

Sources for Imanishi Kinji's views of sociality and evolutionary outcomes^{1,2}

PAMELA J ASQUITH

Department of Anthropology, University of Alberta, Edmonton, AB T6G 2E1, Canada

and

School of Environmental Studies, University of Victoria, Victoria, BC V8W 2Y2, Canada

(Email, pasquith@ualberta.ca)

Prior to the contribution of genetics or the modern evolutionary synthesis (MES) to natural selection theory, social ecologists searched for factors in addition to natural selection that could influence species change. The idea that sociality, not just biology, was important in determining evolutionary outcomes was prevalent in research in social ecology in the 1920s and 1930s. The influence of 'tradition' (or the transmission of learned behaviours between generations) and the view that animals are active in selecting their own environments, rather than passive organisms acted upon by chance, were given as much attention as natural selection theory in European ecology, while animal aggregation and cooperation studies were pursued in America. Imanishi Kinji's personal library and his scientific notes and papers reveal that he was well aware of this literature and had been profoundly influenced by these earlier viewpoints prior to writing his view of nature in his first book, *Seibutsu no Sekai* (The World of Living Things, 1941). Evidence is presented to show that he developed his theories based partly on early western debates in social ecology while finding inspiration and a way to express his views in the writings of philosopher Nishida Kitarō and, perhaps, General J C Smuts. One of Imanishi's lasting contributions is in the demonstrated results of over 40 years of subsequent ecological and ethological research by Imanishi and those trained by him that maintained the broader viewpoints on evolution that had been dropped from the western corpus of research by the 1950s. The current attempt to again get beyond natural selection theory is reflected in debates surrounding genetic and cultural evolution of cooperation, the biology of 'traditions' and the idea of 'culture' in animal societies.

[Asquith P J 2007 Sources for Imanishi Kinji's views of sociality and evolutionary outcomes; *J. Biosci.* **32** 635–641]

1. Introduction

Charles Darwin's theory of evolution was introduced to Japan in 1877 (Morse 1936/1877) during Japan's push to gain military modernity through study of western sciences and technologies and the culture from which they had arisen. In the ensuing decades the theory of evolution was applied as a kind of social scientific tool, i.e. social Spencerism (or social Darwinism) (Sakura 1998:341; Unoura 1999). Sakura (1998) suggests that the theory of evolution did not have much biological application in Japan. Instead, Japanese

applied the idea of 'the survival of the fittest' (which was a misreading of Darwin's natural selection theory) to society and to individuals in the struggle for existence in Japan's new international circumstances (*see* also Gluck 1985: 13, 265).

However, at least by the second decade of the 1900s, and by the time that Imanishi Kinji entered the Kyoto Imperial University, the curricula in the natural and earth sciences were largely based on German language sources and later on English language texts. These exposed students to something very different from a social Darwinist approach in these sciences. New sources that allow us to follow

Keywords. Evolutionary theory; historical ecology; Imanishi Kinji

¹ Imanishi Kinji is the Japanese name order, with family name first. Other Japanese names in the text are also written with family name first.

² A modified version of this paper appeared in Japanese in *Seibutsu Kagaku*, Vol. 57 No. 3, April 2006, pp 142–149.



Figure 1. Imanishi Kinji at Kisoro, Uganda with Walter Baumgartel, 1958. (Courtesy of Primate Research Institute, Kyoto University, Japan).

Imanishi's early intellectual journey reveal that, contrary to a socio-political or cultural underpinning to his ideas as has been maintained by Halstead (1985) and Dale (1986), among others, there was instead an almost seamless fusion of Western and Japanese science and outlook in Imanishi's views as stated in his first book, *Seibutsu no Sekai* (The World of Living Things),³ published in 1941. Revisiting the work of Imanishi allows two important things. One is to correct the misperception of what has been depicted as a purely political or culturally 'made-in-Japan' view of ecology, evolution and sociality of organisms. The second is to permit a re-evaluation and application of ideas that drew on far more than natural selection theory to explain behaviour and evolution within a modern scientific environment that finally has become receptive to a broader viewpoint based on even firmer evidence than was available to the pioneers in ecology. It should be stated at the outset that it was one of Imanishi's former students, Sibatani Atuhiro, who worked for the bulk of his career as a geneticist in Australia, who introduced Imanishi's anti-selectionist theory to English language readers in the *Journal of Social and Biological Structures* urging that biologically, his theory should be assessed seriously (Sibatani 1983).

Imanishi (1902–1992) was an entomologist, ecologist, anthropologist, and founder of primatology in Japan. His

³ The book has been translated into English (Asquith *et al* 2002) and German (Wuthenow and Kurahara 2002).

basic view emphasized cooperation rather than competition in the natural world. This view held that "lifestyle partitioning" (*sumiwake*) among coexisting species explained the origin, or differentiation, of species. His concept of "species society" (*shushakai*, which he named *specia* in English) likewise focussed on members of a species and their interactions with one another as a whole that maintain an equilibrium, rather than on the morphological differences and reproductive fitness of individual members of the species. The species, therefore, was as much a social as a biological phenomenon in Imanishi's view. This view, sometimes called 'Imanishi evolution', has in its turn, like social Darwinism, been marshalled as evidence for Japanese views of the nation in science and beyond. However, this (to modern eyes) seemingly arcane concept of the species society and change in species through time by virtue of factors other than natural selection was not unique to Imanishi. It appears closely related to what Imanishi was exposed to in western sources during his formative undergraduate and graduate years, coupled with influences from Japanese and Western philosophy. We are fortunate that Imanishi wrote his views just after completing his doctorate, at a time when his wide reading had developed into a viewpoint that he followed in his considerable research career that followed. *Seibutsu no Sekai* is written as a philosophical musing on the nature of life, both organic and inorganic. He considered that since they arose together, the organic and inorganic processes should be considered as part of a single interactive world. It



Figure 2. Imanishi Kinji at Mukuyu base, Kabogo Cape, Tanganyika (now Tanzania), 1961. (Courtesy of Primate Research Institute, Kyoto University, Japan).

is very interesting that many of the ideas can be seen in current attempts to look at nature within a broader context. In most cases, entire books are devoted to just one or another of the ideas contained in Imanishi's first book. Thus, in the last 15 years, despite the precedence of genetics research, animal behaviour researchers, cognitive psychologists, anthropologists and theoretical biologists are reexamining the broader explanations for behaviour and evolution, such as the Fragaszy and Perry (2003), and Hammerstein (2003) collections on tradition and cooperation, and Avital and Jablonka (2001), Jablonka and Lamb (2005), Margulis and Sagan (2003) and Wilson (2005) on epigenetic factors in evolution. Of great use to current concerns is that in Imanishi and his followers' research we can see some of the results that can arise from this perspective. We may find also some stimulus from recognizing the earlier viewpoints of western ecology and the talented use to which they were put by Imanishi.

2. New resources on Imanishi's thought

Important new resources for the development of Imanishi's thought have come to light quite recently. In 2001 the personal notes and papers of Imanishi were found in the family home in Kyoto by his eldest son, Imanishi Bunatarō (b. 1930). The collection dates from 1919-1980 and includes approximately 8000 pages of Imanishi Kinji's letters, field diaries and field notes from several decades, volumes of his undergraduate study books, volumes of his notes on western

authors in several disciplines, drafts of papers, travel and field budgets, maps, hotel and book receipts, among others. The materials are written in Japanese, German and English, as for instance, when commenting upon German language sources, Imanishi copied the original passages in German. These sources have been digitally photographed, catalogued, and made available on the worldwide web as *The Kinji Imanishi Digital Archive* (Asquith 2004, 2003). The original materials remain in the Imanishi home.

A second resource that is publicly available but has rarely been utilized is Imanishi's own library of books and papers that he donated to Gifu University when he retired as President of the University. The collection is comprised of some 2900 items, of which approximately 500 are English language volumes.⁴ These latter are books on western anthropology, ecology, evolutionary theory, psychology, sexology, and mountaineering, among others. Imanishi made many notes in the margins of the books, usually in the language of the original. He read these sources so carefully that he actually made corrections or improvements to the English in some passages. He usually obtained new books within a year or two of their publication date, even during the war and immediate postwar years. He thus remained very current with developments in these disciplines. These volumes, together with the digital archive resource, provide a window on Imanishi's intellectual journey.

⁴ A brief description of the donation can be found at: www.gifu-u.ac.jp/~gulib/Eng/shozo/donation.html.

3. Imanishi's intellectual background

A contributing factor to Imanishi's views must be his very broad research background. He received a Bachelor's degree in 1928 from Kyoto University, specializing in entomology. He then turned to the relatively new discipline of ecology for graduate research, excited by the prospect of studying living organisms interacting with their natural environment. He received a Doctor of Science degree in 1940 from Kyoto University. In the next year he published his first and perhaps best known book, *Seibutsu no Sekai*. The book, he said, related the views that had supported his biological work thus far. We can see the unfolding of these ideas in his research notes a full decade before his publication. In later years Imanishi still considered the book to be one of his most important publications and it can be seen as a basis for much of the research that followed.

As an undergraduate and graduate student he witnessed the considerable debate among western ecologists about the efficacy of natural selection theory to explain evolutionary processes. He was to remain a lifelong 'anti-selectionist', or critic of Darwinian and neo-Darwinian evolution, though not of the fact that species have evolved. His personal study notes and papers reveal a probing, restless scholar with a huge capacity for synthesis and for fieldwork in several subfields. Part of what impelled Imanishi's remarkably broad range of scientific interests was an accident of history. At every turn his research was cut off by world events, as he relates midway through his career (Imanishi 1966). He had planned a scientific expedition to Borneo to study orangutans during World War II, but conditions made that impossible. Instead, he went to Mongolia where he began field studies of pastoral tribes. In 1944 he became the first Director of the Seihoku Kenkyūsho (Northwest Research Institute) there doing research in ecological anthropology.

Imanishi left Mongolia in 1946 when the Institute was closed in the aftermath of the war. Shortly after his return to Japan he initiated various naturalistic studies of animal behaviour, which soon became focussed on Japanese macaques and later on other primate species. Much of his reading of the then scanty primate behaviour literature was to understand the evolution of the family (whether that was the originator of human sociality). To this end, he also read widely on American sexology research of the 1950s and 1960s.

In 1950, at age 48, he became a lecturer in the Institute for Humanistic Studies at Kyoto University. In 1959 he became Professor of Social Anthropology at Kyoto University. He also established the Laboratory of Physical Anthropology and in 1962 was appointed Professor there too. After mandatory retirement from the Imperial university, he became Professor of Cultural Anthropology at Okayama University in 1965, and president of Gifu University in

1967, continuing actively to research and publish. For over 20 years after this his interests were with grand theories in evolution.

At the age of 82, he wrote a paper on his proposal for *shizengaku* (nature study) as a culmination of his efforts to dissolve disciplinary boundaries and mechanistic approaches to nature that he saw in the ever increasing specializations in science. Imanishi also found inspiration and a way to express his views in the writings of the philosopher Nishida Kitarō (1870-1945). Nishida's (1921/1990) view that everything came from a single source and fit within a coherent whole was echoed in Imanishi's view of evolution and the current complexity of life. It is only up to us to find how the parts of the whole fit together. Imanishi's opening paragraphs in *Seibutsu no Sekai* also appear to echo passages in General Smuts' (1926) *Holism and Evolution*, as can be seen by those familiar with the contents of *Seibutsu no Sekai*. Imanishi acquired Smuts' volume in 1938, much longer after its publication than usual for Imanishi. Still, it was prior to writing his own first book. If we look at some parallels, Smuts wrote: "Life ... has (not) flown to our shores from some world beyond this world; mind or soul is not an importation from some other universe..." (Smuts, 1926: 8). Elsewhere, Smuts wrote: "A living organism is not an organism plus life, as if life were something different and additional to it; it is just the organism in its unique character as a whole" (Smuts, 1926: 110). Imanishi in his turn wrote about the senseless dichotomy between the body and 'life', and the idea that the body is ephemeral and perishable while the soul is eternal. Sometime after 1938 Imanishi acquired Peter Kropotkin's *Mutual Aid* (1902), but it did not have nearly the impact on his writing as the ideas of ecologists writing in the 1920s and 1930s. Evidence for that is in the extent of notes and markings made in the text by Imanishi as explained below.

4. Imanishi's philosophy

Although the most important list of sources on which Imanishi drew in ecology are contained in the two volumes of *Abstracts from Ecological Literatures*, 1935-1939 and 1940-1945 (which can be read in *The Kinji Imanishi Digital Archive*), one can demonstrate the 'ideas in the air' of the 1920s and 1930s from another source that is strikingly similar in style to Imanishi's *Seibutsu no Sekai* in that the author wrote it as a series of personal reflections on 'The Future of Animal Ecology'. This was Charles Elton's (1930) *Animal Ecology and Evolution*. Elton was professor of zoology and comparative anatomy at the University of Oxford. In Imanishi's signed copy of the book at Gifu University we can see that he acquired it in March, 1931 and read it very closely, making notations on nearly every page.

Elton, along with many ecologists in Europe and America at the time, debated the merits of Darwin's natural selection theory. All were convinced that evolution had occurred, but many looked to factors *in addition to* natural selection for precipitating species change. Animal migration studies by British ecologists had given rise to the idea that animals are active in selecting their own environments, rather than passive organisms acted upon by chance (or natural selection). Elton also acknowledged the contribution of a Canadian ecologist, John C Farthing, of McGill University, who had suggested two of the main ideas put forward in the book (the idea of animals being aware of the suitability of their surroundings and the possible importance of tradition). In other words, these ideas were out in the world, not restricted to a small cohort of isolated researchers.

Elton's summary of five factors that are likely to be important in evolution will sound familiar to people who have read *Seibutsu no Sekai*. He included, in addition to natural selection, indifferent or nonadaptive variation, sexual selection, 'tradition' (or the transmission of learned behaviours between generations), and the selection of the environment by individuals. Further, Elton discussed adaptation as being produced by the *selection of whole populations*, not of individuals. He also suggested that when a population expands into an empty habitat, the *struggle for existence tends to stop*. Imanishi's contention that when it comes time to change all individuals will change appears similar to the idea of selection of whole populations. In particular, Imanishi's view that competition in the natural world is largely wasteful, so that organisms are more likely to avoid it, finds support in these ideas.

During the same period, studies in social ecology in America also reflected the idea that sociality, not just biology, was important in determining evolutionary outcomes. The University of Chicago's W C Allee's (1931) well known *Animal Aggregations* was subtitled *A Study in General Sociology*. Developing the ideas further, Allee *et al* (1949: 6) in *Principles of Animal Ecology*, explained: "We view the population system, whether intraspecies or interspecies, as a biological entity of fundamental importance." Walker (2005:191) also observes that "this 'biosociological' approach inherent in this text reminds one of both Elton and Japanese ecologists in their approach to animal ecology". Mitman (1992:1, 83) has shown how closely linked ideas of cooperation in nature were with evolution in the Chicago school of ecology, as well as the idea that the ecological study of plant and animal societies could help to bring biological understanding to human society. The ideas taken from social ecology and developed by Imanishi and his considerable school of students and young co-workers were very much in the air in Europe and America for decades until genetics research changed the course of evolution studies.

5. Modern echoes

It is difficult to say which influenced Imanishi more, Nishida Kitarō's deeply held view of unity in the world, Imanishi's own observations of nature, or if the writings of western ecologists fit well enough with his own philosophical leanings to make him incorporate them so seamlessly into his writings. Thus far, mention has only been made of writings of scientists, not of western philosophers. Imanishi also read social philosophy and social history such as in the works of Lewis Mumford, Alfred Espinas and A J Toynbee⁵ though these were after he wrote *Seibutsu no Sekai*. Imanishi's intellectual journey reveals that he could plumb western research in a timely manner despite the challenges of extreme political unrest, nationalism and poverty following the Sino-Japanese and Second World Wars, and despite considerable language barriers.

To turn to the more recent developments in theories about the ecosystem and evolution which appear to resonate with Imanishi's work, a selection are considered alongside of Imanishi's comments on the subjects. Among these are the work of Kay and Schneider (1994) in their paper "Embracing Complexity". The authors seek ways to set out rules for proper ecosystem management in the face of environmental degradation and change. They critique the kind of approach whereby people demand quantitative prediction of ecosystem behaviour based on simple, basic, universal laws. This, they say, is almost impossible to come by. Because the world is made of living and non-living stuff with multitudes of interrelationships, any single defined ecosystem is just one package of stuff and relations. An ecosystem can refer to what is happening on our eyelashes, in our gut, or in a lake or a boreal forest. Imanishi in *Seibutsu no Sekai* assumes the same 'completely different worlds' for different life forms. To understand all of the micro-environments of organisms is well beyond our capacity, but to the extent that we succeed we may offset the mistakenly gross view of 'one environment for all', usually understood anthropocentrically, the closer we will be to a realistic view of the world.

Another example is that of Laland *et al* (2000) and Odling-Smee *et al* (2003) who, while remaining within the parameters of natural selection theory, nonetheless recognize that organisms are active in their lives, rather than passively responding to chance. They are exploring the idea that organisms are able to modify sources of natural selection in their environment (called 'niche construction'). By broadening the evolutionary dynamic to incorporate

⁵ Imanishi's extensive notes on these authors, among others, can be seen in the 'Individual Notebooks' section of *The Kinji Imanishi Digital Archive*. They are comprised of 17 volumes of notebooks on western thinkers that Imanishi wrote between 1938 and 1950. Notes on Kropotkin's (1902) book are among these.

ontogenetic and cultural processes, phenotypes can be assumed to have a much more active role in evolution than generally conceived. Even culture can affect natural selection (see also Avital and Jablonka 2001 and Jablonka and Lamb 2005). Imanishi had discussed the micro-environment around each species and each individual, and the organism's effect on its micro-environment in his 1941 publication. In that regard, David Sloan Wilson's (2005) thoughts on the interaction of natural selection and complex systems almost represent a neat summary of Imanishi's observations on microniches of plant and animal life and their relationship with their environment. Wilson writes:

“Consider the community of microbes, fungi and invertebrates that inhabit the root zone of plants. Each plant and its associated fauna can be regarded as a local ecosystem, whose members interact primarily among themselves and with the physical environment in the immediate vicinity of the plant” (p. 157).

Wilson (2005; 154) feels that rejection of group selection (Wynne-Edwards 1962, 1986) was premature and that single-species systems can evolve into adaptive units (and takes it even further to suggest that entire ecosystems can evolve into adaptive units). These are ideas with which Imanishi would have had much sympathy and echo his idea of the primacy of the species society or *specia* over the individual in effecting evolution.

Roger Lewin (1996) in his paper “Evolution's New Heretics” discusses the fact that a growing number of evolutionary biologists think that the interests of groups sometimes supersede those of individuals. This refers, in addition to altruism theory, to the idea that relationships, not only individuals, can be considered as vehicles of selection. These were simply metaphors for Lewin, but he suggested they could give rise to important testable questions. Imanishi and those influenced by him did not consider these to be metaphors, but expected and recorded differences among individuals and groups of the same species to help to build up a picture of species behaviour.

Mary Midgley (2001), a British moral philosopher, argues for the importance of not separating science from the rest of our ways of understanding what is around us. She too cites ideas of how an organism affects its physical and chemical environment (like Imanishi and Laland *et al* above). In a passage eerily reminiscent of Imanishi's metaphor she says that ‘life is not an alien invader, but something which has grown out of the earth itself’. She even uses a ship metaphor of differentiation within one world body – as did Imanishi in his opening passages in *Seibutsu no Sekai* of how diversity came to exist on earth.

In another area, distinctions between living and nonliving were fundamental to Imanishi's viewpoint. In particular, in the final paragraph of his second chapter ‘On Structure’ in *Seibutsu no Sekai*, Imanishi shows that if the world is

conceived as one of space and time, of structure and function and of matter and life, we can conceive of everything as ‘different kinds of life: the life of nonliving things, the life of plants, the life of animals and the life of human beings’. The things of this world are similar in essence, but at the same time they are different. Although they differ, we can perceive a commonality (recognition of degrees of affinity are another important argument for Imanishi); in this we can glimpse the character of this world, which originally grew and developed from one thing. Here, Imanishi does no less than state how the world and everything in it is tied together. More than 50 years later, Stanley Shostak (1999) in a ‘critique of differences that separate life from nonlife’, notes: “The idea of features of life that distinguish it from nonlife is philosophically flawed inasmuch as life's exclusive features are derived tautologically. Ultimately, all the differences of living things that separate them from nonliving things fade at the point where life came from nonlife – whether from ‘ashes’ or abiogenesis – and rudimentary living forms emerged from the physics and chemistry of the early-Earth atmosphere.” Shostak continues: “Conceptions of life based on differences with a nonliving world do dissuade to the search for a unifying theory of life. Even elementary thermodynamic principles inform us that life is inseparable from its abiotic environment, but biologists routinely portray life as an isolated system, as separate from nonlife as black and white. The distortion spreads to all levels of complexity: at the physiological level where individuals exchange oxygen and carbon dioxide with their environment, and at the biogeological level too. Indeed, erasing the present, static charcoal sketch of differences between life and nonlife might reveal an underlying portrait of life in fully saturated colors” (Shostak, 1999; 21).

6. Concluding remarks

The history of science provides plenty of examples of how, in addition to the soundness of an idea, intellectual fashions, politics, or plain luck have affected what topics or approaches become dominant. History also reveals how ideas are constantly refashioned in the global market of the academy, that there is a healthy diversity of ideas and that, before one or other approach takes precedence, most voices are heard in one way or another. Particular observations may become subsumed within larger theories so that originators and nationalities are forgotten.

Imanishi Kinji's *Seibutsu no Sekai* is rather special for two reasons. One is that there is perhaps no other ‘philosophy of nature’ written by a scientist in 20th century Japan. Although it depicts the thought of one person, not a ‘Japanese approach’ to nature, it is nonetheless as important as any single philosophical statement that represents influences of the time on a person's thought. Secondly, Imanishi was very

widely and multilingually read in the natural science of his day as well as being very active in fieldwork across a range of disciplines. This adds to the weight of his ideas as most philosophical comment in science was and is not based in practical experience. The fact that we can see today many echoes of the broad range of ideas that Imanishi incorporated into his own philosophy is simply amazing and deserving of attention, in that Imanishi actually applied this outlook to decades of fieldwork that we can read with renewed interest.

More than a third of the collection, nearly 3000 pages, are fieldwork notes and diaries recorded in *The Kinji Imanishi Digital Archive*. These reveal, more than anything else, how he approached his work, how his ideas developed – what was discarded and what was kept, the moments of sudden inspiration, and the general hard dedication to close and careful fieldwork. There are many wonderful insights into the ultimately human side of research too, for Imanishi and those who worked with him.

References

- Avital E and Jablonka E 2001 *Animal tradition: Behavioural inheritance in evolution* (Cambridge: Cambridge University Press)
- Asquith P J, Kawakatsu H, Yagi S and Hiroyuki T (transl.) 2002 *A Japanese view of nature. The world of living things by Kinji Imanishi* (London: RoutledgeCurzon)
- Asquith P J 2003 Kinji Imanishi – Digital Archive Project; *Kagaku* 1351–1354
- Asquith P J 2004 *The Kinji Imanishi Digital Archive* (<http://tomcat.sunsite.ualberta.ca/Imanishi/>)
- Elton C 1930 *Animal ecology and evolution* (Oxford: The Clarendon Press)
- Fragaszy D and Perry S 2003 *The biology of traditions: Models and evidence* (Cambridge: Cambridge University Press)
- Gluck C 1985 *Japan's modern myths: Ideology in the late Meiji period* (Princeton: Princeton University Press)
- Hammerstein P (ed.) 2003 *Genetic and cultural evolution of cooperation* (Cambridge, MA: MIT Press)
- Halstead B 1985 Anti-darwinian theory in Japan. The popularity of Kinji Imanishi's writings in Japan gives an interesting insight into Japanese society; *Nature (London)* **317** 587–589
- Imanishi K 1941 *Seibutsu no Sekai* (Tokyo: Kōbundō shobō)
- Imanishi K 1966 The purpose and method of our research in Africa; *Kyoto Univ. Afr. Stud.* **1** 1–10
- Imanishi K 1984 A proposal for *shizengaku*: the conclusion to my study of evolutionary theory; *J. Social Biol. Struct.* **7** 357–368
- Jablonka E and Lamb M J 2005 *Evolution in four dimensions: Genetic, epigenetic, behavioral and symbolic variation in the history of life* (Cambridge, MA: MIT Press)
- Kay J and Schneider E 1994 Embracing complexity. The challenge of the ecosystem approach; *Alternatives* **29** 32–39
- Kropotkin P 1902 *Mutual aid. A factor in evolution* (London: Heinemann)
- Laland K, Odling-Smee J and Marcus F 2000 Niche construction, biological evolution, and cultural change; *Behav. Brain Sci.* **23** 131–175
- Lewin R 1996 Evolution's New Heretics; *Nat. Hist.* **5** 12–17
- Margulis L and Sagan D 2003 *Acquiring genomes. A theory of the origins of species* (Perseus)
- Midgley M 2001 *Science and poetry* (London and New York: Routledge)
- Mitman G 1992 *The state of nature: Ecology, community, and American social thought, 1900–1950* (Chicago: Chicago University Press)
- Morse E S 1936/1877 *Japan day by day* (Tokyo: Kobunsha)
- Nishida K 1921/1990 *An inquiry into the good* (trans. by M Abe and C Ives) (New Haven: Yale University Press)
- Odling-Smee J, Laland K and Marcus F 2003 *Niche construction. The neglected process in evolution* (Princeton University Press)
- Sakura O 1998 Similarities and varieties: A brief sketch on the reception of Darwinism and Sociobiology in Japan; *Biol. Philos.* **13** 341–357
- Shostak S 1999 *Evolution of sameness and difference. Perspectives on the human genome project* (Harwood: Academic Publishers)
- Sibatani A 1983 The Anti-selectionism of Kinji Imanishi and social anti-Darwinism in Japan; *J. Social Biol. Struct.* **6** 335–343
- Smuts J C 1926 *Holism and evolution* (New York: The MacMillan Company)
- Unoura H 1999 Samurai Darwinism: Hiroyuki Katō and the reception of Darwin's theory in modern Japan from the 1880s to the 1900s; *Hist. Anthropol.* **11** 235–255
- Walker B 2005 *The lost wolves of Japan* (Seattle and London: University of Washington Press)
- Wilson D S 2005 Natural selection and complex systems: a complex interaction; in *Self-organization and evolution of social systems* (ed.) C K Hemelrijk (Cambridge: Cambridge University Press) pp 151–165
- Wynne-Edwards V C 1962 *Animal dispersion in relation to social behaviour* (Edinburgh: Oliver and Boyd)
- Wynne-Edwards V C 1986 *Evolution through group selection* (Oxford: Blackwell Scientific Publications)
- Wuthenow A-B and Satoko K (transl.) 2002 *Imanishi Kinji. Die Welt der Lebewesen* (München: Iudicium)

ePublication: 10 May 2007