby eliminating the need for most functions of a central government.) Kropotkin, a Russian nobleman, lived in English exile for political reasons. He wrote *Mutual Aid* (in English) as a direct response to the essay of Huxley quoted above, “The Struggle for Existence in Human Society,” published in *The Nineteenth Century*, in February 1888. Kropotkin responded to Huxley with a series of articles, also printed in *The Nineteenth Century* and eventually collected together as the book *Mutual Aid*.

As the title suggests, Kropotkin argues, in his cardinal premise, that the struggle for existence usually leads to mutual aid rather than combat as the chief criterion of evolutionary success. Human society must therefore build upon our natural inclinations (not reverse them, as Huxley held) in formulating a moral order that will bring both peace and prosperity to our species. In a series of chapters, Kropotkin tries to illustrate continuity between natural selection for mutual aid among animals and the basis for success in increasingly progressive human social organization. His five sequential chapters address mutual aid among animals, among savages, among barbarians, in the medieval city, and amongst ourselves.

I confess that I have always viewed Kropotkin as daftly idiosyncratic, if undeniably well meaning. He is always so presented in standard courses on evolutionary biology – as one of those soft and woolly thinkers who let hope and sentimentality get in the way of analytic toughness and a willingness to accept nature as she is, warts and all. After all, he was a man of strange politics and unworkable ideals, wrenched from the context of his youth, a stranger in a strange land. Moreover, his portrayal of Darwin so matched his social ideals (mutual aid naturally given as a product of evolution without need for central authority) that one could only see personal hope rather than scientific accuracy in his accounts. Kropotkin has long been on my list of potential topics for an essay (if only because I wanted to read his book, and not merely mouth the textbook interpretation), but I never proceeded because I could find no larger context than the man himself. Kooky intellects are interesting

as gossip, perhaps as psychology, but true idiosyncrasy provides the worst possible basis for generality.

But this situation changed for me in a flash when I read a very fine article in the latest issue of *Isis* (our leading professional journal in the history of science) by Daniel P. Todes: "Darwin's Malthusian Metaphor and Russian Evolutionary Thought, 1859–1917." I learned that the parochiality had been mine in my ignorance of Russian evolutionary thought, not Kropotkin's in his isolation in England. (I can read Russian, but only painfully, and with a dictionary – which means, for all practical purposes, that I can't read the language.) I knew that Darwin had become a hero of the Russian intelligentsia and had influenced academic life in Russia perhaps more than in any other country. But virtually none of this Russian work has ever been translated or even discussed in English literature. The ideas of this school are unknown to us; we do not even recognize the names of the major protagonists. I knew Kropotkin because he had published in English and lived in England, but I never understood that he represented a standard, well-developed Russian critique of Darwin, based on interesting reasons and coherent national traditions. Todes's article does not make Kropotkin more correct, but it does place his writing into a general context that demands our respect and produces substantial enlightenment. Kropotkin was part of a mainstream flowing in an unfamiliar direction, not an isolated little arroyo.

This Russian school of Darwinian critics, Todes argues, based its major premise upon a firm rejection of Malthus's claim that competition, in the gladiatorial mode, must dominate in an ever more crowded world, where population, growing geometrically, inevitably outstrips a food supply that can only increase arithmetically. Tolstoy, speaking for a consensus of his compatriots, branded Malthus as a "malicious mediocrity."

Todes finds a diverse set of reasons behind Russian hostility to Malthus. Political objections to the dog-eat-dog character of Western industrial competition arose from both ends of the Russian spectrum. Todes writes:

Radicals, who hoped to build a socialist society, saw Malthusianism as a reactionary current in bourgeois political economy. Conservatives, who hoped to preserve the communal virtues of tsarist Russia, saw it as an expression of the "British national type."

But Todes identifies a far more interesting reason in the immediate experience of Russia's land and natural history. We all have a tendency to spin universal theories from a limited domain of surrounding circumstance. Many geneticists read the entire world of evolution in the confines of a laboratory bottle filled with fruit flies. My own increasing dubiousness about universal adaptation arises in large part, no doubt, because I study a peculiar snail that varies so widely and capriciously across an apparently unvarying environment, rather than a bird in flight or some other marvel of natural design.

Russia is an immense country, under-populated by any nineteenth-century measure of its agricultural potential. Russia is also, over most of its area, a harsh land, where competition is more likely to pit organism against environment (as in Darwin's metaphorical struggle of a plant at the desert's edge) than organism against organism in direct and bloody battle. How could any Russian, with a strong feel for his own countryside, see Malthus's principle of overpopulation as a foundation for evolutionary theory? Todes writes:

It was foreign to their experience because, quite simply, Russia's huge land mass dwarfed its sparse population. For a Russian to see an inexorably increasing population inevitably straining potential supplies of food and space required quite a leap of imagination.

If these Russian critics could honestly tie their personal skepticism to the view from their own backyard, they could also recognize that Darwin's contrary enthusiasms might record the parochiality of his different surroundings, rather than a set of necessarily universal truths. Malthus makes a far better prophet in a crowded, industrial country professing an ideal of open competition in free markets. Moreover, the point has often been made that both Darwin and Alfred Russel Wallace independently developed the theory of natural selection after primary experience with natural history in the tropics. Both claimed inspiration from Malthus, again independently; but if fortune favors the prepared mind, then their tropical experience probably predisposed both men to read Malthus with resonance and approval. No other area on earth is so packed with species, and therefore so replete with competition of body