a distance of thirty miles.[1] And when a herd of vicunas was hotly pursued by hunters, H. A. Weddell saw more than once during his journey to Bolivia and Peru, the strong males covering the retreat of the herd and lagging behind in order to protect the retreat. As to facts of compassion with wounded comrades, they are continually mentioned by all field zoologists. Such facts are quite natural. Compassion is a necessary outcome of social life. But compassion also means a considerable advance in general intelligence and sensibility. It is the first step towards the development of higher moral sentiments. It is, in its turn, a powerful factor of further evolution.

If the views developed on the preceding pages are correct, the question necessarily arises, in how far are they consistent with the theory of struggle for life as it has been developed by Darwin, Wallace, and their followers? and I will now briefly answer this important question. First of all, 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 this 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. No one will deny that

[1] L. H. Morgan, *The American Beaver*, 1868, p. 272; *Descent of Man*, ch. iv.

there is, within each species, a certain amount of real competition for food—at least, at certain periods. But the question is, whether competition is carried on to the extent admitted by Darwin, or even by Wallace; and whether this competition has played, in the evolution of the animal kingdom, the part assigned to it.

The idea which permeates Darwin's work is certainly one of real competition going on within each animal group for food, safety, and possibility of leaving an offspring. He often speaks of regions being stocked with animal life to their full capacity, and from that overstocking he infers the necessity of competition. But when we look in his work for real proofs of that competition, we must confess that we do not find them sufficiently convincing. If we refer to the paragraph entitled "Struggle for Life most severe between Individuals and Varieties of the same Species," we find in it none of that wealth of proofs and illustrations which we are accustomed to find in whatever Darwin wrote. The struggle between individuals of the same species is not illustrated under that heading by even one single instance: it is taken as granted; and the competition between closely-allied animal species is illustrated by but five examples, out of which one, at least (relating to the two species of thrushes), now proves to be doubtful.[1] But when we look for more details in order

[1] One species of swallow is said to have caused the decrease of another swallow species in North America; the recent increase of the missel-thrush in Scotland has caused the decrease of the song-thrush; the brown rat has taken the place of the black rat in Europe; in Russia the small cockroach has everywhere driven before it its greater congener; and in Australia the imported hive-bee is rapidly exterminating the small stingless bee. Two other cases, but relative to domesticated animals, are mentioned in the preceding paragraph. While recalling these same facts, A. R. Wallace remarks in a footnote relative to the Scottish thrushes: "Prof. A. Newton, however,

to ascertain how far the decrease of one species was really occasioned by the increase of the other species, Darwin, with his usual fairness, tells us :

"We can dimly see why the competition should be most severe between allied forms which fill nearly the same place in nature ; but probably in no case could we precisely say why one species has been victorious over another in the great battle of life."

As to Wallace, who quotes the same facts under a slightly-modified heading ("Struggle for Life between closely-allied Animals and Plants *often* most severe"), he makes the following remark (italics are mine), which gives quite another aspect to the facts above quoted. He says :

"In *some* cases, no doubt, there is actual war between the two, the stronger killing the weaker ; *but this is by no means necessary*, and there may be cases in which the weaker species, physically, may prevail by its power of more rapid multiplication, its better withstanding vicissitudes of climate, or its greater cunning in escaping the attacks of common enemies."

In such cases what is described as competition may be no competition at all. One species succumbs, not because it is exterminated or starved out by the other species, but because it does not well accommodate itself to new conditions, which the other does. The term "struggle for life" is again used in its metaphorical sense, and may have no other. As to the real compe-

informs me that these species do not interfere in the way here stated" (*Darwinism*, p. 34). As to the brown rat, it is known that, owing to its amphibian habits, it usually stays in the lower parts of human dwellings (low cellars, sewers, etc.), as also on the banks of canals and rivers ; it also undertakes distant migrations in numberless bands. The black rat, on the contrary, prefers staying in our dwellings themselves, under the floor, as well as in our stables and barns. It thus is much more exposed to be exterminated by man ; and we cannot maintain, with any approach to certainty, that the black rat is being either exterminated or starved out by the brown rat and not by man.

tition between individuals of the same species, which is illustrated in another place by the cattle of South America during a period of drought, its value is impaired by its being taken from among domesticated animals. Bisons emigrate in like circumstances in order to avoid competition. However severe the struggle between plants—and this is amply proved—we cannot but repeat Wallace's remark to the effect that "plants live where they can," while animals have, to a great extent, the power of choice of their abode. So that we again are asking ourselves, To what extent does competition really exist within each animal species? Upon what is the assumption based?

The same remark must be made concerning the indirect argument in favour of a severe competition and struggle for life within each species, which may be derived from the "extermination of transitional varieties," so often mentioned by Darwin. It is known that for a long time Darwin was worried by the difficulty which he saw in the absence of a long chain of intermediate forms between closely-allied species, and that he found the solution of this difficulty in the supposed extermination of the intermediate forms.[1] However, an attentive reading of the different chapters in which Darwin and Wallace speak of this subject soon brings one to the conclusion that the word "extermination" does not mean real extermination;

[1] "But it may be urged that when several closely-allied species inhabit the same territory, we surely ought to find at the present time many transitional forms. . . . By my theory these allied species are descended from a common parent; and during the process of modification, each has become adapted to the conditions of life of its own region, and has supplanted and exterminated its original parent-form and all the transitional varieties between its past and present states" (*Origin of Species*, 6th ed. p. 134); also p. 137, 296 (all paragraph "On Extinction").

the same remark which Darwin made concerning his expression: "struggle for existence," evidently applies to the word "extermination" as well. It can by no means be understood in its direct sense, but must be taken "in its metaphoric sense."

If we start from the supposition that a given area is stocked with animals to its fullest capacity, and that a keen competition for the sheer means of existence is consequently going on between all the inhabitants—each animal being compelled to fight against all its congeners in order to get its daily food—then the appearance of a new and successful variety would certainly mean in many cases (though not always) the appearance of individuals which are enabled to seize more than their fair share of the means of existence; and the result would be that those individuals would starve both the parental form which does not possess the new variation and the intermediate forms which do not possess it in the same degree. It may be that at the outset, Darwin understood the appearance of new varieties under this aspect; at least, the frequent use of the word "extermination" conveys such an impression. But both he and Wallace knew Nature too well not to perceive that this is by no means the only possible and necessary course of affairs.

If the physical and the biological conditions of a given area, the extension of the area occupied by a given species, and the habits of all the members of the latter remained unchanged—then the sudden appearance of a new variety might mean the starving out and the extermination of all the individuals which were not endowed in a sufficient degree with the new feature by which the new variety is characterized. But such a combination of conditions is precisely what we do not

see in Nature. Each species is continually tending to enlarge its abode; migration to new abodes is the rule with the slow snail, as with the swift bird; physical changes are continually going on in every given area; and new varieties among animals consist in an immense number of cases—perhaps in the majority—not in the growth of new weapons for snatching the food from the mouth of its congeners—food is only one out of a hundred of various conditions of existence—but, as Wallace himself shows in a charming paragraph on the "divergence of characters" (*Darwinism*, p. 107), in forming new habits, moving to new abodes, and taking to new sorts of food. In all such cases there will be no extermination, even no competition—the new adaptation being *a relief from competition, if it ever existed;* and yet there will be, after a time, an absence of intermediate links, in consequence of a mere survival of those which are best fitted for the new conditions—as surely as under the hypothesis of extermination of the parental form. It hardly need be added that if we admit, with Spencer, all the Lamarckians, and Darwin himself, the modifying influence of the surroundings upon the species, there remains still less necessity for the extermination of the intermediate forms.

The importance of migration and of the consequent isolation of groups of animals, for the origin of new varieties and ultimately of new species, which was indicated by Moritz Wagner, was fully recognized by Darwin himself. Consequent researches have only accentuated the importance of this factor, and they have shown how the largeness of the area occupied by a given species—which Darwin considered with full reason so important for the appearance of new varieties—can be combined with the isolation of parts of the

species, in consequence of local geological changes, or of local barriers. It would be impossible to enter here into the discussion of this wide question, but a few remarks will do to illustrate the combined action of these agencies. It is known that portions of a given species will often take to a new sort of food. The squirrels, for instance, when there is a scarcity of cones in the larch forests, remove to the fir-tree forests, and this change of food has certain well-known physiological effects on the squirrels. If this change of habits does not last—if next year the cones are again plentiful in the dark larch woods—no new variety of squirrels will evidently arise from this cause. But if part of the wide area occupied by the squirrels begins to have its physical characters altered—in consequence of, let us say, a milder climate or desiccation, which both bring about an increase of the pine forests in proportion to the larch woods—and if some other conditions concur to induce the squirrels to dwell on the outskirts of the desiccating region—we shall have then a new variety, *i. e.* an incipient new species of squirrels, without there having been anything that would deserve the name of extermination among the squirrels. A larger proportion of squirrels of the new, better-adapted variety would survive every year, and the intermediate links would die *in the course of time*, without having been starved out by Malthusian competitors. This is exactly what we see going on during the great physical changes which are accomplished over large areas in Central Asia, owing to the desiccation which is going on there since the glacial period.

To take another example, it has been proved by geologists that the present wild horse (*Equus Przewalski*) has slowly been evolved during the later parts

of the Tertiary and the Quaternary period, but that during this succession of ages its ancestors were *not* confined to some given, limited area of the globe. They wandered over both the Old and New World, returning, in all probability, after a time to the pastures which they had, in the course of their migrations, formerly left.[1] Consequently, if we do not find now, in Asia, all the intermediate links between the present wild horse and its Asiatic Post-Tertiary ancestors, this does not mean at all that the intermediate links have been exterminated. No such extermination has ever taken place. No exceptional mortality may even have occurred among the ancestral species: the individuals which belonged to intermediate varieties and species have died in the usual course of events—often amidst plentiful food, and their remains were buried all over the globe.

In short, if we carefully consider this matter, and carefully re-read what Darwin himself wrote upon this subject, we see that if the word "extermination" be used at all in connection with transitional varieties, it must be used in its metaphoric sense. As to "competition," this expression, too, is continually used by Darwin (see, for instance, the paragraph "On Extinction") as an image, or as a way-of-speaking, rather than with the intention of conveying the idea of a real competition between two portions of the same species for the means of existence. At any rate, the absence of intermediate forms is no argument in favour of it.

In reality, the chief argument in favour of a keen

[1] According to Madame Marie Pavloff, who has made a special study of this subject, they migrated from Asia to Africa, stayed there some time, and returned next to Asia. Whether this double migration be confirmed or not, the fact of a former extension of the ancestor of our horse over Asia, Africa, and America is settled beyond doubt.

competition for the means of existence continually going on within every animal species is—to use Professor Geddes' expression—the "arithmetical argument" borrowed from Malthus.

But this argument does not prove it at all. We might as well take a number of villages in South-East Russia, the inhabitants of which enjoy plenty of food, but have no sanitary accommodation of any kind; and seeing that for the last eighty years the birth-rate was sixty in the thousand, while the population is now what it was eighty years ago, we might conclude that there has been a terrible competition between the inhabitants. But the truth is that from year to year the population remained stationary, for the simple reason that one-third of the new-born died before reaching their sixth month of life; one-half died within the next four years, and out of each hundred born, only seventeen or so reached the age of twenty. The new-comers went away before having grown to be competitors. It is evident that if such is the case with men, it is still more the case with animals. In the feathered world the destruction of the eggs goes on on such a tremendous scale that eggs are the chief food of several species in the early summer; not to say a word of the storms, the inundations which destroy nests by the million in America, and the sudden changes of weather which are fatal to the young mammals. Each storm, each inundation, each visit of a rat to a bird's nest, each sudden change of temperature, take away those competitors which appear so terrible in theory.

As to the facts of an extremely rapid increase of horses and cattle in America, of pigs and rabbits in New Zealand, and even of wild animals imported from

Europe (where their numbers are kept down by man, not by competition), they rather seem opposed to the theory of over-population. If horses and cattle could so rapidly multiply in America, it simply proved that, however numberless the buffaloes and other ruminants were at that time in the New World, its grass-eating population was far below what the prairies could maintain. If millions of intruders have found plenty of food without starving out the former population of the prairies, we must rather conclude that the Europeans found a *want* of grass-eaters in America, not an excess. And we have good reasons to believe that want of animal population is the natural state of things all over the world, with but a few temporary exceptions to the rule. The actual numbers of animals in a given region are determined, not by the highest feeding capacity of the region, but by what it is every year under the most unfavourable conditions. So that, for that reason alone, competition hardly can be a normal condition ; but other causes intervene as well to cut down the animal population below even that low standard. If we take the horses and cattle which are grazing all the winter through in the Steppes of Transbaikalia, we find them very lean and exhausted at the end of the winter. But they grow exhausted not because there is not enough food for all of them—the grass buried under a thin sheet of snow is everywhere in abundance—but because of the difficulty of getting it from beneath the snow, and this difficulty is the same for all horses alike. Besides, days of glazed frost are common in early spring, and if several such days come in succession the horses grow still more exhausted. But then comes a snow-storm, which compels the already weakened animals to remain without

any food for several days, and very great numbers of them die. The losses during the spring are so severe that if the season has been more inclement than usual they are even not repaired by the new breeds—the more so as *all* horses are exhausted, and the young foals are born in a weaker condition. The numbers of horses and cattle thus always remain beneath what they otherwise might be; all the year round there is food for five or ten times as many animals, and yet their population increases extremely slowly. But as soon as the Buriate owner makes ever so small a provision of hay in the steppe, and throws it open during days of glazed frost, or heavier snow-fall, he immediately sees the increase of his herd. Almost all free grass-eating animals and many rodents in Asia and America being in very much the same conditions, we can safely say that their numbers are *not* kept down by competition; that at no time of the year they can struggle for food, and that if they never reach anything approaching to over-population, the cause is in the climate, not in competition.

The importance of natural checks to over-multiplication, and especially their bearing upon the competition hypothesis, seems never to have been taken into due account. The checks, or rather some of them, are mentioned, but their action is seldom studied in detail. However, if we compare the action of the natural checks with that of competition, we must recognize at once that the latter sustains no comparison whatever with the other checks. Thus, Mr. Bates mentions the really astounding numbers of winged ants which are destroyed during their exodus. The dead or half-dead bodies of the formica de fuego (*Myrmica sævissima*) which had been blown into the

river during a gale "were heaped in a line an inch or two in height and breadth, the line continuing without interruption for miles at the edge of the water."[1] Myriads of ants are thus destroyed amidst a nature which might support a hundred times as many ants as are actually living. Dr. Altum, a German forester, who wrote a very interesting book about animals injurious to our forests, also gives many facts showing the immense importance of natural checks. He says that a succession of gales or cold and damp weather during the exodus of the pine-moth (*Bombyx pini*) destroy it to incredible amounts, and during the spring of 1871 all these moths disappeared at once, probably killed by a succession of cold nights.[2] Many like examples relative to various insects could be quoted from various parts of Europe. Dr. Altum also mentions the bird-enemies of the pine-moth, and the immense amount of its eggs destroyed by foxes; but he adds that the parasitic fungi which periodically infest it are a far more terrible enemy than any bird, because they destroy the moth over very large areas at once. As to various species of mice (*Mus sylvaticus*, *Arvicola arvalis*, and *A. agrestis*), the same author gives a long list of their enemies, but he remarks: "However, the most terrible enemies of mice are not other animals, but such sudden changes of weather as occur almost every year." Alternations of frost and warm weather destroy them in numberless quantities; "one single sudden change can reduce thousands of mice to the number of a few individuals." On the other side, a warm winter, or a winter which gradually

[1] *The Naturalist on the River Amazons*, ii. 85, 95.

[2] Dr. B. Altum, *Waldbeschädigungen durch Thiere und Gegenmittel* (Berlin, 1889), pp. 207 *seq.*

steps in, make them multiply in menacing proportions, notwithstanding every enemy; such was the case in 1876 and 1877.[1] Competition, in the case of mice, thus appears a quite trifling factor when compared with weather. Other facts to the same effect are also given as regards squirrels.

As to birds, it is well known how they suffer from sudden changes of weather. Late snow-storms are as destructive of bird-life on the English moors, as they are in Siberia; and Ch. Dixon saw the red grouse so pressed during some exceptionally severe winters, that they quitted the moors in numbers, "and we have then known them actually to be taken in the streets of Sheffield. Persistent wet," he adds, "is almost as fatal to them."

On the other side, the contagious diseases which continually visit most animal species destroy them in such numbers that the losses often cannot be repaired for many years, even with the most rapidly-multiplying animals. Thus, some sixty years ago, the *sousliks* suddenly disappeared in the neighbourhood of Sarepta, in South-Eastern Russia, in consequence of some epidemics; and for years no *sousliks* were seen in that neighbourhood. It took many years before they became as numerous as they formerly were.[2]

Like facts, all tending to reduce the importance given to competition, could be produced in numbers.[3] Of course, it might be replied, in Darwin's words, that nevertheless each organic being "at some period of its life, during some season of the year, during each generation or at intervals, has to struggle for life and

[1] Dr. B. Altum, *ut supra*, pp. 13 and 187.

[2] A. Becker in the *Bulletin de la Société des Naturalistes de Moscou*, 1889, p. 625.

[3] See Appendix V.

to suffer great destruction," and that the fittest survive during such periods of hard struggle for life. But if the evolution of the animal world were based exclusively, or even chiefly, upon the survival of the fittest during periods of calamities; if natural selection were limited in its action to periods of exceptional drought, or sudden changes of temperature, or inundations, retrogression would be the rule in the animal world. Those who survive a famine, or a severe epidemic of cholera, or small-pox, or diphtheria, such as we see them in uncivilized countries, are neither the strongest, nor the healthiest, nor the most intelligent. No progress could be based on those survivals—the less so as all survivors usually come out of the ordeal with an impaired health, like the Transbaikalian horses just mentioned, or the Arctic crews, or the garrison of a fortress which has been compelled to live for a few months on half rations, and comes out of its experience with a broken health, and subsequently shows a quite abnormal mortality. All that natural selection can do in times of calamities is to spare the individuals endowed with the greatest endurance for privations of all kinds. So it does among the Siberian horses and cattle. They *are* enduring; they can feed upon the Polar birch in case of need; they resist cold and hunger. But no Siberian horse is capable of carrying half the weight which a European horse carries with ease; no Siberian cow gives half the amount of milk given by a Jersey cow, and no natives of uncivilized countries can bear a comparison with Europeans. They may better endure hunger and cold, but their physical force is very far below that of a well-fed European, and their intellectual progress is despairingly slow. "Evil cannot be productive of good," as

Tchernyshevsky wrote in a remarkable essay upon Darwinism.[1]

Happily enough, competition is not the rule either in the animal world or in mankind. It is limited among animals to exceptional periods, and natural selection finds better fields for its activity. Better conditions are created by the *elimination of competition* by means of mutual aid and mutual support.[2] In the great struggle for life—for the greatest possible fulness and intensity of life with the least waste of energy—natural selection continually seeks out the ways precisely for avoiding competition as much as possible. The ants combine in nests and nations; they pile up their stores, they rear their cattle—and thus avoid competition; and natural selection picks out of the ants' family the species which know best how to avoid competition, with its unavoidably deleterious consequences. Most of our birds slowly move southwards as the winter comes, or gather in numberless societies and undertake long journeys—and thus avoid competition. Many rodents fall asleep when the time comes that competition should set in; while other rodents store food for the winter, and gather in large villages for obtaining the necessary protection when at work. The reindeer, when the lichens are dry in the interior of the continent, migrate towards the sea. Buffaloes cross an immense continent in order to find plenty of food. And the beavers, when they grow numerous on a

[1] *Russkaya Mysl*, Sept. 1888: "The Theory of Beneficency of Struggle for Life, being a Preface to various Treatises on Botanics, Zoology, and Human Life," by an Old Transformist.

[2] "One of the most frequent modes in which Natural Selection acts is, by adapting some individuals of a species to a somewhat different mode of life, whereby they are able to seize unappropriated places in Nature" (*Origin of Species*, p. 145)—in other words, to avoid competition.

river, divide into two parties, and go, the old ones down the river, and the young ones up the river—and avoid competition. And when animals can neither fall asleep, nor migrate, nor lay in stores, nor themselves grow their food like the ants, they do what the titmouse does, and what Wallace (*Darwinism*, ch. v.) has so charmingly described: they resort to new kinds of food—and thus, again, avoid competition.[1]

"Don't compete!—competition is always injurious to the species, and you have plenty of resources to avoid it!" That is the *tendency* of nature, not always realized in full, but always present. That is the watchword which comes to us from the bush, the forest, the river, the ocean. "Therefore combine—practise mutual aid! That is the surest means for giving to each and to all the greatest safety, the best guarantee of existence and progress, bodily, intellectual, and moral." That is what Nature teaches us; and that is what all those animals which have attained the highest position in their respective classes have done. That is also what man—the most primitive man—has been doing; and that is why man has reached the position upon which we stand now, as we shall see in the subsequent chapters devoted to mutual aid in human societies.

[1] See Appendix VI.