

# Petr Alekseevich Kropotkin (1842-1921)

Petr Kropotkin proposed the theory of Pleistocene ice age, alternative theories of evolution based on embryology, and he advocated anarchist and communist social doctrines in Europe during the nineteenth and twentieth centuries. He traveled in eastern Siberia and Manchuria from 1863 until 1867, and his subsequent publications about that area's geography became authoritative until the middle of the twentieth century. Kropotkin argued that his geographic and geologic observations in Asia, Finland, Sweden, and Canada, supported the theory of Pleistocene continental glaciation, often called the ice age. He was one of the first to study the ancient geography and climate of the Quaternary period, which spans from 2.5 million years ago until the present. Around the turn of the nineteenth century, Kropotkin offered what he said were complementary amendments to Charles Darwin's 1859 theory of evolution by natural selection. Kropotkin employed a variety of arguments from natural history, embryology, and geography to support his theory of mutual aid, which he argued was a positive mechanistic addition to the theory of evolution.

Kropotkin was born in Moscow, Russia, on 9 December 1842 to Ekaterina Nikolaevna Kropotkina and Prince Aleksei Petrovich Kropotkin. Petr's mother was the daughter of a Cossack general, and as his father was a general in the military and a descendent of the Rurik dynasty, the rulers of Russia prior to the Romanovs. Along with extensive landholdings, Kropotkin's family owned almost twelve-hundred serfs in three different Russian provinces. When Kropotkin was four-years-old, his mother died. In 1857, at the age of fifteen, Kropotkin was sent to a military preparatory school for the Russian elite called the Page Corps in St. Petersburg, Russia. His distinction in the corps, graduating at the top of his class, in addition to his hereditary aristocratic status, earned him a position as the personal liege to Czar Alexander II.

At the end of his time with the Page Corps in 1862, Kropotkin chose a commission in the Afar region of eastern Siberia with the Amur Cossack army, instead of a more comfortable position with the Czar. Kropotkin said that he chose this region because he thought it would afford him an active role in implementing the social reforms that were supposed to follow the Edict of Liberty. Russian Czar Alexander II had signed the Edict emancipating the serfs in March of 1861, according to the Russian Orthodox calendar. It was through Kropotkin's appointment as adjunct to General Kukel, the chief of staff to the governor-general of eastern Siberia, and the benefits of military logistical support and funding that came with it, that Kropotkin did much of his early geographical and zoological exploration and observation. Kropotkin received the Golden Medal of The Russian Geographic Society for his expeditions in 1864.

Kropotkin's work with the military culminated in the 1866 Olekma-Vitim expedition, which he led for the Russian Geographical Society, headquartered in St. Petersburg. After this expedition Kropotkin resigned from the military, and in 1867 he enrolled in the department of mathematics in St. Petersburg University in St. Petersburg. In 1868 the members of the Russian Geographical Society elected Kropotkin their secretary of physical geography.

Kropotkin, in support of his theory of Pleistocene glaciation, cited the smooth-peak topography of the Eastern Sayan Mountain Range. He particularly described the Tunkinskiye Goltsy Mountains, which he had visited and climbed in 1865. During his 1866 Olekma-Vitim expedition, he found further evidence for his theory of Pleistocene glaciation in the smoothed surfaces of the gneiss mountains surrounding the Olekma River basin, and in the presence of proximal striated boulders, which are rocks dragged by ice-floes along the ground, causing parallel scratches, or striations, on the rocks. The Russian Geographic Society sent Kropotkin to Finland and Sweden in 1871 to study glaciers and evidence of past glaciation in Europe. In 1873 Kropotkin's "Otchet ob Olekminski-

Vitimskoy ekspeditiisii" (Report of the Olekma-Vitim Expedition) was published, followed two years later by "Obshchyy ochherk orografii Vostochhony Sibiri" (A General Essay on the Orography of Eastern Siberia).

Kropotkin's ice age hypothesis explained otherwise anomalous phenomena, such as the large boulders found in the low relief plains of northern Europe, later called glacial erratics, and loess, a silt as fine as flour that suspends in water, giving it a characteristic milky opacity. Kropotkin argued that loess could only be formed by glacial erosion, which later researchers confirmed. Kropotkin presented about the ice age hypothesis to the Russian Geographical Society on 21 March 1874. He was arrested shortly after the presentation and was forced to finish his work on the subject in prison, in the fortress of St. Peter and St. Paul in St. Petersburg, Russia. The work was published by the RGS in 1876 as "Issledovanie o lednikovom periode" (An Investigation of the Glacial Period). The Russian Geographic Society published the article as a monograph while Kropotkin remained in prison.

While in St. Petersburg from 1867 until 1874, Kropotkin had participated in anarchist political groups, including the Chaikovsky Circle. Kropotkin said that he became disillusioned about the prospects for rational reform of czarist Russia after witnessing the corrupt bureaucracy in Afar, the wrath of Alexander II after the Polish insurrection of 1863, and the arrests weavers and students in 1869 who had agitated for workers' rights. Kropotkin said that he became an anarchist-communist for these reasons. In March of 1874 Kropotkin was arrested and taken to the fortress of St. Peter and St. Paul, where other political dissidents such as Princess Tarakanova, the writer Fyodor Dostoyevsky, and the anarchist Mikhail Bakunin, had all been recently imprisoned.

In prison Kropotkin became deathly ill with rheumatism and was transferred after twenty-one months from his cell in the fortress to a military hospital for care. On 30 June 1876, under less guard than he had been at the fortress, and with help from local anarchists, Kropotkin escaped his hospital prison, left Russia, and went into exile. He fled across the Finnish border, stopped briefly in Edinburgh, Scotland, and then quickly went to London, England. His life from then on was marked by constant travel interspersed with occasional imprisonment. From London, Kropotkin went to Switzerland to participate in more revolutionary activities. In 1881, he was expelled from Switzerland for approving of the assassination of Alexander II, and he returned to London. From London he went to France to engage in more radical political activity. After his arrival in 1883, he was arrested for his anarchist advocacy. He spent the next three years in French custody, in Lyons and in Clairvaux. After his release in 1886 Kropotkin moved back to London where he stayed until the 1917 February Revolution in Russia, upon which time he returned to his homeland.

During his time outside of Russia, Kropotkin continued to publish about the geography of Europe and Asia. He assisted Jacques Élisée Reclus with his book *Nouvelle Géographie Universelle: La Terre et les Hommes* (A New Universal Geography: Earth and Men), published in 1866. In 1892, when Thomas Huxley retired from the job, Kropotkin became the editor of the "Recent Science" section of *The Nineteenth Century and After* (hereafter *The Nineteenth Century*), a literary magazine published in the UK.

In 1893 Kropotkin became a member of the British Association for the Advancement of Science. He continued to work on theories of a quaternary ice age and in 1897 went to Canada to to work on the Americas portion of the theory. In 1896 he was offered a chair in geology at Cambridge University in Cambridge, England, contingent upon his discontinuing political activism. He declined the post.

Many of Kropotkin's publications on evolution and inheritance appeared as a series of essays printed in *The Nineteenth Century* written from 1890 through 1896, in reply to Thomas Huxley's 1888 piece "The Struggle for Existence." Kropotkin compiled five of those essays and published them in October of 1902 as a book titled *Mutual Aid: A Factor of Evolution*. Kropotkin earlier had read Darwin's 1859 *On the Origin of Species* while a liege to Alexander II, as well as during his travels in Siberia and Manchuria from 1862 through 1867. However, the correspondence between Kropotkin and his brother indicate that both men adopted theories of evolution prior to reading Darwin's book.

Kropotkin's defended a theory of heritability that postulated the adaptive effects of the direct action of the environment on organisms. Lamarckism, named after the evolutionist Jean Baptiste Lamarck who proposed the hypothesis in the early nineteenth century, is the doctrine that offspring inherit

the traits that their parents acquired during their lifetimes. This theory is often called the inheritance of acquired characteristics. Kropotkin rejected the claim that Lamarckism was incompatible with Darwinism.

In 1798 Thomas Malthus, in England, had published *An Essay on the Principles of Population*, which detailed his claims on the problem of resource scarcity with respect to population growth. Malthus's essay had influenced evolutionary theory since Darwin's 1859 *On The Origin of Species*, in which Malthus is favorably cited. Kropotkin, recalling his zoological observations in eastern Siberia, opposed the widespread acceptance of Malthus's theory among western evolutionists, arguing that the Malthus's theory did not accurately describe the environmental conditions in which animals found themselves. Contrary to Malthus and Darwin, Kropotkin said that over-population, with the consequence of fierce in-group competition, was not the primary adaptive problem that animals in eastern Siberia faced. For Kropotkin, the weather of eastern Siberia was the primary adaptive problem animals faced. So the theory that evolution was a kind of *bellum omnium contra omnes* (war of all against all), supported by the Malthusian individualist conception of evolution, was for Kropotkin not only morally undesirable, but also empirically inaccurate.

In the twentieth century, historian of science Stephen J. Gould argued that Kropotkin's claims about the role and power of mutual aid came from his experience in northern climes, where the harsh environment forces populations of animals to cooperate for survival. Gould and others historians of science likened Kropotkin's travels in Siberia to Darwin's Beagle voyage in terms of the impact the explorations had on the men's perspectives. Siberia's climates are fierce, and to Kropotkin individuals and groups were better fit if they cooperated, putting solidarity rather than competition at the center of natural selection theory.

In his book *Mutual Aid*, Kropotkin noted that Darwin suggested three forms of the struggle for existence: between individuals within a population of individuals similar to each other (intraspecies conflict), between individuals of diverse populations (interspecies conflict), and between an individual and its environmental circumstances, which Kropotkin called the direct action of the environment on evolution. Kropotkin argued that the latter two forms of conflict provided evolutionary pressure towards cooperation among individual within groups, and that they would select against an exclusively individualistic competitor. Kropotkin notes that individuals of the same population in nature support each other against adverse environmental conditions, conditions that are almost always widespread geographically. Because of this general ubiquity of environmental conditions, large groups, possibly even whole species, faced similar adaptive challenges. To meet those challenges, groups find in-group cooperation to be the best strategy to survive and reproduce.

Citing the second volume of Darwin's *Life and Letters*, specifically a letter from Darwin to Joseph D. Hooker in 1860, Kropotkin suggested that Darwin weakened the claim that natural selection was the only cause of evolution. Kropotkin aimed to show that the direct action of the environment on evolution was a process of equal theoretical status as natural selection between individuals, and that this direct action of the environment undermined the individualism inherent in natural selection.

In the 1910 essay "The Theory of Evolution and Mutual Aid," Kropotkin argued that the developmental sensitivity of an organism or group of organisms to the environment generates traits that are adapted to their current environment. If these adaptive traits enhance an organism's fitness, they are preserved in the population by natural selection. Later scientists called these traits exaptations. An exaptation is a trait that either evolved for some function and was later co-opted by natural selection for some other function, or a trait that evolved for no function, a non-adaptation, and was co-opted by natural selection for a function. A common example of the first form of exaptation is the feathers on birds, which some scientists argue were adaptations for heat-regulation and latter were co-opted by natural selection for flight. A common example of the second form of exaptation is the use of the umbilicus of snails, a geometric feature of shell growth as a tube expands around an axis, that the individuals of some species use as a brood chamber for their offspring.

In later publications, Kropotkin focused on variation, inheritance, and embryology to develop an argument for his theory of the direct action of the environment on processes of biological inheritance. In these publications Kropotkin argued against August Weismann of Germany, and against Weismann's theory of germ-plasm, which stated that the material that offspring inherit from their

parents is only in germ cells, and not in other body cells. Kropotkin argued that Weismann used inappropriate methods to justify his theory of inheritance and to reject Lamarckism. For example, Kropotkin objected to Weismann's method of removing the tails of mice, breeding them, and checking to see if their offspring lacked tails, because the method elided the fact that mice don't have the potential to develop without tails. Kropotkin argued that a sophisticated synthesis of Lamarckism and Darwinism, such as that provided by Marcus Hartog in Ireland, emphasized that the parts of organisms were developmental variable and so they could develop differently in different environments. Therefore, as cutting off the tails of mice was not one of the developmental options for mice, Weismann's experiments said nothing about how the environment interacts with developing organisms to alter the traits that are selected for and are inherited by offspring.

In order to develop this synthesis between Lamarck's theory of heredity and the theory of evolution by natural selection, Kropotkin appealed to contemporary embryological research. Kropotkin cited the work of Hartog as an example of embryological work that supported his claims. Hartog claimed that a majority of biologists dogmatically adopted the theory that no acquired characters could be transmitted from parents to offspring, and he provided what Kropotkin took to be convincing arguments against that theory and in favor of Neo-Lamarckism. Kropotkin also suggested that the work of US scientists John T. Gulick on the snails of Sandwich Island and Alpheus Hyatt on fossil Cephalopodes supported his position.

Kropotkin considered himself to have made at least four important contributions to evolutionary thinking. First, he said he had rid Darwin's theory of evolution by natural selection of its Malthusian character with the geographical and zoological evidence presented in *Mutual Aid*. Second, he claimed to have shown the effects of the direct action of the environment on biological inheritance. Third, he said he had shown that the effects of the environment provided an adaptive direction to evolution and thus undermined the theory of random mutations. Fourth, he claimed that populations of organisms within a species that were isolated from each other evolved into new species not only when they could no longer interbreed, but also when geography isolated them from each other.

In 1912, the Royal Geographical Society in London, England, celebrated Kropotkin for his work on geography and geology and for his work on the theory of evolution, on the occasion of his seventieth birthday. After his return to Russia in 1917, Kropotkin worked on a book about ethics. In 1921, after four years in Russia, Kropotkin died in poverty, isolated from the political and scientific world in Dmitrov, a town outside of Moscow. This end of his life is recounted by his friend and anarchist colleague, Emma Goldman, in her autobiography *Living My Life*. Kropotkin's final book *Ethics: Origin and Development* was published posthumously in 1924.

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