Imperial Ecology

Environmental Order in the British Empire, 1895–1945

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Harvard University Press
Cambridge, Massachusetts, London, England | 2001

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The Oxford School of Imperial Ecology

The success of *Aims and Methods in the Study of Vegetation* brought Arthur Tansley in 1927 to the prestigious Sherardian Professorship in botany at Magdalen College, Oxford University. His appointment was not accidental; ecology was much in vogue among biologists at Oxford, who thought it could provide a new and better way of ordering nature, society, and knowledge in an empire shattered by the First World War. This chapter will discuss in depth this ecological research from the eve of the war to Smuts's lectures on holism at Oxford in November 1929. How did a new generation of postwar ecologists at that university push ecology beyond botany into forestry, zoology, and finally sociology? An ecologist has rightly pointed out that ecology in the 1920s "was a botanical science primarily, handicapped by a certain restriction of vision associated with those whose eyes are focused on the sward."[1] How did ecologists come to broaden their vision?

I have labeled this second generation of ecologists Tansley met and engaged with the *Oxford school of imperial ecology* because they shared the same aims and methods in their research. What brought the Oxford undergraduate and graduate students as well as scholars from a whole range of disciplines into one group of ecologists was a series of university-based expeditions. Indeed, I have not been able to find one Oxford student or scholar in ecology at the time who did not participate in an expedition, so I will focus on this obviously important mode of research. In particular, I examine the ecological research in forestry by Robert Scott Troup and Ray Bourne, the emerging field of animal ecology in the work of Charles Elton and Julian Huxley, and the subsequent writings on human ecology by Alexander Morris Carr-Saunders and H. G. Wells. These scientists (including Tansley) form the core of the Oxford school of imperial ecology, with the notable exception of Wells, who engaged with Oxford scholars on a more independent basis by popularizing their research through easy readers and science fiction.

The enlargement of ecological research beyond botany was achieved by

means of three aims and methods that distinguish the Oxford ecologists from other ecological programs, such as that found in South Africa.

First, the Oxford aim was to establish a new environmental order through cannibalization[2] of what they saw as an old-fashioned natural history tradition by synthesizing such research into ecological charts of relations. The ecologists turned what was conceived of as an aim in itself by natural historians (describing and classifying new species) into a means of achieving a higher ecological aim, namely, an overview of how species relate to each other in an environment. The ecologists thus placed themselves above natural historians in the hierarchy of knowledge. The chief reason that ecologists were able to synthesize natural history into charts and maps of interrelations was their aerial perspective on nature. Such a perspective was already apparent in earlier ecological works, such as Warming's research on the Danish beaches, Oliver's ecological view of the French seashore, and Clements's investigations of sand dunes (one only needs to be about six feet above the ground to get an overview of these environments). Tansley's and Bews's work on the ecology of altitudes in the Swiss and Natal mountains provide other examples of a bird's-eye view on a landscape. Smuts also thought in terms of mountains and vistas. What distinguished and enforced the aerial perspective at Oxford was the introduction of airplanes as tools for ecological research. Such usage moved ecologists from a local to a global perspective on the world—from local sand dune and mountain perspectives to global views provided by avant-garde aviation technology. The real impact of aviation technology on ecology arrived in the 1930s, but in this chapter I will trace the emerging globalization of ecology offered by aviation back to its earliest sources, and locate the political and cultural circumstances that shaped the development of this method in ecological research.

Second, Oxford ecologists tried to establish a new social order according to the aims and values of their patrons within various British colonial agencies and commercial companies, who saw ecology as a means to enlarge and improve the management of the empire. The development of airplanes during the First World War made it possible to carry out ecological surveys on a hitherto unknown scale, and it was precisely this grand overview of natural resources that the patrons of ecology desired as an administrative management tool for the environment. Elton's research serves as a prime example, for his natural economy of animals carefully reflects British commercial interests in territorial exploration and exploitation. His research on Bear Island and the Spitsbergen archipelago can be understood in the context of the mining industry, and his research for the Hudson's Bay Company can be read in the context of the economy of fur trading in London. It was Elton's idea that hu-

man ecology could be an extension of animal ecology, which enabled him to connect nature's economy with the commercial economy of his patrons. This argument leads to an analysis of Elton's concept of ecological zones of interrelations among species, including human technological, political, and scientific activity.

Third, the aim of the Oxford ecologists was to establish a new order of knowledge to manage academic disciplines. The establishment of an ecological order of nature and society soon transformed into a new order of truth-statements about nature, in other words an ecological order of knowledge. Through the work at Oxford, ecology became a scientific management tool meant to develop effective social systems not only for society at large but also for the administration of knowledge within a university. Elton's animal ecology again serves as a focal point, and I argue that his ecological order of animals and human beings implied a new administrative order for the sciences.

The first chapter of this book discussed how Tansley's ecological approach was based on Freudian psychology and how he applied this to empirical research in botany at the request of his imperial and colonial patrons. Although he had a firm interest in social welfare, he had yet to develop a convincing theory of how social psychology related to vegetation ecology and vice versa. He had so far based his arguments on sweeping and methodologically shaky analogies.[3] This would all change at Oxford, where his theoretical discussions would mature into his famous ecosystem theory, spelling out the relations among plants, animals, and human beings. There were three aspects in particular of the Oxford community that captivated Tansley's interests on the road to his ecosystem theory: the debates at the Magdalen Philosophy Club, the system approach to forestry management among his colleagues at the Imperial Forestry Institute, and finally the emergence of animal and human ecology at the Department of Zoology.

Tansley's numerous discussions of social psychology at the Magdalen Philosophy Club will be the topic of the next chapter. These debates were at the heart of his dispute with John Phillips about the value of a holistic approach to ecology. This chapter focuses on the latter two issues—first situating the meaning of the word "system" in the forestry research of Troup and Bourne, and next discussing the broadening of ecological reasoning into animal and human ecology. The emerging fields of animal and human ecology were crucial to Tansley, the botanist, who now could develop a more comprehensive theory about ecology at large. The writings of Carr-Saunders, Huxley, and Elton established this broad ecology that could successfully compete with the idealistic holism of South African ecologists.

Tansley's Program for Imperial Ecology

It was probably Herbert Warren, the president of Magdalen College and curator of the Botanic Garden, who asked Tansley to apply for the Sherardian Professorship in January 1927, a position that implied responsibility for chairing the department. The election of Tansley was not a controversial decision this time. Tansley's antagonist Isaac Balfour was no longer on the Board of Electors (he had died in 1923), and Tansley's old "Bolshevik" friend Frederick Keeble had resigned his professorship to become an advisor to Imperial Chemical Industries. When the chair suddenly became vacant, it was only natural to elect a candidate who had been perhaps unjustly rejected back in 1920. Tansley recollects that he was considering becoming a professional psychoanalyst, and that he was in great doubt whether he should accept the position.[4] Eventually he decided to go to Oxford and entered one of the most productive phases of his life. As a professor, he would realize some of those educational reforms in botanical research that he had propagandized in the 1917 manifesto.

The prime patron of botanical research at Oxford before Tansley's arrival was his old friend and supporter George Claridge Druce, a field curator in the Botanic Garden and one of Oxford's *nouveau riche* who through his pharmacy had become one of the richest people in town. A former mayor of Oxford and a Freemason, he was well known in various scientific and botanical societies, including the influential Ashmolean Natural History Society of Oxfordshire. Druce's enormous social network was probably an important element in securing Tansley's access to the secretive Oxford political and social milieu. His scrapbook of hundreds of greeting cards from his eightieth birthday in 1930 shows a social network far beyond what one could normally expect for a botanical curator, including royalty and nobility from all over the empire.[5] Druce became a true fan of Tansley's work at Oxford, donating his house, library, herbaria, and £12,000 to various botanical research projects at Oxford upon his death in 1932, an event that helped to secure a place for ecological research at the university.

Yet Druce was the very incarnation of an old-fashioned natural historian. He and his fellow curators at the herbarium were definitely within the older generation compared to Tansley, who then was fifty-five years old. Some members of the department had retired in 1926 or were expected to retire within a couple of years, and the curatorship of the Botanic Garden consisted until 1932 primarily of retirees.[6] Tansley's arrival—in a powerful Sunbeam two-seater[7]—was thus clearly a sign of a new generation of botanists coming to Oxford.

In his inaugural lecture in November 1927, Tansley made it clear that he intended to transform botanical research at Oxford entirely along the new promising lines of imperial ecology. It was about time to get rid of the outdated "sterile academicism" of laboratory biology, a scientific approach that Tansley in unusually harsh words described as "so-called research," "alien to the true spirit of investigation," and "definitely not worth publishing at all," because of its reputation as being detached from social responsibility.[8] He suggested in its place a broader agenda: "The Government has now given us a clear lead . . . [t]he practical aim which we must set before ourselves [is] to conserve and to develop the resources of the Empire."[9] The network of patronage he had nurtured through the Imperial Botanical Conference and proposed in *Aims and Methods in the Study of Vegetation* was now ready to wed itself to ecology.

Ecologists, Tansley argued, should focus their efforts on the colonies because of job opportunities. He could proudly report to the Oxford dons that "the demand is now much larger than the supply" for ecologists throughout the empire, and that the Colonial Office was offering "Colonial Agricultural Scholarships" and other "monetary support" to botanical research that had "a clear and unequivocal public utility."[10] It was urgent for the department to develop imperial ecology: most economic support would come from the colonies, and most future posts in agriculture, forestry physiology, mycology, ecology, and pastoral science would emerge in the colonial administration. This administration needed people with flexible abilities and interdisciplinary knowledge. The most common task for such ecological entrepreneurs throughout the empire was to transform forests to farmland, deserts to grassland, thus creating environments fit for various colonial interest groups. Tansley thus stressed the importance of interaction and cooperation with foresters, agriculturists, and zoologists in order to educate students with the ability to construct such environments. Ecology was an ideal science for such activity because its main concern was precisely transformation or succession of landscapes. Tansley also envisioned an academic network that included forestry, agriculture, and zoology under the wings of ecology.

Tansley's program for imperial ecology sums up the core program of the Oxford school in ecology. It should thus be seen in the context of other ecological research at the university, especially in the light of research at the Imperial Forestry Institute, where Troup worked out a new systems approach to forestry, and alongside the Department of Zoology, where Elton launched his animal population ecology.

The New Management System for Imperial Forestry

Tansley and his colleagues at the Department of Botany worked closely with the staff at the Imperial Forestry Institute. The history of forestry research at Oxford goes back to the opening of the School of Forestry in 1905. The school's main task was to train forest officers for colonial agencies (especially for the Indian Forest Service), and most students were required to do research abroad. The Imperial Forestry Institute was established in 1924 to secure higher education in forestry, and its aim was to reach beyond forestry in India towards a science that could secure the needs of the empire.[11] The institute was to be associated with a new, more responsible forestry. When, for example, the Prince of Wales spoke to the Empire Forestry Association in 1926, he allied the higher forestry education at Oxford with "a wonderful change" away from "the time not very long ago when the British race had the unenviable distinction of being the most ruthless destroyer of forests in the world."[12] New forestry researchers saw themselves as professional foresters; instead of repeating past mistakes they would develop progressive schemes for responsible forest management.

Robert Troup, the director of both the institute and the School of Forestry,[13] was three years younger than Tansley, but had an equally impressive list of publications, which consisted mainly of descriptions and suggestions for economic exploration of forests throughout the empire. To avoid mismanagement he favored broader state control and planning at the expense of what he regarded as irresponsible private exploitation of forest resources.

Troup's 1928 textbook, *Silvicultural Systems,* lays out his management approach, and offers a scientific context for Tansley's research. Students read this book in connection with Tansley's lectures in botany and forestry ecology.[14] The book points to how previous depletion of forests "in many parts of the world gives genuine cause for alarm," and pleads for forest conservation and protection. Troup then describes the systems that professional management must use to solve the problem by combining both protection and utilization of forests:

> A *silvicultural system* may be defined as the process by which the crops constituting a forest are tended, removed, and replaced by new crops, resulting in the production of woods of a distinctive form . . . [It] embodies three main ideas: (1) the method of regeneration of the individual crops constituting the forest, (2) the form of crop produced, and (3) the orderly arrangement of the crops over the forest as a whole, with special reference to silvicultural and protective considerations and the economic utilization of the produce.[15]

The rest of the book is devoted to a discussion of the suitability of various systems for different types of environments, with a focus on how properly to synchronize economic and silvicultural systems to the best advantage of the long-term interests of society.

Although Troup uses the ecological terminology of succession and climax extensively, he does not discuss the ecological relations of forest vegetation to other plants and animals but restricts his topic to forestry. One reviewer thus found the book to be a bit too narrow, though the general reception was favorable and the book immediately reached the status of a standard reference book.[16] Its main relevance to the history of ecology is as a contextual work for Tansley's ecosystem theory.[17]

An Aerial View: Aviation Technology and Ecology

One of Troup's many duties was to edit the Oxford Forestry Memoirs, a series of books addressing forestry issues in the empire (including Chipp's doctoral dissertation on synecology in Gold Coast forests). Among the memoirs at the Plant Sciences Library at Oxford the pages of one volume are particularly well-worn: *Aerial Survey in Relation to the Economic Development of the New Countries* (1928), by Ray Bourne.[18] Bourne was a lecturer at the Forestry Institute and from 1923 had been in charge of following developments in aerial surveys, relating them to methods of reconnaissance in forests. His importance to the history of ecology derives from his promotion of aerial photography as a research tool among ecologists at Oxford.

The art of distinguishing culture from nature in aerial photos stems from techniques developed by John Moore Brabazon, who as a captain used spy pictures taken from an aircraft to identify German trenches and fortifications during the First World War. After the war Brabazon and his pilots formed a company called Aerofilms Limited to develop their techniques through commercial air photography, a firm which by 1928 was transformed into The Aircraft Operating Company Limited (a leading firm for aerial surveys and photography well into the 1950s).[19]

It is important to recall that civil aviation in England during the inter-war period was imbedded within a larger culture of extreme enthusiasm for the airplane; the airplane was a symbol of avant-garde technology and an icon of imperial power that captured the dreams of a whole generation.[20] Aeronautical research was a high-status activity, supported by the world's largest aircraft industry, and the Oxford community was no less enthusiastic about the novel and breathtaking technology.

One enthusiast was Osbert Stanhope Crawford, who thought aviation marked a new beginning in archeological exploration, and used aerial photography to unveil the patterns of ancient walls and the remains of forgotten Roman buildings. He served as a map-printer and photographer for Brabazon during the war, from whom he learned the art of distinguishing barbed wire from bushes and hideouts from grassland. This knowledge served Crawford well in his postwar work, locating ancient ruins often buried under layers of soil and vegetation. Tansley would later in life comment on the lack of reference to vegetation in Crawford's descriptions of landscapes.[21] The two authors saw different phenomena in aerial photos; whereas Crawford saw a landscape embedded in culture, Tansley recognized a landscape formed by forces of nature.

The forestry lecturer Ray Bourne was an old buddy of Crawford from their years together at New College, Oxford, and it is likely that he followed his friend's series of archeological publications with great interest.[22] Bourne's concern was not to locate cultural artifacts in a landscape, but to distinguish types of vegetation and their various levels of ecological succession. In 1928 he was invited by the Aircraft Operating Company to join them in an expedition to Northern Rhodesia. Its commission was to conduct air reconnaissance and survey for the Rhodesian Congo Border Concession. The purpose of the aerial photos was to establish an exact border between the colonies, and the estimation of ecological resources was a crucial part of these negotiations.

The words "rapidity, economy and accuracy" are repeated like a mantra throughout Bourne's report from the expedition.[23] The airplane's speed meant they could cover large and often unexplored territories. Patrons were thankful for the low cost of the research, thanks to relatively moderate needs of personnel and equipment. Bourne concluded that "these surveys might prove to be one of the most profitable investments that the Empire could make in the immediate future."[24] The convincing maps Bourne produced from his observations by the means of aerial photography far surpassed other methods. Former forest surveyors, he claimed, were neither rapid, inexpensive, nor accurate. They could not "see the wood for the trees," whereas aerial surveying gave the forest reconnoiterer the much-desired overview.[25]

Another central theme that emerges on almost every page of Bourne's book is the importance of cooperation between politicians, administration, aviation technologists, and scientists throughout their shared fields of interests. Ecology was especially suitable for such cooperation because by definition it was a science about interrelations, and the cry for multidisciplinary research was thus implicitly a cry for the empowerment of ecologists. Bourne pointed out that the maps generated by ecologists through aerial surveys should ideally unveil layers containing a wide variety of information: geological and mineral zones, climatic zones correlated with the spreading of the

tsetse-fly, zones of forests and other vegetation, and finally various types of soil. Bourne gathered some of this information by collecting soil samples and geological information along a dirt road going through the area he had flown over. Information about climatic zones he borrowed from other scientific sources, but most of the material on vegetation he inferred by studying the photos. The final result was a colorful interdisciplinary map filled with zones of various plants, soils, waters, minerals, and geological formations.

The aim of the survey of the borderland between Northern Rhodesia and the Belgian Congo was to get an overview of all the natural resources so that the final border could be fair to both parties. Bourne thus coordinated his research so that the economy of nature could serve the economy of the colonies. After unveiling all the scientific results he concluded, "With this information before them the local government should be, for the first time, in a position to view in real perspective their present and future problems. Moreover, *they would have a scientific foundation on which to build*."[26] The issues at stake were the coordination of the political border with natural zones, recommendations for sound settlement and commercial zones, as well as recommendations for road and railway building. In such scientific-political negotiations native cultivation tends, as Bourne explains, "to obscure the issue."[27] A shared assumption among both ecologists and governmental agencies was that the activities of black people obscured an untouched nature. This attitude mirrored the social policy of settlement, colonization, and civilization. The shared narrative or social resonance between ecologists and the colonial government did not include natives, who had to be either ignored or naturalized to be scientifically and politically manageable.

The final layer of cooperation was between Bourne, the ecologist, and the Aircraft Operating Company, for whom the survey was a vehicle for improving techniques. The grassy vegetation zones were to them emergency landing fields for planes whose engines all too often failed in the air. (Their pilot Cochoran Patrick died because he did not locate a grassy glade soon enough.) The ecologists stretched the pilots' abilities with their demand for successive overlapping series of pictures taken from the exact same altitude in parallel flight routes. The technicians and the ecologists exchanged knowledge when they established ecological zones at the Aircraft Operating Company's offices in London, where they carried out the complicated procedure of mosaic assemblage of photos.[28]

In sum, ecological zones defined through photos of vegetation landscapes in Northern Rhodesia exhibit a trading of knowledge among scientists, politicians, and technicians. The language used in this exchange was the language of visual communication, through the interpretation of photos and the creation of maps. Such images created different challenges for different audiences; the scientists saw types of vegetation, the government agency thought

in terms of settlement and colonization, and the technicians focused on improvement of apparatus for greater efficiency and accuracy. The ecologist was the mediator in the midst of these negotiations, with the master perspective from above.

The immediate reception of Bourne's *Aerial Survey* was mixed. A forestry reviewer thought it was "an interesting and arresting record."[29] Though he recognized aerial photography as a promising tool for drawing ecological connections between different species and habitats as well as between disciplines, he did not fully appreciate that it was a radical break with previous forestry traditions. On the other hand, the notice in the *Journal of Ecology* (probably written by Tansley) was very positive, and predicted "a great future for this new method of survey" because of the cost-effectiveness of such ecological research.[30] The ability to transgress traditional boundaries in science and see the environment as a whole was intriguing to both Tansley and Troup, since their research policy focused on scientific collaboration. Bourne credited both of them, and emphasized that "to approach the problem [of aerial surveying] from an ecological standpoint" was not only cost- and time-effective; as an overreaching discipline ecology was made for aerial surveying of forests and other botanical habitats.[31]

The press was excited about the book. The Aeronautical Correspondent in the *Times* noted in an enthusiastic review that the cost of aerial forest surveying was only £1 per square mile in an area of 200,000 to 300,000 square miles. Air surveys would thus "repay in a hundred ways the capital expenditure involved."[32] This dramatic reduction in the price of surveys would now make a full-scale survey of a colony or even a continent possible, even with the constrained colonial budgets emerging from the growing depression. Yet the inexpensive price of aerial surveying was a minor advantage compared to the great virtue of getting the administrative overview, as the *Times* reviewer put it:

> Mr. Bourne . . . emphasizes first of all that cooperation between agriculturists, foresters, geologists, and other specialists is essential if needless repetition of field work is to be avoided, and if Government Departments are to be presented with a view of their problems as a whole . . . With this information before them the local government should be, for the first time, in a position to view in real perspective their present and future problems.[33]

Ecology was something more than the sum of its parts; it offered an administrative overview of a whole range of scientific results that could be helpful in colonial management.

The use of the airplane by ecologists is important for understanding the globalization of the discipline, yet botany and forestry could not offer a

sound ecological overview of social relations without the help of zoology, since only the science of animals could lead to a full account of the human condition. I therefore turn to the Oxford zoologists to explain the growth and empowerment of ecologists, and their comprehensive ecological order of nature, knowledge, and society.

The Revitalization of the Department of Zoology

After the war the Department of Zoology suffered greatly from the loss of two of their leading staff members, Geoffrey Smith and John Wilfrid Jenkinson, both of whom died in the trenches. The teaching situation was quite desperate, so the university turned to its former students Alexander Morris Carr-Saunders and Julian Huxley to rescue and energize the troubled department by launching a new genetically oriented approach. Together with J. B. S. Haldane they were offered positions as lecturers in zoology. Charles Elton was among their new students.

Carr-Saunders was born in 1886 into a wealthy underwriter family who sent him to Eton, where he was known as a lonely and "intensely unhappy" student.[34] From Eton he went to Magdalen College at Oxford. He graduated in 1908 with a degree in biology supervised by Smith and Jenkinson, and he subsequently became a demonstrator in comparative anatomy. However, laboratory life at Oxford could not compete with the exciting science of eugenics. In 1910 Carr-Saunders moved to London, where he studied biometrics under Karl Pearson, became the secretary of the research committee of the Eugenics Education Society, and was called to the Bar of the Inner Temple. He was deeply concerned about all kinds of social ills and problems, and saw the solution to all of them in Francis Galton's emancipatory writings about how through eugenics society could be engineered into a better condition. The outbreak and subsequent horror of the First World War confirmed Carr-Saunders's belief in the urgent need for biological tools for improving social and international relations. Because of his knowledge of French, he was posted at a ration depot in Suez, where he had plenty of leisure time to plan his subsequent book on human eugenics and population dynamics while watching the ongoing slaughter from the sidelines. He came back to England severely depressed about the human condition and settled outside Oxford, where he developed a passion for farming and alternative agricultural economy, and started to teach students in the Department of Zoology at the university.

Huxley was one year younger than Carr-Saunders and belonged intellectually to the same generation of scholars excited about the promising field of eugenics and genetics. He was—according to his own account—born in 1887 "with great advantages, genetic and cultural" into a family whose literary and scientific fame he carefully documents in his autobiography.[35] In it he also describes a "devastating . . . love affair" with a young man named Eric Forbes-Adam, and "nervous mannerisms" while studying together with Carr-Saunders at Eton. Later in life Huxley would "shudder" thinking about "what a really ingenious neo-Freudian would make of this."[36] It was in this period of sublimation and personal crisis that he found rescue in being "mystically united with nature." In his own words: "I could *see* right down into the center of the earth, and embrace the whole of its contents and its animal and plant inhabitants. For a moment I became, in some transcendental way, the universe."[37] This "cosmic vision" is the very key to understanding Huxley's life. He emerges on several occasions in this history of ecology as one whose dream of becoming "the universe" permeates his literature, biological research, scientism, patronage of ecology, political writings, support of environmentalism, and leadership of UNESCO.

Huxley took courses in zoology and comparative anatomy together with Carr-Saunders at Oxford. He graduated in 1909 as first in his class in natural sciences, and also received the Newdigate Prize for English Verse. The university saw in him an incarnation of his famous grandfather and hired him as a lecturer in zoology (Carr-Saunders's old job) from 1910 to 1912. He then moved on to Texas as assistant professor at the Rice Institution before he returned to the continent and fought for the last two years of the war as an army intelligence officer in Italy. When the war ended, he continued—like his namesake in Stendahl's novel *Le Rouge et le Noir*—to build a career in the civil service with a growing reputation as a biologist.

Carr-Saunders and Huxley were both Elton's mentors at Oxford, and shared the responsibility of teaching him natural history, ecology, and zoology. They introduced him to a series of books on animal communities.[38] During his first years at Oxford, Elton felt "decidedly on the outside," though not because of his background. He was born in Manchester in 1900, the son of a university professor in English literature. He went to Liverpool College until 1918, served his country for four months in the Army Cadet School, and continued on to Oxford for undergraduate studies. Both of his mentors were impressed with their student (particularly Huxley, who copied material from Elton's notebooks for his own publications), and invited him to join the Oxford University Spitsbergen Expedition in the summer of 1921.[39]

Spitsbergen: From Political Anarchy to a New Gibraltar?

It is necessary to make a short digression into the history and political circumstances of Spitsbergen to fully appreciate the context of Oxford expeditions to this arctic archipelago. People from various countries had been exploiting the natural resources on these islands as early as the sixteenth cen-

tury, but there was hardly any permanent settlement there because of the harsh arctic climate.

Spitsbergen and Bear Island were not yet part of any country's domain, and their territorial and political status was a hotly debated issue. It was in the early 1920s still a *terra nullis* where anyone could claim and defend property rights.[40] One simply marked the land with a flag and a name, noted the annexation to the Foreign Ministry of one's home country, avoided occupation of an unreasonably large area, and, most important, mixed one's labor with the land and physically guarded the property from intruders.[41] Pointing to the accomplishment of such tasks, at least one prominent British explorer at the Royal Geographical Society loudly and solemnly declared in 1920 that Spitsbergen rightly belonged to the empire.[42] Yet earlier debate clearly indicates that most British historians, explorers, and geographers wrote about Spitsbergen as a "No Man's Land" yet to be explored by science and annexed to the empire.[43]

They were not alone. A horde of explorers, adventurers, and companies from most countries of northern Europe had before the war rushed to the region to claim boundaries and declare property rights for land believed to have all kinds of mineral treasures and resources. The political anarchy involved created bitter boundary disputes. Ownership had to be proven by the creation of mines, investment in scientific exploration, and defense of the site from intruders. "Crime and punishment, in the legal sense of the terms, [were] unknown," and the pressure on the land increased with a rapidly rising demand for coal in the immediate aftermath of the war.[44] There were rumors about British occupation of the islands, and talk in the British press about establishing an arctic Gibraltar. Coal prices were rising and optimism soared. British scientific institutions and individual companies invested much time and money in exploration and exploitation, and some even expected that the islands would be annexed to the British Empire.[45] Neutral Norwegian war-profitmongers had gained from the situation by buying or occupying estates and establishing profitable mining syndicates. Consequently, by the end of the war Norwegian companies dominated the islands and Norwegian diplomats were (according to British opinion) in an extremely strong bargaining position when peace negotiations began in Versailles.[46] In Paris they demanded political sovereignty over the archipelago, which was granted in the Spitsbergen Treaty of 1920 with the important proviso that all nations and people had a right to explore, exploit, and settle on the islands. This was no immediate problem, since there were only about 200 or 300 people living there on a year-round basis in 1920, with a summer population of about 1,000, nearly all located in the mining camps.[47]

The treaty was up for ratification from 1920 to 1925 and all parties with territorial interests would have to prove their ownership of land to their respective governments during this period. The Royal Geographical Society in London was eager to secure British industrial and scientific interests, and told the Secretary of State for Foreign Affairs to hold out for a policy that would establish the hegemony of the empire.[48] Movers within the society pointed to Spitsbergen's strategic military importance for submarine warfare, and argued that the islands were valuable to British maritime interests and that the country consequently should not ratify the treaty.[49] However, the British were not the only ones keeping a close eye on the archipelago. There was hectic economic development at both Spitsbergen and Bear Island in the early 1920s, and roughly fifty major and minor scientific expeditions and inspections from all over Europe flooded the region.

Oxford Expeditions to Bear Island and Spitsbergen

It was into this tense, anarchic climate of territorial dispute, occupation, and investigation prior to the final ratification of the treaty in 1925 that the Oxford expedition sailed northward in early June 1921. They too were keenly aware that they were sailing into a lawless "no man's land" of rough miners, and few believed the treaty would be ratified (so it is no wonder that they included plenty of spirits, tobacco, and cigarettes in their luggage).[50] The expedition was organized by the arctic entrepreneur George Binney, with Huxley and Carr-Saunders as the main scientific personnel, and the famous ornithologist Francis Charles Robert Jourdain as the leader. The rest of the twenty-member team consisted of a mix of graduate and undergraduate students in ornithology, glaciology, geology, paleobotany, and taxidermy, with Elton and Victor Samuel Summerhayes as ecologists.[51] There exists no record of the patronage of the expedition, but judging from hints in the accounts, it seems to have been paid for by the university, with the aim of educating young students in field research and at the same time revitalizing a Zoology department devastated by the war experience.[52]

Shortly before he died in 1991, Elton wrote a long and detailed account of the expedition, because he thought the events were of the utmost importance for understanding the early development of animal ecology. Though the manuscript was never published, it reveals a surprisingly accurate and charming flashback to what certainly must have been some of Elton's very fondest memories. He recalls that he was "very inexperienced, very raw indeed"; he had barely turned twenty-one and had never left the soil of Britain.[53] With some pocket money from his father, Oliver, and army equipment and clothing from his brother, Leonard (who had just returned from war), he bade farewell to his family in the first week of June 1921 to test his manhood and scientific capability on a voyage with famous Oxford scholars. It is no wonder he was enthusiastic.

After a short stopover in Tromsø, the party sailed north under the midnight sun, which inspired Huxley to write the following poem:

> Round and ever the circling sun
> Travels the summer's single day
> The single day that is never done
> Till the snow and the frost shall have their way
> And come with their comrade Night to stay.[54]

The party's fascination with the midnight sun is especially important to understanding Elton's research, which later would focus on arctic light as a special source of energy for arctic workers.

Meanwhile the explorers sailed towards Bear Island, where they would stop for ten days to carry out a biological survey. Elton had been violently seasick for two and a half days and Tom Longstaff (the expedition's medical officer and ornithologist) gave him so much brandy, and on such an empty stomach, that he "went ashore sitting on top of a large load of baggage in the whale-boat, and singing loudly!"[55] The party landed at Walrus Bay and soon occupied and made themselves comfortable at an apparently deserted whaling station.

The exuberant explorers had unwittingly settled in the middle of a bitter property controversy. The ownership of Bear Island was as disputed as the Spitsbergen archipelago. The Swedes argued that they owned the land because Swedish naturalists had discovered it (in 1596) and described its botany, but they had clearly failed to labor the land and defend it from intruders. The owner of the whaling station argued that he owned the land, but failed to convince the Norwegian Foreign Ministry that he needed the entire island to hunt whales (the station was not abandoned but used seasonally).[56] The only party who with some force could claim property rights to the land was the Norwegian firm Bjørnøya Kullkompani I/S, who had occupied parts of the island from 1915 in order to mine coal and sell it at a premium to both sides in the ongoing war.[57] The prices continued to rise after the war with a dramatic increase in coal production. The company soon hired British mining engineers, who produced a grand plan of how they could develop the land to increase coal production even more. In the summer of 1921 the company was in the process of developing new production procedures, improving infrastructure and the harbor, rebuilding and opening new mines, and restructuring management so that the mining interest could increase its efficiency and strengthen its case for property rights before the final ratification of the Spitsbergen Treaty (which included Bear Island) in 1925.

The chief manager in charge was taken by surprise when Elton and Longstaff showed up in his office one day to borrow the company's telegraph. He took great delight in showing Elton and Summerhayes around the island

while the rest of the expedition searched for rare or unknown species.[58] All had not gone well for the mining company that summer. The miners had been on strike for weeks demanding better salary and living conditions and were consequently sent home. While waiting for new, less troublesome workers, the manager (who was probably Thor Haabeth) had plenty of time to show the Oxford students around the island. He had a keen interest in wildlife, and told them about the seasonal migrations of birds, the arctic lives of ptarmigan, foxes, seals, and polar bears. He showed them the inland and sea fisheries, and the locations of various bird habitats. The miners had to rely on local species for fresh food, so his interest in wildlife was hardly recreational—it had more to do with managing the local resources to improve the efficiency of the company. Inspired by this information, Elton and Summerhayes investigated the island with great speed while closely following the emerging data from their fellow explorers. What especially intrigued them was the small size of the island, its lack of biological diversity, and its largely flat, stony, and sparsely vegetated life zone, which enabled researchers within a short period of time to get a good overview of all its plants and animals. They compiled and synthesized their findings in one of the most famous articles in the early history of ecology, known for its diagram of the island's nitrogen cycle (see Figure 3).[59]

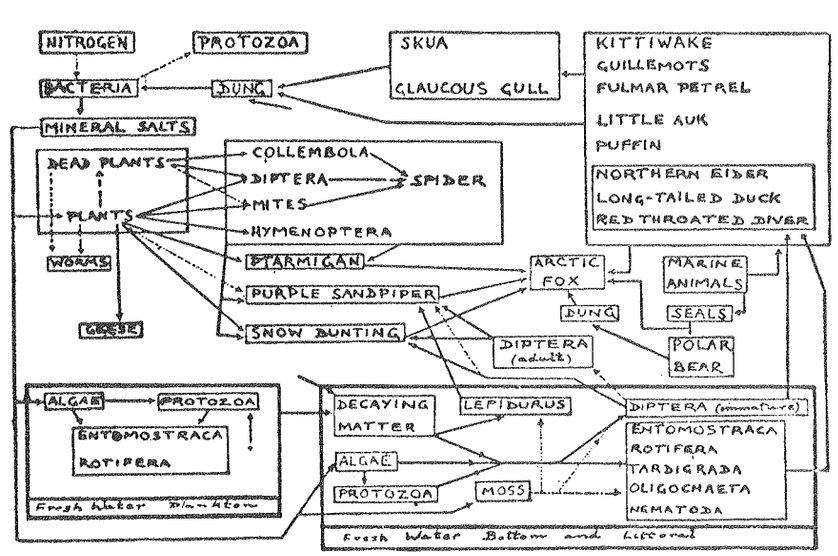

Figure 3. In 1921 Victor S. Summerhayes and Charles S. Elton visited Bear Island. One result was this diagram of the island's nitrogen cycle, published in the *Journal of Ecology* 11 (1923): 232. Reproduced courtesy of Blackwell Science Ltd.

Most of the species in the diagram were described and discussed at length by other natural historians, so the arrows indicate not only species relations, but also relations of credit among different scientific works, fields of research, and fellows within academia. The only field of research that is *not* included in the diagram is ecology, since Elton and Summerhayes could not draw arrows to their own diagram. The ecologists are instead placed in the privileged position of designers of the diagram, drawing lines of relations between scientific findings (and also in the position of predators at the very top of the food-chain, since they ate most of the species they caught.)[60] Finally, the force of the ecological approach lay in the visual aesthetic of the diagram, which was familiar to engineers and managers. It conveyed to them sources for fresh food and gave them information for a more diverse utilization of their environment.

The Bear Island experience was for the young ecologists just a preview or a model for a much larger ecological investigation of the entire Spitsbergen archipelago. After leaving the island the expedition continued northward along the west coast of the Spitsbergen mainland, where they made short stops at various mining camps. They had their first experience with a lawless country when some Russians raided a research area for bird eggs. The mixed interests of the scholars and their students implied that the group spread out upon landing and inquired into their respective topics, such as animal populations, rare birds, aquatic life, plant communities, geological formations, and topographical exploration. At every camp Elton laid out geographical zones based on local climatic conditions. He plotted his own and his companions' findings into ecological maps, whose function was to provide an overview of all the research.[61]

The most telling example is perhaps the map of the research zone around Bruce City in Ice Fjord. It was a fictitious "city" of three small huts founded by the Scottish Spitsbergen Syndicate to prove their property rights through a fancy name and some small-scale mining. The syndicate gladly lent Bruce City to the expedition because it would add to their legal case for proving that the region was in active use, and research on their land could unveil unknown natural resources besides coal. As a result, Scottish coal miners and managers lived alongside Oxford scholars for an entire month.[62] A number of the voyagers, however, shunned the place and went on a long sledge tour (including Huxley, who left on a hike with his fellow ornithologists to peep at courtship among arctic birds), and another group had already left to catch up with the expedition at another research location further north.[63] The party left at Bruce City was thus reduced to three who studied geology, paleology, and glaciology in relation to mining, plus Carr-Saunders, who was in charge of the camp, and Elton, who served as his personal assistant in his research on

aquatic life. Elton's main focus was again to lay out the ecological zone around Bruce City together with John Walton, a newly graduated paleobotanist from Cambridge.[64] Together they climbed nearby Mount Campbell to get what Elton thought was crucial to any ecological research: an aerial overview that would enable him to draw maps of ecological zones of the almost flat delta landscape. The extensive "'aerial' sketch maps" and field notes from Bruce City reveal Elton's preoccupation with ecological zones between species in relation to their respective environment and climate, and consequently with the network of knowledge exchanged among the participating scientists. These notes would serve Elton well in his later writings. So would the time he spent strolling around the seashore together with Carr-Saunders, who used the summer at Spitsbergen to resolve the basic features of his forthcoming book about the human population problem.

The first thing Elton set out to do upon his return was, as he put it in a letter to Huxley, to "do some ecology propaganda!" by completing his Spitsbergen papers. He was forced to delay his enthusiasm for a year and concentrate on his graduation, with a final paper not on ecology but on warning coloration of mites.[65] Huxley was obviously pleased with his student because he managed to secure him a part-time position as demonstrator in zoology at the department, which enabled Elton to sit down with Summerhayes in the summer of 1922 to write out their ecology paper.

Carr-Saunders did not publish anything about aquatic life at Spitsbergen and instead, with the help of Huxley, finished his major work, *The Population Problem*. The book was, as he put it, "an accident of the war" that tried to explain the tragedy by tracing the evolutionary "quantity and the quality" of mankind.[66] His method was to explain the evolution of inherent characteristics through statistical surveys of human fecundity in different climatic zones. The voyage to Spitsbergen was to Carr-Saunders a visit to a prehistoric past to an ice age without political order, from which location he takes his readers through human evolutionary history.[67] Neo-Malthusian arguments served as the point of departure in Carr-Saunders's numerical analysis, and Galton's eugenics as a vehicle for his qualitative analysis of population dynamics. The population problem, as he saw it, was the evolution of primitive people with low mental and physical qualities and high reproduction rates. What worried Carr-Saunders was how the "over-population" of human races with lower mental capacities endangered "the standard of living" of races with higher qualities.[68] He predicted a bleak scenario of more wars or an over-populated world of 246,114 million people with low capabilities in the year 2400 if world leaders did not consciously adjust the human population to a responsible level by eugenic methods.[69]

The book was an instant success, which overnight established Carr

Saunders as one of the leading British sociologists in the inter-war era. His book received rave reviews in the press, and a series of major journals received him as one who had brought "Malthus up to date . . . from the standpoint of the twentieth century."[70] He was instantly spotted by academic headhunters and offered the Charles Booth Chair of Social Sciences at Liverpool University, where he remained from 1923 to 1937 working on his next book, *The Professions*, which examined the sociology of professions in an urban environment torn apart by class divisions.[71] In Oxford he left Huxley puzzling over the methodological relations among statistics, biological evolution, and genetics, and he left Elton pondering how the human population problem related to animal population dynamics.

In the summer of 1923 a new expedition arranged by Merton College sailed northward to Spitsbergen, now with Elton as chief scientist. The voyage failed to deliver much significant scientific research, however, because of rough weather and ice conditions.[72] Elton spent most of his time aboard and was only able to make extensive notes on climate, information that later would prove helpful in determining climatic zones around the archipelago. The third Oxford expedition of 1924 deserves a closer look because it laid the foundation for Elton's subsequent works on Spitsbergen and animal ecology by using the airplane as a major research instrument.

The approximate total cost of the journey was £8,300, which was drastically reduced to £5,300 by generous donations of fuel, equipment, and technical personnel from various companies, with the British Petroleum Company and the Civil Aviation Department of the Air Ministry as the largest donors. An additional £3,000 emerged anonymously (through George Binney), and the Royal Geographical Society gave £100 in an attempt to create momentum for their case for British annexation of the archipelago. "The University of Oxford gave its name to the expedition, and a donation of £50," and the rest was collected from the members.[73] The pro forma patron was the Prince of Wales, whose name gave the impression of a scientific impartiality above private interest groups. Nevertheless, the expedition was closely linked to industrial exploration and British colonization, all carried out under the general aim of surveying as yet unclaimed or disputed land.

The expedition left England incognito. The logistics were planned in secrecy and the members left Oxford in small groups to avoid attention. They turned away journalists, and promptly rejected a tempting offer of £1,000 for exclusive press rights to photo material.[74] They were going to disputed or unclaimed land, and newspaper articles and photos could start a race, and might stir up unhelpful political tension in the ratification process for the Spitsbergen Treaty. The Civil Aviation Department of the Air Ministry (the most important patron of the Oxford Expedition) had just completed long negotiations with the Norwegian government over the regulation of civil aviation between the countries and their domains. Regulation of the airspace above the Spitsbergen archipelago, however, was still in limbo.[75]

The airplane was a crucial instrument for the British government in keeping political control over remote areas, but could the plane also operate effectively in the Spitsbergen archipelago? Could a seaplane land safely and routinely in these icy waters? These were crucial questions relating to political control of the islands, of direct relevance to the issue of regulation of air-traffic in the north. This political context explains why the key purpose of the Oxford expedition was, in "the spirit of the ancient Vikings, . . . to test the powers of a new method of attack by observation from the air."[76] Their seaplane—the *Avrolynx*—was brought with much complication to the island by the expedition boat. The seaplane could easily cause alarm. Planes were still thought of, particularly among the Germans, as key spying instruments. Such associations could easily arise among foreign companies if they heard about British planes flying over their properties. Air reconnaissance might indicate whether or not they were actually mixing labor with the land, a key condition for claiming property rights. Moreover, a seaplane could land without a runway on remote places yet to be claimed. There were thus good reasons for keeping a low media profile.

The expedition spent most of its time on largely unclaimed land at the very north of the archipelago, with three sledge tours over the northeast and numerous flights as the main activity. Elton was the expedition's chief scientist and thus spent most of his time in the base camp organizing the scientific tasks of various sledge tours, flights, and student activities while researching soil conditions as a basis for the geographical distribution of plant life.[77] He was also in charge of cooking (see Figure 4), though his interests were definitely not in the culinary arts (he did a terrible job even by English standards). The experience was nevertheless positive because his camp duties gave him an overview of all the expedition's activities. When the explorers returned, often tired after hours of walking in rugged terrain, a fit and well-rested Elton took notes of their findings around the campfire where he began, as scientist in charge, to edit and synthesize all the research.

Elton's article about the movement of fly swarms from island to island within the archipelago and their immigration from the mainland is a telling example of how Elton based his argument on evidence collected by his colleagues. He took notes on their observations of fly swarms in various regions and extrapolated apparent movements. He cleverly placed himself in the socially fortunate position of synthesizing knowledge, and his article is consequently loaded with a long list of credits to his fellow travelers.[78]

The expedition leader was very pleased with Elton's ability to summarize

all the activities in one ecological scheme, which took the form of maps of local geology, vegetation, animals, and so on, in zones defined by the climatic environment. Elton thus created at each camp along the route a research zone where an exchange of results and knowledge took place. The pilot and the technicians were active participants in this ecology of knowledge, since with their airplane they could offer an overview of the landscape while gaining important technical knowledge and experience. The plane was of course an exciting new research instrument that everybody was "inclined to idealize," and much of the official travelogue is consequently about the use and welfare of the plane.[79] Nearly all of the images from the expedition are either of the plane or taken from it, ending with a kitsch photo by Elton of the seaplane in the midnight sun.

Figure 4. Charles S. Elton, chief scientist for the Oxford University Expedition to Spitsbergen in 1924, cooking at the camp. Reproduced courtesy of Dr. Robert Elton, from George Binney, *With Seaplane and Sledge in the Arctic* (1925).

The ornithologists were naturally enthusiastic about this new ability to fly like a bird, and made effusive analogies between a bird's nest and an "aeroplane factory."[80] To carry out observations from the plane was a popular research activity, and Elton was not left out: With the help of the plane he could see nature from above, which dramatically changed his perception of the environment. He would always try to establish an overview when writing about relations between animals and their environments, or between different academic disciplines. For the rest of his life his outlook on nature and academia would essentially be from above.

Charles Elton: The Economy of Population Ecology

One result of Elton's voyage to Spitsbergen was a celebrated article on periodic fluctuations in animal populations that appeared in 1924. The paper was supervised by Huxley, who also secured its publication. It is clearly inspired by Carr-Saunders's book, as well as a whole range of secondary sources about the animals in question. Through an overarching theory about the effect of climatic cycles on animal populations, he attempts an overview or synthesis of others' work. The article's fame derives from its thesis that the population dynamics of lemmings force them to march "with great speed and determination into the sea."[81] These images of masses of lemmings drowning in the sea or falling off cliffs originate in folklore among Nordic highlanders which mirrors their daily worries of losing sheep or reindeer in a harsh arctic climate. Elton did not observe such phenomena, but relied on a word-by-word dictionary translation of a work by the Norwegian biologist Robert Collett, reinforced by cock-and-bull stories from Norwegian sailors.[82] Collett accepted uncritically such lemming mythologies and tried to provide a sober scientific explanation for the population dynamics of lemmings in terms of cycles of diseases and predators, and to explain their strange migration in terms of mass suggestive behavior. Elton saw no reason not to trust the validity of such stories when a local expert like Collett confirmed them, and those shades of doubt that do exist in Collett's long discussion disappeared in Elton's halting translation.

Why was such a folktale about mass suicide among animals so appealing to British zoologists? It was certainly appealing to Elton on a personal level, for he surely thought of the importance of accidental occurrences in population dynamics after falling through the ice and nearly drowning.[83] More important is the fact that Elton explored this topic in 1921 together with Carr-Saunders, who at that time had been pondering why thousands of young men during the war left the safety of the trenches to become targets for the enemy's bullets. Consciously or not, with the image of masses of lemmings

falling over the cliff or drowning themselves in the sea Elton captured the social image and destiny of his own generation. It is then hardly any wonder that lemming speculation could survive and blossom in the British scientific community for such a long time after.[84]

Yet the more practical question remains: what possible interest could Elton's patrons have in the mass suicide of lemmings? A closer look at his conclusion reveals that his scientific motivation for gathering stories about lemmings was not only to investigate the lives of these animals; his interest was also to foster "a new method of getting at the facts of climatic cycles."[85] He believed that climate was the key factor in determining the population dynamics of lemmings, and consequently saw these fluctuations as a kind of "weather indicator." Thus his article was primarily a contribution to climatology. If one understood past cycles of lemming populations one could predict future climatic patterns. Such information was crucial to oil prospecting. A method for advance determination of mild summers in the arctic would be crucial for the success of Elton's patron, the British Petroleum Company.

Elton's part-time position at Oxford did not make ends meet, and he was thus looking for grants and new patrons. He found one in his friend George Binney from the Spitsbergen expedition, who recommended him as a consultant for the Hudson's Bay Company in 1925 as part of a larger attempt to revitalize the business.[86] The company was selling fur-bearing animals hunted mainly by native Canadians and Eskimos, and Elton's task was to study fluctuations in such animals' populations to improve the company's management of fur resources. The aim of his research was to forecast population cycles of fur-bearing animals and to predict the prices at the fur auction in London. His method is telling. He hardly did any fieldwork, but, as he had done while studying fly swarms, he placed himself in the midst of a social network of data collectors. He established a recording system in which hundreds of company workers from a wide geographic area provided often anecdotal[87] input for his analysis, which he combined with an historical analysis based on the company's account books. The result was "quite juicy," an outline of the economy of the company and economy of nature that traced the population dynamics of fur-bearing animals in Canada back to the early eighteenth century.[88] This enormous body of material was unfamiliar terrain for Elton; it consisted of voluminous accounting books and sale statistics from which he was supposed to extrapolate results readable by his business patron. To work for the Hudson's Bay Company thus meant that he had to recast the ecology of fur-bearing animals into mathematical terms so that it would match the evidence he was working with. Elton also had to adapt to the language of numbers and statistical methods in order to be understood by his patron, whose economy relied upon the economy of nature.

The reception of Elton's work by the fur trade business may be seen in a plate prepared by the Hudson's Bay Company that shows the relationship between cycles of animal populations and fluctuations in the fur industry (see Figure 5).[89] The governing factor was a cyclic pattern of sunspots causing climatic changes, which explains the variability of food supply and consequently fluctuations in the number of fur-bearing animals. The balance in the center of the image represents the statistical balance of nature that determined the health and prosperity of the company's laborers (Eskimos and Indians). At the end of the food chain (or statistically at the top of what Elton later called "the pyramid of numbers") one finds furs offered for auction in London. The economy of nature was an integral part of the economy of the fur industry and vice versa. The ecologists helped to naturalize and legitimize the division of labor and the profit for shareholders, hence the balance, the age-old symbol of justice that centers and integrates the picture. Indeed, the paternalistic management of native Canadians and arctic Eskimos by the Hudson's Bay Company during this period was all "natural" according to the science of human ecology.[90]

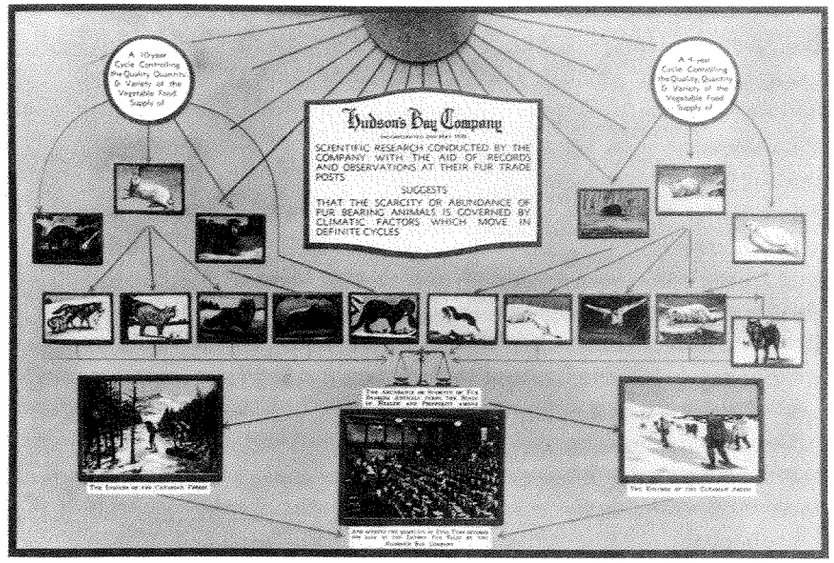

Figure 5. Chart illustrating the relationship between wildlife and human prosperity, published by the Hudson's Bay Company in 1932 based on Charles Elton's research. Reproduced courtesy of the Hudson's Bay Company Archives, PAM, HBCA Photographs 1987/363-H-23/26.

From Animal to Human Ecology

In Oxford Elton continued to organize ecological research, to compile work from the Spitsbergen expeditions,[91] and to collaborate with Huxley, who encouraged Elton to write a book that could launch animal ecology as a field within zoology. Huxley was now deeply involved in the so-called Science-for-All movement, whose concern was to educate the British public through a series of semi-popular books, which Huxley edited. His own contribution, *Animal Biology* (1927), was written with J. B. S. Haldane. It focuses on how systems of energy in the animal body (or machinery as the authors preferred) could explain the daily and evolutionary life of animals by tracking budgets of cyclic gains and loss of calories.[92]

The book was written at a time when Huxley was spellbound by psychology; he wrote poetry about understanding repression after reading Freud, and started to work on his own version of a Faust play based on his psychology. Only the beginning remains of this "Freudian Faustulus," in which some main metaphysical entities introduce themselves:

> I am Matter. I am the condensation,
> The Kink in empty space that provides resistance
> Precious inertia—mine the sole foundation
> On which swift energy's flow of fluid emanation
> . . .
> I am Energy. Sublime and meaningless Energy
> I stream in floods across the empty ocean
> Of space, where island-universes float
> Each like a little lonely boat
> I set the world in motion.[93]

Huxley also introduces the Self, the Ego, and the Super-Ego accompanied by Time and Space before the play is supposed to begin. One should perhaps not put too much emphasis on this attempt "to set down my own state of mind," as Huxley put it, but it does confirm what already has been apparent in Tansley's research: the major source of inspiration for formulating a mechanistic biology based on matter and energy was clinical psychology. Huxley's poetry was written in honor of Freud, not scientists from other fields.

In short notice Huxley gave Elton the opportunity to write a follow-up to *Animal Biology* on animal ecology as part of the Science-for-All series. Elton (who was busy teaching) managed to write the book at night within eighty-five exhausting days, and it appeared in 1927 with an editorial introduction by Huxley, who now fashioned himself as the father of animal ecology—"destined to a great future"—by emphasizing his teacher-pupil relation with

Elton five years after his graduation.[94] However, the chief source of inspiration for Elton was not Huxley but Carr-Saunders's book on human population dynamics. Elton explained that whereas Carr-Saunders was concerned with the "sociology and economics" of human beings, he outlined "the sociology and economics of animals."[95] He thus humanized nature by reading the social sciences into the realm of animals: "Throughout this book," he explained, "I have used analogies between human and animal communities. These are simply intended as analogies and nothing more." There is nothing simple about analogies, though. Analogies were crucial—in Elton's words—"to drive home the fact," and he could not do without them.

The audience familiar with ecological terms was almost exclusively botanists, and Elton thus starts off his book with a short recapitulation of vegetation ecology, which included high praise for Tansley's *Practical Plant Ecology* and *Types of British Vegetation*. He also secured the attention of his colleagues at the Imperial Forestry Institute by beginning the book with an aerial photograph of a tropical forest climax. He immediately stresses the importance of seeing nature from above: "If it were possible for an ecologist to go up in a balloon and stay there for several hundred years quietly observing the countryside below him, he would no doubt notice a number of curious things before he died, but above all he would notice that zones of vegetation appeared to be moving about slowly and deliberately in different directions."[96] Elton's approach was, to paraphrase a famous sociobiologist, like that of a zoologist from another planet (say Mars) completing a catalog of species in the free spirit of natural history.[97] This paragraph captures the core principles of his ecological reasoning: the view from above, the social and physical distance between the ecologist and the life-world, the classification of environments into life-zones, a teleological narrative, and, above all, a nearly endless temporal perspective. The book is an ecological *tour de force* of the animal kingdom with Elton as the pilot. He first lays out all the environmental zones (such as climate, topography, and temperature) and explains how these determine animal communities. He then outlines the key terms for population dynamics in an environment; food-chains and cycles, niches, and pyramids of numbers. He concludes with an ecological account of animal evolution.

Elton's methodology was not very inventive; he recycled analogies, concepts, and methods found in his mentor's book about population pressures. The notion of food-chains and cycles hailed from Carr-Saunders's discussion of economic cycles and class conflicts in industrial England. The niche concepts stem from Carr-Saunders's discussion of mental characteristics, of the origin of human traditions, and of the social division of labor in various professions.[98] (The activities of a badger and a vicar respectively are Elton's own examples of two types of niches in the animal and human community.)

Finally, the idea of pyramids of numbers came from Carr-Saunders's chapter on statistic regulation of human populations and Elton's review of the Hudson's Bay Company's accounting books. Elton's achievement was to read by analogy Carr-Saunders's sociology into nature, and thus to construct an order of nature that reflected and reinforced Carr-Saunders's eugenic tendencies and Malthusian agenda of selected human superiority.

That human beings were at the very heart of his animal ecology is clear when Elton returns to his experiences from Spitsbergen to illustrate an ecological balance among seals, polar bears, and human beings. The reason Norwegian hunters could kill thousands of great bearded seals without damaging its overall population was that sealers also killed large numbers of polar bears, whose diet consists largely of seals. Elton drew a little diagram of the food chain, which probably is the first published ecological illustration that includes human beings.[99] This as an indication of the possible economic utility of animals, although management of food resources was not at the forefront of the book. It was not rationality, emotion, or a sense of history that distinguished human beings from seals and polar bears as Elton saw it, but our ability to eat on every level of the food chain. Through an investigation into our eating habits, he believed, one could understand mankind's place in history and the world.

That the inclusion of human beings in the animal community was important is clear from the final paragraph of his book, in which Elton criticizes the contemporary practice of human ecology:

> Human ecology and animal ecology have developed in curious contrast to one another. Human ecology has been concerned almost entirely with biotic factors, with the effects of man upon man, disregarding often enough the other animals amongst which we live. Owing to the fact that most of the workers in this subject are themselves biotic factors, an undue prominence has been given in history and economics to these purely human influences.[100]

The term "human ecology" in the 1920s had mainly been used as a catchword among a small group of sociologists in the United States with little background in vegetation or animal ecology, and whose main concern was urban planning and social geography.[101] Elton was clearly not inspired by this view of human ecology and consequently set forth to rescue the term. He questioned the traditional boundaries between humans and animals: animal communities, he argued, are socially comparable to human communities and human behavior resembles that of animals. This circular reasoning of humanizing nature and naturalizing mankind opened up a large new research field.

As a point of departure for a scientific human ecology Elton cites the importance of a series of books by Ellsworth Huntington at Yale University, and his London counterparts Leonard Hill and Argyll Campbell (both at the National Institute of Medical Research). Huntington and one of his colleagues had recently published a lengthy study, *Climatic Changes,* in which they argued that the world now faced a gradual decrease in the average world temperature.[102] This was a topic of concern because Huntington saw clearly the connection between civilization and climate, outlined in his 1915 book of the same name, which Elton read in its third revised edition of 1924. The basic argument in this work is that "the distribution of civilization" around the world corresponds to "the distribution of human health and energy on the basis of climate."[103] The crux of the matter was that the important climatic zones could be distinguished on the basis of temperate and nontemperate climates, and consequently one could expect respectively high and low distributions of human energy in these zones. This energy, and thus level of civilization, could be measured by the number of inventions, the power to lead, and, above all, the trading of goods and knowledge.[104] It was exactly this entanglement of nature's economy and human economy that Elton envisioned in his concept of human ecology. According to Huntington's scheme, the low energy of the arctic climate of Spitsbergen implied little human civilization. Thus, what was at stake for arctic entrepreneurs was whether or not it was scientifically possible to spread the British Empire of trading to such an arctic climatic zone. The focus in Elton's second major article about Spitsbergen, published with Summerhayes in 1928, was on climate as the major factor for determining life-zones in barren, dry, and inner fjords.[105] They produced a grand map of the archipelago of all the various life-zones crucial for their patrons to determine the best possible settlement zone or outpost for British civilization.

Much of the industrial and commercial activities at Spitsbergen were conducted during the summer season in the midnight sun, and much of the fascination with the arctic was with this phenomenon. The question then was whether the arctic light had a potential health effect or supplied a special kind of energy that would stimulate arctic workers. Elton's chief source of inspiration with respect to this issue was Hill and Campbell's book *Health and Environment* of 1925. The aim of this study was to promote the idea of fresh air and sunlight in smoke-polluted and dark English industrial cities. Pollution and lack of sunlight could cause various illnesses (such as tuberculosis), for which they suggested various treatments. They proved—through rather kinky experiments—that the most effective treatment was *heliotherapy* in the open air.[106] The theory that the human body could heal and be energized through adaptation in different climatic zones was intriguing to Elton, since the arctic climate offered plenty of fresh air and sunlight. These were all fac-

tors of importance in judging the human ecology of Spitsbergen in relation to British settlement.

Human ecology was not only about explaining the development of human civilizations and trading as a product of climatic and environmental zones. Elton also envisioned human ecology as a means of organizing knowledge within academia. On the final page of his book he prints a diagram—without any explanation—just "as a reminder that ecology is quite a large subject" (see Figure 6).[107] The animal ecology of food cycles had been transformed into a grand ecology of academia. This scheme for intellectual cannibalism is crucial in understanding the emerging scope of a broad ecology. The implication of human ecology was that the academic community should be understood and organized as an animal community. Biological surveys, Elton indicates, should digest almost all niches of research except, perhaps, some humanistic professions like literature, philosophy, or history of science. Medicine and ethics, for example, have formed a research niche dealing with the topic of "parasites." They consume the "regulations of numbers," a research niche held by astronomers as well as zoological and social economists. The result is a new way of organizing knowledge along ecological lines, where the biological survey itself is a zone in which various disciplines consume and trade each other's knowledge.

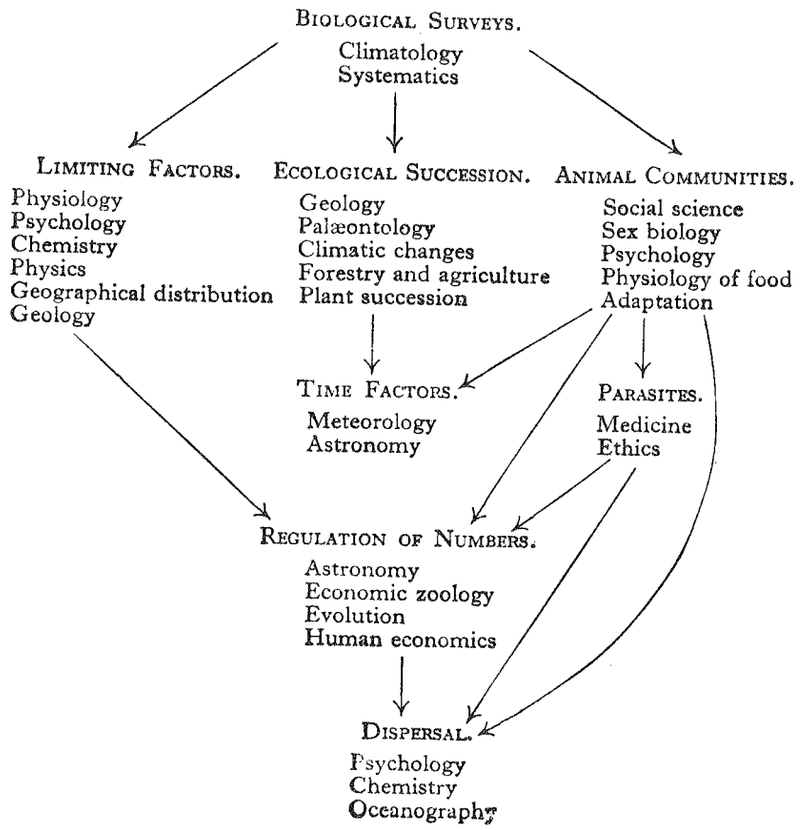

Figure 6. Charles S. Elton's diagram of biological surveys from his book *Animal Ecology* (1927).

Elton's ecological scheme for organizing knowledge did not go unnoticed. Edgar Worthington used it in his administration of a grand African survey and later in the International Biological Programme. However, though the reviews of *Animal Ecology* in academic journals flattered Elton, they did not notice the implications of his work for human activities and research.[108] The press reviewed his book as a new approach to natural history for the general reader. The *New York Herald Tribune,* for example, pointed out that ecology emerged from the old natural history tradition, but that Elton's success lay in his drawing the field "away from sentiment and anecdote towards the precision that characterizes scientific, that is, valid and usable knowledge."[109] Similarly, the *Times Literary Supplement,* which reviewed the book along with a whole series of popular natural history and nature writings, stressed that it was "an excellent introduction" to scientific natural history emancipated from "the sterner disciplines of morphology and embryology."[110] Animal ecology was thus perceived both in the press and in academic journals as a fresh and new scientific approach that carried on the best of the old amateurish natural history tradition.

Most notable among the reviews was a lengthy and very favorable discussion by Tansley in the *Journal of Ecology.* There were social reasons for such a positive review. Elton had praised and used Tansley's work in his book. Besides, Tansley had just arrived at Oxford and it was important for him to make friends among the new generation of ecologists at this university. But Tansley's praise went far beyond polite networking; Elton had in Tansley's view opened a path to solving one of the main problems in his own research, namely, the yet tenuous connection between botany and social psychology. Tansley now envisioned "a period of intimate cooperation between botanists and zoologists in ecological work" that over time would provide "the solution of the numerous economic problems" for human welfare.[111]

Another factor that may have stimulated Tansley to collaborate with zoologists was the issue of gender. Zoology was much more attractive to "the average 'biological minded' boy" than botany, which, according to Tansley, suffered from "the reputation of being rather 'a girls' school subject.'"[112] In

1929 he had only two students planning to take their final exam in botany compared to ten at the zoology department. To link botany to zoology through ecological relations was thus a way for male botanists to gain entry into a more respected research environment. A broad ecology would be more appealing to Tansley's prospective male students than botany, which was easily associated with the typical female activity of picking flowers. (Research on animal ecology and the Oxford expeditions were exclusively male activities. Women were not welcome as Elton's students until the late 1940s when his first female student was accepted on the condition that she do the dishes.)[113]

Yet some scholars did not like Elton's book. These were the specialists, who disliked the seemingly general, and thus for them unscientific, ecological approach. One scholar with no interest in ecology challenged Elton on some of his more sweeping statements on freshwater copepods, and asked whether or not "the Ecologist [was] attempting the impossible by working upon such an unlimited field? He cannot hope to master the systematic study of many groups of animals or plants, and if he sets himself the task of sifting the reliable records from the unreliable his work is almost as impossible."[114] What this critic reacted to was the unpleasant experience of having his own research field digested as a means to a different end. Elton replied with a long survey of the literature on the nature of copepods, but admitted with unmistakable British irony that "the ecologist has before him an impossible task, and, as Tansley has said, 'to the lover of prescribed routine methods with the certainty of "safe" results the study of ecology is not to be recommended.'"[115]

Elton was now an established scholar. He received a research grant and the university was moving towards offering him a full-time position as demonstrator at the Department of Zoology. At the prospect of such a fortunate development, he noted with joy to Huxley that "I never thought to be an Empire-Builder; but perhaps it's better than staying indefinitely as a Don!"[116] Elton did indeed became an empire-builder, starting with the intellectual cannibalization of competing disciplines he had outlined in the final pages of *Animal Ecology*. His first "meal" would be the natural historians. In the 1920s there were more than sixty journals in which authors wrote about topics relevant for animal ecology, most of them journals of vigorous natural history societies. Elton thought it would be good "to bring these local journals to some extent into the general circulation, and make such ecological work available to the professional scientists . . . [in a] system of references or abstracts."[117] He knew that Thomas Ford Chipp was about to compile the British Empire Vegetation Abstracts for the *Journal of Ecology,* and he approached Tansley with the idea of a similar series of abstracts for zoology. Tansley approved the project and Elton compiled his series, which was published at the same time as the vegetation abstracts. Elton later continued this

rather unusual practice by publishing hundreds of abstracts in every single volume of his own *Journal of Animal Ecology*. For many of his students, these abstracts provided primary source material when they laid out food chains and ecological diagrams.

The Ecological Answer to "the Depression of the Human Trade Cycle"

Elton had yet to get a firm position within the Oxford community and was constantly in search of patrons. He had terminated his contract as university demonstrator in 1928, was living off grants, and those funds ran seriously low. What was worse, fur coats went out of fashion with the crash in the stock market and economic depression, the Hudson's Bay Company had to pinch and scrape, and in 1931 Elton was consequently let go. Much of the economic debate at the time was naturally about business prospects and the duration of the crisis, and Elton soon found himself engaged in this discourse of economic cycles. The patron for this new research was a wealthy American wilderness-lover and stock trader named Copley Amory (of Boston), who thought the ecologist could provide a scenario for business cycles. This was not so far-fetched. In 1929 the Carnegie Institution of Washington arranged a series of conferences on cycles, at which prominent ecologists such as Frederic Clements lectured along with economists on the methods of cycle studies.[118] Their basic message to the anxious business community was that what goes up must come down, that nature's spinning wheel has to go around, and that the stock market thus eventually would go up again. The terminology of succession, climax, and plague captured this narrative of cyclic patterns, and Elton set forth to confirm it in his research on the population dynamics of voles, mice, and lemmings. Amory, his patron, was a large investor in the fishing industry along the Gulf of St. Lawrence in northern Quebec, and in 1931 he invited several ecologists including Elton to his private Matamek River estate to gain a deeper understanding of the economic-ecological dynamic of what Elton labeled "the Depression of the human trade cycle."[119] The trade in fur-bearing animals, game birds, lobsters, cod, and mackerel was at an all-time low, and Amory was concerned about the future of his business. The conference was a major event that included notable professors, directors of companies and museums, the president of the Royal Society of Canada, the deputy minister of mines, and Aldo Leopold (representing the Sporting Arms and Ammunition Manufacturer's Institute).[120]

The result was a beautiful leather-bound volume of the proceedings, *The Matamek Conference on Biological Cycles,* published by the Matamek Factory. Apparently every word of the discussions was recorded by the company's ste-

nographers, and the volume thus provides a lively account of ecological debates at a conference where the management of native Canadians was one of the main topics. Ellsworth Huntington, a particularly broad-minded man, explained to an amazed business community that political parties in the Midwest were determined by climate, that the Russian Revolution could be explained by cyclic sunspots (since "climate has a lot to do with the inert condition of the Russian peasant"), and that there was an apparent relation between climate and sexual activity in Japanese brothels. Climatic cycles were the key to all of this, and the aim of his paper was to explain the natural "ebb and flow of human population" in relation to native Canadians suffering from the collapse of the fur industry.[121] Elton was no less self-confident and used human ecology to explain, for example, why "wives will be for sale" every ten or eleven years in Central Asia because of famine, but he disagreed with Huntington's narrow focus on climatic explanations.[122] For years Elton surveyed the Hudson's Bay Company's archives. He used statistical methods to analyze historical data on fluctuations in fur-bearing animals. To an audience familiar with economic calculations he thus suggested the use of mathematical models and statistics instead of meteorology as the chief tool for understanding evolution and the fluctuations of animal populations. Such studies would "throw considerable light on the way the human population should be regulated," he concluded in a rapid shift from descriptive to normative claims.[123]

For Elton the conference was above all a fundraising event that resulted in major grants from Amory and eventually from the New York Zoological Society between 1932 and 1934. These grants and several others, including one from the Rhodes Trust that was secured by Smuts, helped Elton to establish his Bureau of Animal Population at Oxford.[124] To create even more momentum he wrote several popular books on animal ecology to boost interest in the discipline.[125]

The Oxford University Exploration Club

Elton's activities and the Spitsbergen expeditions caused much excitement within the Oxford community. Students in ecology soon demanded to have their share of the fun and founded the Oxford University Exploration Club. The club was started by the ornithologist Edward Max Nicholson with Elton and Tansley as its first patrons. It was dominated by young students in ecology dreaming about organizing more expeditions to Spitsbergen, the arctic, and beyond.

Expeditions organized by the club were at the very heart of the now-blossoming Oxford school in ecology. Students were encouraged to participate in

multidisciplinary research arranged through the club, with Elton and Tansley as the prime movers behind the scene.[126] Both found the academic setting at an old and traditional university like Oxford a bit odd for a new and progressive science like ecology, and deliberately moved their students out of town to create a suitable educational environment: "[T]he real function of undergraduate exploration," one of the club's members notes, "[is] the extension of an academic education which is inherently out of touch with the wide world."[127] Another function was the male-bonding activity of travelling. The club was remarkably active in the early 1930s, thanks to an annual grant of £50 from the university to carry out at least one expedition a year. Elton was a particularly eager organizer and patron of the club who sent his best undergraduates on a long series of expeditions:[128]

1928: Oxford University Greenland expedition
1929: Oxford University British Guiana expedition
1930: Oxford University Lapland expedition through Norway
1931: Oxford University Hudson Strait expedition
1932: Oxford University expedition to Sarawak (Borneo)
1933: Oxford University arctic expedition (Spitsbergen)
1933: Oxford University New Hebrides expedition
1934: Oxford University expedition to Ellesmere Land
1935–1936: Oxford University arctic expedition (Spitsbergen)
1935: Oxford University Greenland expedition
1936: Oxford University Greenland expedition
1937: Faeroes biological expedition
1938: Oxford Cayman Islands biological expedition
1938: Oxford University Greenland expedition

Ecology was a guiding theme in most of these expeditions, excursions that investigated a whole range of topics through interdisciplinary research ranging from geology to anthropology. It was crucial for undergraduates to cast their applications for grants as ecologically oriented research if they were to get travel money.[129] This was Elton's attempt to carry out the ecological cannibalization of academic research he suggested in his diagram on the final page of *Animal Ecology*. As participant, "home agent," or examiner for returning undergraduates, he would stress the importance of the ecological academic overview of various research fields, and the ability to see relations among the fields.

By 1939, most of the 172 members of the club had participated in at least one expedition. The exclusiveness and macho culture of the expeditions is noteworthy; to be included among the Oxford explorers was a high honor granted to the best male undergraduates, and many who would soon be lead-

ing scientists conducted their first field research under the patronage of the club.[130]

The policy of the club had a clear north-south dimension; many of the arctic explorers felt that their second challenge would be the tropics and thus took a second voyage south, and first-time explorers of the tropics often longed to see the arctic as well. Travelers to Guiana, for example, noted, "The idea of an expedition to the tropics arose quite naturally in Greenland, and members of the 1928 [Greenland] expedition were largely responsible for the experiment."[131] The ecological explorers were used to laying out zones in the sparsely vegetated arctic, and they continued to use this method in the tropics, where they often relied on a pidgin English to communicate with the locals about the nature of various ecological zones.[132]

Another repeated theme in the club literature was environmental concern, and many students learned to cast such problems in ecological terms. Tansley's student Nicholas Polunin, for example, learned to appreciate ecology as a way of framing environmental issues during his visits to Sami-land in the north of Norway and with the Hudson Strait expedition.[133] It was especially the aerial overview of a landscape that taught Polunin to frame environmental issues as global ecological problems. The master perspective from above was crucial to his agenda and to the rest of the Oxford school of imperial ecology.

Huxley and Wells: The Board of Directors in the Economy of Nature

What were the social aims and values of the Oxford school of ecology? At one level the Oxford ecologists clearly had a romantic affection for nature, with zealous arguments for protection and preservation of environments that were about to change because of human intervention. Max Nicholson at the Oxford University Exploration Club, for example, had a keen interest in nature writings in what the historian Donald Worster has labeled the "Arcadian" tradition, from Gilbert White. Nicholson fashioned himself as a follower of White's by writing a long preface to a limited 125-copy gift edition of White's *Natural History of Selborne,* which was clearly meant for romantic high-society nature lovers.[134] However, such Arcadian snobbism was the exception rather than the rule among Oxford ecologists, who endorsed both romantic environmental preservation and hard-core ecological management. To understand this apparent contradiction one may turn to the ecological writings of Julian Huxley and H. G. Wells, two highly respected and widely read intellectuals in their time who saw themselves as forerunners of the new

ecological approach to both preservation and management of the world's natural resources.

In 1925 Huxley resigned his position at Oxford to become a professor of zoology at King's College, London, a decision that seems to have pleased both institutions. Some conservative dons at Oxford realized that Huxley was too much a reincarnation of his grandfather with all his public appearances and popular writings, and Huxley was tempted to work for a better salary in a more progressive teaching environment. Yet Huxley kept in close contact with the Oxford ecologists, including Elton and Tansley (the latter asked Huxley to be "a general biological editor and colleague" in his journal work).[135] In London Huxley made new social connections. One was with the world-famous novelist and science-fiction writer H. G. Wells, who was not only enthusiastic about Huxley's popular writings and Science-for-All series, but also shared his interest in ecology.

Wells's importance to the history of ecology has long been ignored, though his writings are crucial to understanding the popularization of ecology, a word which in the 1920s was still one of those odd scientific terms only a few specialists would understand. This would change through popular ecological writings in best-selling books by Wells, whose numerous novels and scientific essays were for many nonspecialists their primary source of knowledge about science and its importance for understanding the human condition. It was Huxley who introduced Wells to ecology through their collaboration, and together they soon promoted the popularization of ecology (as well as moderate eugenics).

Huxley learned to appreciate Wells's thinking through his novel *Men Like Gods* of 1923. His enthusiastic review of the book shows that he read it as a novel about a future ecological utopia: "The triumphs of parasitology and the rise of ecology have set him thinking; and he believes that, given real knowledge of the life-histories and inter-relations of organisms, man could successfully proceed to wholesale elimination of a multitude of noxious bacteria, parasitic worms, insects, and carnivores."[136] Indeed, Wells's book is about a future harmony of nature in which humans have risen above individual competition and chosen cooperation in a World State, rational birth control, and total manipulation and ecological control of food chains.[137] What Huxley found most fascinating in the novel was an ecological manipulation of nature achieved without utilitarianism. The utopian ecological society was reached, Huxley argued, through the combined interest in two concepts: "the understanding of Nature for its own sake, and its control for the sake of humanity. By control Mr. Wells means not only utilitarian control, but that which, as in a garden, is to please and delight, and that highest control of all, artistic and

scientific creation."[138] These ideas about scientific humanism and social planning would be central themes in both Huxley's and Wells's writings. Their work unveiled a holistic vision for ecology, which however differed from Smuts's holism by focusing on mechanistic explanations and support of international socialism and global planning.

When Huxley met Wells late in 1925 he was immediately invited by him to collaborate with his son George Philip Wells (a former student of Lancelot Hogben working as a zoologist at University College, London), on a book about current trends in biology for a larger popular audience.[139] Huxley seized the opportunity and they soon created a plan for a money-making book with numerous printings and large personal profits gained through heavy marketing and a popular style, a game Wells apparently knew very well. A successful book in the science-for-all genre would give each of the authors a remarkable income of at least £10,000 (in comparison, Huxley earned £1,000 a year as a professor at King's College).[140] No wonder then, that Huxley was thrilled by the economic prospects and, pressed by an impatient Wells, chose to resign from his professorship two years after he got the job in order to devote his time wholly to the promising enterprise of sharing science with the masses.[141] The book was written with great speed and published as *The Science of Life* in thirty glossy fortnightly parts, beginning in March 1929 and ending May 1930, when the parts were then compiled into a book format.[142]

The book's section on ecology is introduced with a picture of a beastly lion, who with shining green eyes bares its teeth over a dead zebra, with the subtitle "I am the Eater and the Meat" as an illustration of "An African Food-Chain."[143] This was clearly not an image of nature on the lines of Smuts's holistic harmony, but rather a view of nature dominated by the dreadful force of the survival of the fittest. The section about ecology is representative of the Oxford school in ecology—it was written by Huxley and scrutinized in its entirety by Elton before it was edited to fit the science-for-all style by Wells.[144] It follows the sequence of a natural history survey of life on Earth, and the aim of the section was to summarize and to help readers obtain a grand overview of the life sciences discussed in the book.

The role of ecology was to organize the natural history of species into a "community or society of organisms" that created the "vital balances" of nature. The authors fashioned these balances of nature as "biological economics" after political economy, arguing that "ecology is really an extension of economics to the whole world of life."[145] The economy of nature was not an analogy or metaphor for the economy of the state—the relation between nature and society was much closer than that. Ecology was an *extension* of political economy:

> [Political Economy] tries to elucidate the relations of producer, dealer, and consumer in the human community and show how the whole system carries on. Ecology broadens out this inquiry into a general study of the give and take, the effort, accumulation and consumption in every province of life. Economics, therefore, is merely Human Ecology, it is the narrow and special study of the ecology of the very extraordinary community in which we live.[146]

Social economics was another word for human ecology, and the close connection between economy and ecology (also seen in Elton's animal ecology) demonstrates that British ecologists were deeply engaged in human interaction with nature.[147]

What concerned the authors was the relation between human agency and "Nature's agency" (with a capital *N*).[148] They saw nature itself as an actor and agent in the evolutionary and eugenic drama that formed and continued to transform the human condition. The coherence between human agency (economics) and nature's agency (ecology) explains how human communities evolve into complex societies dependent on life communities in nature. As an example they used Elton's research for the Hudson's Bay Company on the statistics of lynx skins bought from 1830 to 1914 to illustrate the connection between ecological circles and political economy. Human communities cope with the balance of nature in different ways, they argued, because some people have a stronger ability to control nature's ecological agency than other people. This gives them power to colonize other countries: "[t]he colonization of new countries, the change from forest to fields, the reclamation of land from sea, the making of lakes" are all commensurable events in "The Ecological Outlook."[149]

It is remarkable and telling that colonization of a country, including suppression of its people, was no different from changing forest to fields, reclaiming land from the sea, and constructing lake ecologies. Wells, Huxley, and Wells admit that the process of colonizing other countries can cause change "forced on nature at the point of human consciousness," but their own conscience was only concerned with the "danger" of "tapping new [natural] sources of chemical supply and new sources of energy" and thus disturbing an old balance of nature, and even introducing "devastating pests."[150] To succeed in the ecological colonization of another country one had to enslave nature's agency and force evolutionary processes in the direction of colonizing for the country's welfare. The authors were well aware of the hubris involved in the attempt to control nature's agency. Great things can be achieved, they argued, but this might have unexpected outcomes. In a manner similar to the structure of Wells's *Men Like Gods,* these authors reel

off an impressive list of the glorious things mankind can accomplish with the Ecological Outlook, but they also remind the reader of the unforeseeable consequences of the ecological project: "[Man] can colonize a new country in record time . . . [but he] upsets the balance of nature . . . He can reduce disease and the wastage of human life; [but] he is brought up against the danger of perpetuating weakly stocks that might better never exist at all."[151] This is the very danger, this is the hubris, of departing from the ecological laws of nature.

Faced with the danger of people being born who from the ecological outlook should not exist, the authors conclude that "[man] cannot leave details to Nature and expect her to be on his side" unless scientific research swiftly controls the circulation of energy and matter: "From the standpoint of biological economics, of which human economics is but a part, man's general problem is this—to make the vital circulation of matter and energy as swift, efficient, and wasteless as it can be made; and, since we are first and foremost a continuing race, to see that we are not achieving an immediate efficiency at the expense of later generations."[152] Another impending danger, the authors argued, was the inefficient and extensive use of matter and energy at the expense of future generations. Humans waste "bottled sunshine" (oil and coal), for example, "thousands of times more quickly than Nature succeeds in storing it," they kill more animals than nature produces, burn more trees than nature can grow, and so on.[153] Confronted with such environmental havoc humans need to reconsider their fundamental values: "Man's chief need today is to look ahead. He must plan his food and energy circulation as carefully as a board of directors plans a business. He must do it as one community, on a world-wide basis; and as a species, on a continuing basis."[154]

Needless to say, the authors had a bold answer to the environmental crisis. The concept of management is taken to an extreme, with a board of directors planning the business of food and energy circulation on a worldwide basis. This was not metaphorical language: they literally envisioned themselves as being on the board of directors in the economy of nature, managing the circulation of matter and energy for the world. The model was not free-market utilitarian economy, but rather socialistic planned economy. Chapter 6 will discuss this in some detail; at this point, however, it is worth mentioning that Huxley later realized his plan when he became director-general of the United Nations Educational, Scientific and Cultural Organization, as well as initiator of the International Union for Conservation of Nature.

The task for the directors of nature's economy was first of all "to adjust population to supplies" (not the other way around).[155] Following Carr-Saunders, they argued that the job of population control was pressing "as urgently as war" because the limited amount of resources in the world could not sustain the growth of the human population. The authors thus felt they somehow had to find means to control human sexual behavior. To pin down their point, they stressed the urgent need to keep a credit-worthy economy of nature: "[The human] species must have its reserves of nitrogen and phosphorus, of timber-growth and soil-fertility, of useful animals and of sources of energy, just as surely as the Bank of England must have its reserves of gold and credit."[156] John Maynard Keynes had yet to influence financial thinking when *The Science of Life* was written, so a fixed gold standard and balanced state budgets were still part of the holy dogma of economics in the late 1920s.[157] The gold reserves at the Bank of England and its policy of a firm gold standard were seen, at least in Britain, as the very foundation of the British Empire. The common opinion was that economic fluctuations had the form of *cycles:* some argued that fluctuations occurred because of seasons and climate, whereas others pointed to banking practices with cycles of loans and reserves. Yet another more radical group stressed that fluctuations in the market were caused by maldistribution of wealth in society. The consensus, however, was that to minimize the trouble caused by economic cycles one had to balance all budgets and have a firm base in a natural gold reserve. It is therefore no surprise that the authors of *Science of Life* appealed to the gold reserve of the Bank of England as a basis for the economy of both nature and society. Population growth was conceived as a problem because more children meant more consumption of natural resources, which would undermine the balanced budget of the economy of nature and thus the hope of ever balancing the state budget and keeping the gold standard.

The engineers had a crucial role in the economic model the directors of nature's economy imagined, since they would carry out the struggle against the industrial or natural environment. The engineer and the scientist played crucial roles in the management of nature's economy through their knowledge of labor discipline and workshop organization based on scientific studies of human efficiency. Studies that filmed laboring workers were in *Science of Life* expanded to ways of organizing and disciplining nature's agency.[158] The goal was higher efficiency and energy output from the labor source in the economy of nature while maintaining a balanced budget of nature. The nuts and bolts of ecological research, the material methods of investigation such as use of quadrates, life zones, vegetation maps, and aerial photography, could be used to improve the efficiency of nature's labor. These would in turn be of great help to humanity, since human economy was an integrated part of nature's ecology. The executives of nature should lead it all. Chapters on "The Nourishment of the Body," "Fresh Air and Sunlight," "The Present Health

of Homo Sapiens," as well as several chapters on the development of the human mind in relation to the environment all emphasized how nature can be modified for human purposes and reciprocally how humans must change their own habits to fit in with the balance of nature.[159] These include action against smoke pollution, an urgent need for cleaning up the atmosphere and limits on the use of coal and oil, ecologically sound ways of using fertilizers, and a slowdown of the current "breeding storms" in human communities by the means of birth control and eugenic improvements of the human stock.[160] This, the authors envisioned, can best be achieved through a collective human mind—or a "World Brain" as Wells later put it—represented by the joint body of scientists around the world.[161]

Science of Life was a great success, and the reviewers went out of their way to praise its educational value. "Wells at His Best," one reviewer noted (his son and Huxley were largely ignored)—"a fine introduction to ecology."[162] The sales of the fortnightly parts exceeded expectation; they were first compiled into a three-volume edition followed by a two-volume release, which soon was made into one book before it was re-released in a nine-volume edition, followed by a four-volume version, and so on—all subject to variations in the science-for-all movement in various countries and languages.[163] There is thus good reason to believe the authors made the fortune they had envisioned, with a steady flow of royalties well into the 1950s, when the volumes were gradually replaced as the standard textbooks for core courses in biology. Yet the book's importance was not limited to students and lay people. Various Oxford ecologists used ideas from the book in their research, and as a bulwark against General Smuts's politics of holism.

In sum, Oxford ecologists managed through a series of expeditions in the 1920s to enlarge their discipline beyond botany into forestry, zoology, and finally sociology through a process of cannibalizing competing approaches into an ecological order of nature. The chief research instrument in this process was the airplane, which offered the ecologists a desired overview of the environment they investigated. The aim of their research was to empower the social order of their patrons in various colonial agencies or commercial companies by ordering the economy of nature so that it could serve the social economy of British imperialism. This was achieved by rendering the ecological order of nature into an order of knowledge suitable for managerial overview. This aerial view on nature, society, and knowledge—*the master perspective from above*—was at the very core of British ecological reasoning.

Yet there were still methodological problems that troubled the Oxford ecologists, concerns brought to the surface by Smuts, who came to Oxford

in November 1929 to lecture about the politics of holism. These lectures sparked a heated controversy between Tansley and Phillips (the follower of Smuts and Clements), which will be the topic of the next chapter. As Elton noted in a letter to Huxley in 1929, "Clements is drugged with words. And yet, I am coming to the conclusion that biology may after all need a complete new language before we can get much further."[164]