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Resource Management and the Development of *Homo*

The Long March toward Farming

David Olney, Arthur Saniotis, and Maciej Henneberg

It is undeniable that the development of farming in a number of places, and the domestication of different animals at the same time, mark a pivotal point in the history of *Homo*, but there is a danger of obscuring the developmental processes that led to this point if too much emphasis is put on the endpoint. There is most definitely a point at which humans can be said to be farmers and a long period of time before this point during which they cannot be said to be farmers, but not being farmers does not mean that *Homo* was disorganised and/or a poor resource manager. On the contrary, it can be effectively argued that *Homo* has been on the trajectory toward an increasingly sophisticated resource management for at least two million years. The first two factors that help *Homo* to develop the ability to manage resources were fire and time, both of which opened the door to other developments in resource management. Once *Homo* learned how to control fire and manage time, environmental extractive efficiency and human resource management acquired the necessary foundations to develop. Human resource management must develop once extractive efficiency increases because a population that has access to more resources has to discipline itself in order to manage the environment, along with controlling the size of the population living off the environment, so that resource exploitation does not lead to an environmental and/or population collapse. Appearance and development of all other typically (though perhaps not exclusively) human facilities, such as erect bipedalism, technology, language, serial monogamy, food sharing, female ovulatory crypsis (Lovejoy 2009), colletive parenting, prolonged childhood, body decorations, art, and hierarchical social structure, are natural consequences of resource management initiating and maintaining a set of self-amplifying feedbacks (Bielicki 1969; Henneberg 1992). Such ongoing development has only recently begun to falter as the rise of individualism has had a deleterious impact on human relations and resource management.

Resource Management in Early *Homo*

Numerous attributes distinguishing humans from animals have been so far proposed: Aristotle mentioned the antero-posteriorly flattened chest and relatively large brain; Abrahamic religions proposed an immortal soul; other authors pointed to the use of language (Burke 1966) and tools (Oakley 1962), to unusual encephalisation (e.g., Jerison 1973; Martin 1998), etc. Today most palaeoanthropologists agree that the prime distinguishing characteristic of the human tribe (*Hominini*) is erect bipedalism (Lovejoy et al. 2009). It can be argued, however, that all these characteristics are static and isolated traits that identify human uniqueness rather than functional entities explaining this uniqueness. Within mammals, functional uniqueness of humans can be defined as sustained management of multivariate resources. Such dynamic entity can explain all specific characteristics named above and provide an explanatory framework for human evolution. Humans, unlike most other mammals, do not only alter their environment while obtaining food for immediate consumption or building nests; humans also reshape their surroundings and elements of the environment for future use, thus distributing time and effort required for survival over periods when no immediate needs are felt. This increases human extractive efficiency.

For any population of animals, the extractive efficiency of its members must provide enough matter and energy from a given environment to satisfy all needs of this population required for its survival. A population is understood here as an assemblage of individuals jointly capable of self-reproduction for an indefinite period.

Let "C" represent the carrying capacity of the environment, "E" the extractive efficiency of the population, and "S" the sum of population needs. Then the equation of the basic law of adaptive relations is (Henneberg and Ostoja-Zagórski 1984; Henneberg and Wolanski 2009): $C \cdot E \geq S$. If extractive efficiency is limited to obtaining from the environment what it naturally provides, the equation is fulfilled when C is sufficient. If it is not, the population size will decrease or the population must move to a new environment. When members of a group (besides extracting what is immediately needed for their survival) begin to alter the environment by redirecting their extractive abilities towards storing resources or using energy from outside their bodies, the equation becomes more complicated and a set of autopoietic positive feedbacks between the environment, the population and its extractive efficiency develops (Bielicki 1969; Henneberg 1992). Arthropods, especially social insects, demonstrate efficacy of this approach in restructuring their environment by building complex nests protecting increased temperature of their bodies, storing food for their offspring (e.g., honeycombs), etc., and, as a consequence, modifying their population members into separate categories of infertile workers, fertile females, short-lived males, and in some instances fighters. Such populations, structured into subgroups, produce systems of interindividual communication and reshape their environments by physical alteration of geological and organic materials and even by incorporation of living organisms (symbionts) into their functional systems (Wilson 2000).

This level of systemic organisation was rather rare in mammals, if not non-existent at all, before the evolutionary appearance of humans. The question whether a single point in time can be designated for human emergence is still open. It seems that, like in other organic lineages, according to biological and environmental feedback mechanisms changes were occurring at varying rates over evolutionary time. Moreover, each living system is informed according to aristocratic networks that are self-organising. This is what Gregory Bateson (1972) refers to as "recursive patterns," or systems that are composed of interdependent parts. The idea of recursion seems to be an intrinsic feature of all biological systems and is an aspect of mind – the sum of cybernetic and interdependent processes immanent in nature. The following is an equation of mind in nature:

$$M = (P \cdot L)^{rt},$$

- M mind, a number of metapatterns,
- P number of patterns,
- L number of existing life-forms,
- r rate by which stochastic systems evolve,
- t length of time by which living systems co-evolve and co-operate.

Furthermore, all organisms seem to maintain their internal physiology or metabolic homeostasis despite changes occurring in the external environment, a condition which reinforces organismic autonomy (Ho 1998). The universality of autopoietic systems testifies to the extraordinary development of life on earth. Some scientists noted that since the Cambrian explosion the earth has not had so many living species. An estimate of currently living species is approximately 8.7 million, a remarkable number of life forms. The geneticist Sinnott in his book "Cell and Psyche" (1950: 48) poignantly explains this autopoietic principle:

> In some unexplained fashion, there seems to reside in every living thing, … an inner subjective relation to its bodily organization. This has finally evolved into what is called consciousness … through this same inner relationship, the mechanism which guides and controls vital activities towards specific ends, the pattern or tension set up in protoplasm, which so sensitively regulates its growth and behaviour, can also be experienced, and this is the genesis of desire, purpose, and all other mental activities.

As noted earlier, the regulation of co-operative behaviour among life forms is an important aspect of managing the environment, which has led to the development of complex societies throughout the animal kingdom. Of course, this level of co-evolution was evident in the earliest life forms during the Proterozoic Period which saw the development of eukaryotes. According to Margulis (1970), eukaryotes evolved by the co-operation of smaller cells which amalgamated in order to increase survival. This proto-cellular co-organisation proved to be evolutionary advantageous, eventuating in the advent of multi-cellular organisms during the Cambrian period. Thus, the development of the human autopoietic system appears to be a natural consequence of the evolution of life. As all living systems are open to stochastic influences of nature, the human system, however well developed, is prone to errors.

A prime example of human extractive efficiency taken to the extreme is the development and collapse of human society on Easter Island (Nagarajan 2006). Over a period of slightly less than one thousand years, the human population of the island went from a small number of settlers up to possibly twenty thousand people before a collapse that reduced the population to around one and a half thousand people. As a consequence of very high extractive efficiency, the population of the island created a large surplus, which allowed them to invest significant time and effort in carving, moving, and erecting stone monuments. When the extractive efficiency reached the inevitable tipping point of taking more than the environment could sustain, the collapse in food production and other resource availability led to dramatic levels of violence, possible cannibalism, and societal collapse.

The Origin of Human Resource Management

Palaeontological and archaeological evidence of earliest humans provides only some clues as to when our ancestors started engaging in effective resource management. The earliest instances could be those of *Ardipithecus ramidus* collecting and transporting attractive fruit foods to obtain favours of females (Lovejoy 2009; Lovejoy et al. 2009) or of *Australopithecines* producing weapons or tools by modification of hard objects. What differentiates resource management from simple use of resources is a deliberate change of the purpose for which the resource is used. Most animals use fruit to feed themselves. Bringing fruit to other individuals in order to engage in sex is quite a different action. Primates will pick up rocks to throw at other individuals or to hit and break a hard shell of a tasty nut (Van Schaik et al. 1999), but they will not use that rock to modify the shape of another rock that cannot be immediately used. The modified rock may be used in the future to procure food by killing or dismembering a prey animal, but this is not apparent at the time of its manufacture. Chimpanzees will wield pieces of wood as clubs or insert thin twigs into termite mounds to obtain food, but they will not initiate or maintain a chemical reaction of cellulose with oxygen to release energy in the form of fire.

As Timothy Taylor (2010: 6) has argued: “Our relationship with material products is bizarre and complex but also straightforward and familiar. We use things not just to adapt to the natural world, manipulate the laws of the physical, and subvert the instincts of the biological: we use them to construct ourselves. … We use, believe in, take for granted, become obsessed by, die for, and kill with things. Not just any things, not natural things. What is most distinctively human about us is our relationship with artifice.” What Taylor refers to as artifice can be more plainly described as the life of the mind. Humans visualise what they would like to do, and how they might do it, in their minds, and then apply this life of the mind to transforming the world, and consequently themselves, in order to fulfill their plans. Each advance in extractive efficiency is related to developments in the life of the mind, and with greater extractive efficiency humans have more opportunities to buy time for the life of the mind. At what time surpluses of time, materials, and energy first appeared in human groups may be beyond precise explanation, but a myriad of factors have created opportunities to use surpluses to buy time for the life of the mind: management of fire producing light in the darkness, cooking of food, transforming elements of the environment to become useful resources, and gradually becoming more sedentary. Resource management, even in a primitive form, has a potential to produce surpluses of material or energy above what is required for immediate survival. Ability to collect and transport food may provide a mass of food exceeding immediate appetite of participating individuals, use of a skilfully sharpened weapon may result in efficient killing, and dismembering a prey animal whose meat will be more than enough to satisfy immediate nutritional needs of a group to which successful hunters belong. Fire can then be used to preserve uneaten meat so that it can be consumed a day or two later instead of going to waste or being easy prey for scavengers.

With the ability to create a physical surplus that can be used later on, *Homo* also created a surplus of time. Rather than working endlessly to meet nothing more than immediate physical needs, *Homo* purchased time to think about what to do and who to become. Albert Camus sums up the importance of having surplus time in his first novel, “A Happy Death” (1973), in a way that makes the importance of a surplus and the life of the mind clear. In the novel “Zagreus,” a dynamic young man who has been crippled in a car accident, states that: “Only it takes time to be happy. A lot of time. Happiness, too, is a long patience. And in almost every case, we use up our lives making money, when we should be using our money to gain time. That’s the only problem that's ever interested me. Very specific. Very clear" (Camus 1973: 34). What Camus means by happiness in this novel is a humans' opportunity to become whatever they have the discipline, intelligence, and resources to become. The process of becoming is what makes the central characters of Camus's novel happy, and the only way Camus can see to have the chance to become, is to have a surplus of money (resources), which gives a human the opportunity to focus on becoming rather than just surviving. Camus's central characters need to develop, or benefit, from high extractive efficiency, and they are driven by life of the mind to become more than they currently perceive themselves to be. Camus gives the central character of the novel, Patrice, the opportunity to combine a surplus and the life of the mind, and states his position as follows: "I know what kind of life I'd have. I wouldn't make an experiment out of my life: I would be the experiment of my life" (Camus 1973: 33 f.). Patrice represents a modern human ideal for Camus, but the forces that drive him and the way he employs resource management are far older than modern humans.

Fire Management Informing Human Evolution

In physical terms, fire releases energy stored in chemical compounds, typically of organic kind, by chemical reaction between those compounds and oxygen. This reaction is exothermic and increases significantly local temperature. Temperature gradient can be used to transform materials put into or close to the fire. The exothermic reaction also releases photons from particles in the fire. Light of wavelengths perceptible to humans and many other organisms is the result. Very few animals deliberately cause or maintain exothermic chemical reactions outside of their bodies.

For the above reasons of particular interest is the use of fire by early humans. Use of fire has been documented for African sites like Swartkraans (Brain and Sillen 1988) and East African plains (Clark and Harris 1985) for 2.0–1.5 Ma (million years). For most animals, the vigorous chemical reaction producing moving flames, fumes, and scorching temperatures is alien and frightening. Somehow, early humans perhaps guided by curiosity learned to appreciate the warmth and the light provided by the fires and to tend those fires by adding fuel (typically dry wood, turning to charcoal retrievable in archaeological excavations). Tending a fire does not produce food immediately nor does it provide sexual rewards. Benefits of fire can only be appreciated if a chain of events is recognised. The proximity of fire provides some level of protection against mammalian predators, an increased temperature, which is especially significant during cold nights, and light during the night. Substances such as hardly palatable tubers or tough cuts of meat when carefully put into fire turn into easy to eat, tasty meals. Wooden objects are hardened by the fire and thus an opportunity arises to expand the repertoire of weapons and tools available to early humans. Therefore, fire became a source of energy – thermal and photonic – and a means of chemical processing of weapons, tools, and foods that became more palatable, more digestible, and less perishable. Cooked meat spoils slower than the fresh one, fire-dried fruit stays palatable longer than a fresh one.

Of special importance was the light provided by the fire. Humans, like most *Pongidae*, are diurnal animals. Light provided by the fire extended the length of day for an indefinite period, buying them a surplus of time that they never had before, but only in a limited area around the fire. Good visibility was present only close to the fire, and in this way members of a population had a focal point around which to congregate at night. While present around the fire, they experienced proximity of others. This required the structuring of social relations – recognition of hierarchical status of individuals and appropriate interindividual relations. Since the world around the fire at night was limited as to the number of visible features, imagination could occupy a larger part of individual attention while communication between individuals consisted of postures, grimaces, gestures, and sounds. All of these opportunities and limitations extended the possibilities of life of the mind. It can be asserted that in the situation around the fire lie the beginnings of symbolic communication. Particular gestures or sounds could take a meaning of events or objects invisible at night but encountered during the day. One individual could send messages to many of those gathered round the hearth rather than to those dispersed in the landscape during the day. In the hubbub of diurnal activities, messages sent by an individual are out of necessity short because individuals move dispersed in the environment and it is difficult to keep their attention for longer periods. When gathered around the fire, the situation is different. Many individuals are quietly "sitting" and concentrating their attention on the fire or on an individual who wants to communicate by sounds and gestures. This individual has an opportunity to tell a story – i.e. send a longer series of messages to all those gathered around the fire.

The use of fire, therefore, not only had an indelible effect on developing sociality of early *Homo* but also may have had increased human imagination, thereby prompting brain evolution. Human communication is symbolic and contoured by imagination. Early use of fire may have also influenced the earliest human rituals, thus propelling the mythopoietic imagination. Such rituals may have consisted of using techniques for producing altered states of consciousness, including individual and collective dancing or usage of psychotropic substances. For example, McClenon (1997) notes that human beings have a genetic propensity towards self-hypnotic states that were evolutionarily advantageous in ancestral environments. Self-hypnosis may have had various functions, such as lowering psycho-physiological stress, ameliorating blood loss, and increasing fertility in early humans. When employed in collective rituals, self-hypnotic states may have enhanced social cohesion and expanded symbolic consciousness. According to Winkelman (2002), shamanic-based techniques such as collective rituals prime the cannabinoid system, thereby producing "endogenous opiates" via "ritual manipulation of physiological responses" that lead to stress and pain reduction and immune system enhancement. Moreover, altered states of consciousness elicit both serotonergic responses in areas of the brain which are replete with serotonergic receptors (i.e., hippocampus, auditory and visual centres, pre-frontal cortex), which act as a modulatory system in the brain (Winkelman 2004: 199). It may be therefore suggested that the use of fire during the Paleolithic period could have been linked to shamanism.

Our thesis on fire and ritual can be supported by traditions of ancient and contemporary indigenous societies. There is, for instance, evidence of ritual-based *pyloratry* among Vedic, Zoroastrian, and Hellenic cultures. In ancient Greece, a war dance (*pyrrhikhê*) was performed by the funeral pyres (*pyrrhos*) of fallen warriors. Among Zoroastrians, fire was a central element of various rituals where it symbolised purity. Similarly, Vedic civilisation used fire as an important item of ritual worship and was implicated in the idea of reincarnation, where cremation was deemed necessary for releasing the soul from the body (Sharma 2001). Similarly, present-day Sufis' use of fire is often connected with their mystical practices. For example, the Indian Qalandar Sufis sit around a fire (*dhoonee*) each evening where they engage in the ritual smoking of hashish (*chillum*). The use of *dhoonee* is considered a religious act. The smoking of hashish is accompanied by *nara* – spontaneous expletives which honour Ali (cousin of the Prophet Muhammad) and Sufi saints. Another Sufi mystical practice for evoking spirit beings (*jinn*) includes gazing at fire for an extended period of time. In Tarahumara culture, a fire baptism is performed as a way of negotiating agricultural fecundity and individual protection. Being primarily agriculturalists, Tarahumara identity is linked to the land and annual seasons (Slaney 1997). Among extant populations in India and Sri Lanka, firewalking is considered as part of the spiritual devotion to gods. Firewalking is well represented in these countries and has received theoretical attention by various scholars,[1] as has a similar ritual practice, the so-called *anastenaria* found among modern-time Greek peasants. Doherty (1982) describes the Greek firewalkers as being protected by Saint Constantine, while Danforth (1989) notes that the firewalking ceremony may last for hours in which the firewalkers enter into altered states of consciousness.[2] One of the earliest traces of the use of fire was discovered inside the cave at Swartkrans (Brain and Sillen 1988). This discovery means that users of fire were not only able to cook meat on it (burnt ends of animal bones were found in the cave) but also had the ability either to transport the fire from its natural origin to a desired sheltered location or of lighting the fire where they wanted.

The number of objects or processes modified by humans has gradually increased in the course of evolution to include, among other things, body decorations. No mammal demonstrates deliberate actions aimed at modification of its body beyond cleaning and removal of external parasites. Humans, by contrast, developed production of jewellery that serves no utilitarian purpose, as well as decorate their bodies through painting, scarification, and tattooing. Such acts produce no immediate benefits in terms of food, shelter, or health while, in certain cases they may even endanger health. Humans also produce figurative art with the purpose of conveying messages.

The earliest and still debatable example of human aesthetic production are Acheulean hand axes produced nearly 1.5 million years ago in large quantities, in similar form of bifacial flattened drop-shaped stone artefacts over the large areas of Africa, Europe, and Western Asia. They may have had some utilitarian purpose, but their quantities and symmetry indicate a use other than simply as tools (Goren-Inbar and Sharon 2006; Hodgson 2011). Perfecting the manufacture of one kind of tool enhances both individual technical skills and confidence to imagine and leads to production of more complex tools. *Homo* would not have produced large numbers of tools if they did not have the surplus time

1 Malhotra and Khomne (1980); Obeyesekere (1978); Freeman (1974).

2 See also Kondos (2000); Xygalatas (2011).

to do so; they would not have used their surplus time in this way either unless they gained some sort of satisfaction out of the activity. A fine stone axe may have been useful to enhance one's status within the group or may have been a significant prop to be used in the symbolic/spiritual world that developed around the fire. Similarly, the oldest beads for decorative necklaces are known from the Middle Palaeolitic (e.g., Châtelperronian culture; Bednarik 2001: 552 f.). Why would any individual interested only in the satisfaction of its immediate biological needs spent hours collecting shells and teeth, drilling small holes in them, producing a string, and then putting drilled teeth and shells onto this string to be worn around the neck? Did it produce more food, provide better shelter, or allow fertilisation of an egg? Clearly, the jeweller had spare time and energy to produce objects that served to satisfy aesthetic feelings of the bearers and probably helped to signify social status.

The production of aesthetic items is likely to have a number of implications for early humans in relation to resource management as well. Seeing the environment as something more than a way to fulfil basic physical needs extends its potential usefulness while simultaneously increasing the way it might be managed and transformed via the life of the mind. Looking for resources in order to make aesthetic products adds subtlety and depth to the perception of the environment, and consequently moves humans beyond thinking in terms of being only prey or predators. Every resource that can be put to an aesthetic use enhances the significance and value of a given environment, strengthening the bonds that lead to sedentarism. Staying still to work with resources for aesthetic purposes suggests that humans have full bellies and time to spare, which has to be a significant factor for the beginning of sedentarism. As aesthetic production would give the environment value directly related to the value of aesthetic products, the land that made aesthetic products possible would take on some of the symbolic and spiritual values of the objects it enables. In practical terms of physical survival, appreciating the value of resources within an ecological niche is likely to lead to a more efficient management of resources and hence to a further transformation of the environment. If an apparently useless plant is growing in the middle of someone's favourite berry patch, then there is a good chance that this plant might be trod on or pulled out, resulting in the opportunity for the favoured plant to spread. If the favoured berry is eaten beyond the berry patch, then there is a good chance that the seeds will be spread promoting the expansion of the plant's range within the environment. If two saplings stand side by side, *Homo* is most likely to use the least favoured species as a tool, enhancing the chances of survival and growth of the favoured young tree. The environment will be transformed in this way and more innovative ways of managing resources are likely to be developed in the process. A transformed environment will satisfy human's wants more fully, both physically and symbolically, which is likely to lead to a growing commitment to preserve the environment.

Human Expansions

At the beginning of the time when *Homo* appears in the fossil record, before 1.5 Ma ago, human remains are known from all three continents of the Old World. This means either that ancestors of *Homo* were living on all three continents or that *Homo* expanded from some more restricted location. There is an absence of evidence of human ancestors outside Africa before 2 Ma, but the absence of evidence is not an evidence of absence. While humans were expanding, migrations moved populations farther into new territories as population sizes increased. Some populations of *Homo* either had to expand, or wanted to expand, outward. If *Homo* wanted to expand outward, it implies that they had sufficient resource management skill to harvest and transform new environments to fulfil their needs. But if they had to expand outward, then it suggests that once population sizes reached more than the environment's carrying capacity could sustain the pressure to expand outward could be both environmental and social. Since there is neither a clear proof that human populations expanded into new territories nor that they were forced to expand by overexploiting carrying capacities of their original environments, we have to rely only on highly speculative evidence from the post-agricultural history. During that period, most successful cultures expanded by both pushing outwards the limits of their territories (e.g., ancient Egypt, early Roman Empire, Russia) and by overseas expeditions (Phoenicians, Greeks, Portuguese, British, Dutch, Arabs, Indonesians).

If extractive efficiency is greater than environmental carrying capacity, then a population either has to leave the exhausted area, invent new ways of resource management, or suffer some sort of population collapse because of associated hardships. As it appears that early humans knew how to manage their time and other resources, there is no reason to assume that people kept moving because they were exhausting their current environment. It is far more reasonable to assume that people who knew how to manage their resources refined their techniques, so that they would not have to face the uncertainty of finding an environment that could match or exceed their needs. Having a surplus of time and resources reinforces the value of maintaining such a state of being because spare time and resources enhance the quality of life via the life of the mind, symbolic communication, and representation, and the development of emotionally rewarding activities.

When a population exceeds both the carrying capacity of the environment and the resource management techniques of a population, then it is likely that some part of a group would move beyond the familiar environment and apply everything that they have learned in the new land. In the case of wolves, it is quite normal for a wolf to simply say goodbye to its pack one morning and head out over the horizon to find a mate and create a new pack and territory (Rowlands 2008). A "Lone Wolf," as these wolves are called, is not some sort of malcontent who is responding to hard times or low social status. Lone Wolves leave in both good and bad times, and come from any social rank. Since a "Lone Wolf" can be inquisitive and opportunistic, apparently wondering what is over the horizon, there is no reason for us to assume that humans would not have learned their survival and social skills and then wondered about wandering over the horizon. The link between the life of the mind, resource management, and transforming environments suggests that wanting to try out a new idea might be a good reason for an early human to branch out on their own, leaving the rest of the group to live in a sustainable way on their patch of transformed and symbolically invested land. Similarity between actions of wolves and humans must have been recognised some 100 thousand years ago when first dogs were domesticated (Wayne and Ostrander 1999). As social animals, canids and humans found it mutually beneficial to live in each other's vicinity and collaborate in hunting tasks, sharing the prey and provide mutual security.

Specialisation and the Origins of Politics

As effective extractive efficiency and resource management lead to surpluses of time and material, individuals gain ever more time and material to invest in manifesting their particular proclivities. A leader might invest in shoring up their position, while an individual with a spiritual bent might invest in considering and expressing spiritual and symbolic meaning. The most capable hunter could work with the most capable toolmaker to develop a better weapon. An inquisitive plant gatherer could begin to investigate less familiar plants to see what uses they might have. In short, surpluses allow a specialisation, which results in social differentiation. Social differentiation changes the relationship between individuals and could result in both social alliances and tensions within any human group (Buckley 1958).

As a consequence of the emergence of specialisation and social differentiation, difference has to be managed so that it does not result in dangerous levels of competition, envy, or social disconnection (Lawrence and Lorsch 1967). Managing difference and specialisation is the basis of any and all political action, as can be observed in works as diverse as Rousseau's "Discourse on the Origin of Inequality" (1994) and Cohen and Arato's writing on civil society theory (1995). Even at the most fundamental level, such as access to food and sexual partners, all human behaviour is political. In a state of being, where there are very limited surpluses of material and time, individuals may not have much of an opportunity to think about political action, but with every increase in the size of surpluses political opportunities and the need for political stability grow (Meillassoux 1972). Political decisions need to be made about who and in which way gets access to food and sexual partners, how the group will be bonded together, how specialisation will be regarded and rewarded, how leadership will be maintained, and how resource management will be most effectively implemented to ensure the survival of the group. A group of humans who have invested time, effort, and symbolic value living in an environment are likely to incorporate the environment they have transformed and symbolically invested into their political decision-making. The environment is both a place to act and a politically valuable resource on which to act, and must be perceived as a stage for the life of the mind through political action. The political decision to manage food resources effectively could involve both prohibiting hunting by particular individuals within a species (young and fertile females) and not taking every piece of fruit from a favoured source (Gadgil and Berkes 1991).

Each step toward better food resource management is both a step toward the techniques of agriculture and a step toward creating a population that is disciplined enough to engage in agriculture. The selective killing of animals changes how that species is perceived: even if all members of a species are available as immediate prey, some are for now and the rest are for later. The politically imposed hunting discipline will change the species being hunted (by altering which members are alive to breed), alter how the environment is perceived (by increasing tendencies toward future planning), and change the people doing the hunting (by reinforcing the power of political beliefs and prohibitions to shape their lives). Political power is always applied in order to shape how humans think and behave. If a group of humans does not develop and apply political power, then their ability to manage and transform the environment is not going to develop quickly. As developing extractive efficiency and resource management has taken hundreds of thousands of years, it is clear that political power and subsequent discipline within human society did not emerge quickly. Nonetheless, the fact that the evolution of *Homo* has clearly led towards the development of political power and social discipline makes it reasonable to progress with an analysis that holds these factors central to human development.

As Michel Foucault (1979) presents and analyses human behaviour, all political behaviour is designed to discipline a population of humans. Humans must learn to self-regulate their behaviour so as to behave in a normalised fashion that is appropriate to the society in which they live. The discipline required to make individuals conform to social, politically defined norms must initially come from externally applied pressure, but the discipline that is instilled must be maintained through self-regulation, because external surveillance and behaviour management are too costly to be the primary source of appropriate behaviour. A society that has surpluses of time and resources would not want to waste them on only achieving appropriate, politically defined behaviour, because there are far more interesting and enjoyable things that can be done with spare time and material. Any society with effective political behaviour management techniques is going to normalise its members' behaviour as quickly as possible and guide them toward effective self-regulation through common custom and belief.

One of the most immediate benefits of such politically instilled discipline for a population who have successfully become more sedentary, as a result of effective extractive efficiency and resource management, would be to manage the inevitable population explosion that happens when humans settle in one area. With an ever-increasing population putting more stress on the environment, as well as social structures for differentiation and specialisation, political discipline takes on an increased importance. Young sexually mature males need to be kept away from young sexually mature females in order to ensure that the population explosion does not continue, preventing the collapse of the environment and society in which so much has been materially and symbolically invested. A growing population has to be disciplined into behaving appropriately toward each other, so that population growth does not result in social tension or break down (Bender 1978; Divale 1972).

The distribution of humans on the surface of the Earth, however incompletely illustrated by fossils, indicates a population continuity already at some 1.7 Ma with still variously named *Homo erectus* residing in East Africa, borders of Europe, and in Asia extending down to the Southeast Asian islands, at present belonging to Indonesia. At some 500–200 ka, a differentiation of physical characters of groups of people living in Europe, Asia, and Africa indicates increasing association of groups of people with their respective territories. We have morphological forms of *Homo antecessor* in Europe, *Homo heidelbergensis* in Africa, and *Homo erectus* in Asia. This differentiation is clearest at about 50 ka with Neanderthals and "anatomically modern" *Homo* (*sapiens*) being distinguishable anatomically and behaviourally as evidenced by stone tool type differences and differences in artistic expressions (sparse in Neanderthals and abundant in anatomically moderns). Nonetheless, detailed analyses of paleoenvironments in the last 2 Ma until the obvious agricultural land management are not available, which makes a study of possible influence of human resource management on flora and fauna difficult. Towards the end of the Pleistocene, there are indications of resource management manifested in changes of the fauna. The disappearance of megafauna in Australia (Wroe and Field 2006) and of mammoths in Europe, Asia, and the Americas can be interpreted as a result of human resource management, in this particular instance of rather poor quality – overhunting. It may, however, be postulated that the megafauna disappears not as a result of direct killing of too many mammoths and other large mammals but as a result of changing via human activity of the flora that sustained those large animals. Alternate explanation of the disappearance of the megafauna due to natural changes in the environment is a possible and still plausible explanation that needs to be further considered.

Another social and political development through which we can discern a disruption to the long-term development of human resource management is the rise of individualism (Macpherson 1964). Individuals in themselves are the most fundamental point from which an analysis of biological, social, and political forces can be researched. All broad systems contain individuals, but it is only a recent phenomenon of *Homo* that individuals conceive of themselves through the lens of individualism. Human extractive efficiency has reached such a level of efficiency that there are more of us than are necessary to produce what we need, and there are too many of us to discipline via the traditional mechanisms of human resource management, which used to sustain environmental and population management. Such individualist mindset is the culmination of human development leading to a version of *Homo* that is constantly aiming at transforming him/herself into an agent able to function beyond the limitations set by available resources. As Camus demonstrates through Patrice's life in "A Happy Death" (1973), the experiment of one's life can either be sensitive to other individuals and an environment, or self-absorbed and disconnected from other individuals and the environment. An individual, like Patrice, who learns to situate his individualism within the broader context of people and a place, remains connected to patterns of resource management that keep the system going. But an individual who views his/her individualism as the ultimate arbiter, represents the disruption of processes of resource management that has driven human evolution for at least two million years. The current collapse in social capital (Putnam 1995) and the self-absorbed nature of the "Generation Y" (Eisner 2005) illustrate that resource management is not a given, even though it has given us so much.

Conclusion

In the above analysis, the domestication of plants and animals does not feature prominently. We allege that the main features of human resource management and its consequences arose in the evolutionary sequence of *Homo* much earlier than the appearance of agriculture and animal husbandry and thus that the role of these domestication-based strategies in the origin of human characteristics is exaggerated.

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