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SEEDWAYS

THE CIRCULATION, CONTROL AND CARE OF PLANTS IN A WARMING WORLD

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Bengt G. Karlsson & Annika Rabo (eds)

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ABSTRACT

This is a book about seeds. It revolves around questions of why and how seeds matter today, as in the past. The focus is on human-seed relationships, and how seeds and plants co-evolve with humans and other living beings. Human history is fundamentally a multispecies story, and seeds thus function as a lens to trace relations and interdependencies between humans and plants. Through seeds we explore the cultural and sensorial or affective connections between people, plants, and places. Seeds are often used as metaphors or tropes of possibilities, of hope and aspirations that are inherent, yet not fully realized, in the present. Engaging with seeds also brings us to critical political questions about control over the material basis of our existence, that is, the main food crops. Accelerating climate change, the expansion of monocultural plantations, loss of biodiversity, and ruthless extraction of natural resources all point to increasingly difficult times ahead. Collecting and saving seeds has become a global concern to help face the uncertain and troubled future.

KEYWORDS

Seeds, plants, crops, agriculture, domestication, climate change, corporate power, conflict/war, symbols, ritual, and people-plant relations.

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BENGT G. KARLSSON & ANNIKA RABO

Introduction

> Seeds embody the biology of passing things down.
> In a sense, that is also the root of their deep cultural significance.
> Seeds give us a tangible connection from past to future, a reminder
> of human relationships as well as the natural rhythms of season
> and soil. (Thor Hanson, *The triumph of seeds*, 2015)

The extraordinarily mild winter of 2017 caused an unexpected crisis for the management of the Global Seed Vault in Svalbard, Norway. The vault, also known as the Doomsday Vault, is supposed to provide safe storage for close to one million seed samples that have been collected from all over the world. It had been designed to withstand all possible man-made and natural catastrophes without active involvement of any personnel or source of power. But escalating climate change caused water from melting ice to seep into the corridor leading to the vault where the seeds are kept. The facility was hence not foolproof, as it was supposed to be. As one of the managers explained, "We have to find solutions. It is a big responsibility and we take it very seriously. We are doing this for the world". To this a colleague added: "This is supposed to last for eternity".[1]

The Svalbard Global Seed Vault, inserted deep into the permafrost ground, is a potent image of our uncertain times. The very rationale of the seed vault is the possibility – or risk – of a major catastrophe. Survivors would have access to seeds from most of the world's heritage crops, giving them a possibility to grow food and re-build life in the ruins. In this way the vault becomes a site of both apocalypse and of hope, of death

1 Reported in *The Guardian*, 'Arctic stronghold of world's seeds flooded after permafrost melts', by Damian Carrington, 19 May 2017, https://www.theguardian.com/environment/2017/may/19/arctic-stronghold-of-worlds-seeds-flooded-after-permafrost-melts.

and life. It is thus no surprise that the seed vault has attracted much attention from the media, and from scholars. During a visit, anthropologists Tracey Heatherington and Bernard C. Perley found themselves in the crowded company of a number of international film crews, and observed, "The Global Seed Vault excites the imagination because it is a liminal space where the material substance of biodiversity – our seed heritage – returns to a state of seemingly infinite potential" (Heatherington & Perley 2017). Elsewhere Heatherington wrote: "As we grow worried about changing climate and losses of biodiversity, we realize seeds are important" (Heatherington 2017).

SEEDWAYS

This is a book about seeds. It is an outcome of a multidisciplinary symposium titled *Seedways: The dispersal, evolution and commodification of seeds and plants in a warming world*, held in Stockholm on 14–15 November 2018. In the symposium call we made an open invitation to a number of prominent scholars to speak about why, and how, seeds matter today, as in the past. This symposium addressed human-seed relationships, and more particularly how seeds and plants co-evolve with humans and other living beings. Human history is fundamentally a multispecies story, and seeds thus function as a lens to trace relations and interdependencies between humans and plants. Through seeds one can explore the cultural and sensorial or affective connections between people, plants, and places. Seeds are often used as metaphors, or tropes, of possibilities, of hope and aspirations that are inherent, yet not fully realised, in the present.

Engaging with seeds also brings us to critical political questions about control over the material basis of our existence, that is, the main food crops. Over the last half-century agro-industrial interests have been gaining control over the global seed stock, and securing elaborate patents or breeders' rights of key plant cultivars. Farmers are prevented from replanting seeds from the previous harvest and are instead made to buy new seed annually. These controls create a reduction in agricultural diversity, and the cultivation of only a limited number of varieties of, for example, the main food crops such as wheat, rice, and corn. The introduction of new "superior" varieties also leads to the eradication of traditional varieties and seed exchange systems, important for maintenance of biodiversity and resilience in agriculture. In Sweden, this process began more than a century ago, and is still on-going in many parts of the world. Multinational companies within the agricultural, agro-chemical, and biotechnology sectors are furthermore pushing for the development and introduction of genetically modified crops, often specifically developed to suit special packages of pesticides and fertilisers. There have been large-scale protests against these crops, the so-called genetically

modified organisms (GMOs), based on the perceived risks of releasing such organisms into nature. Concomitantly, proponents tend to stress the immense benefits of GMOs. They argue, for example, that genetically modifying crops is just another form of plant breeding, and that developing high-yielding crops is a necessity to feed the growing population in the world.

The symposium further addressed seeds and plants in relation to present concerns and debates about climate change. We have now entered the Anthropocene, a new geological era where human activities are considered to have global impact and where our collective survival is under threat from the warming climate. Certain parts of the world already face critical climate issues with raising sea-water levels, lack of rain, too much rain, extreme drought, hot spells, and paradoxically also extremely cold weather in some places. The changing climate spurs fears and anxieties. Apocalyptic dystopias are circulating about the end of the world, or catastrophes followed by war and conflicts over land, water, food, and natural resources. Even those taking a more moderate stand find reasons to prepare for future difficulties. Seeds have come to figure prominently as part of such precautions. Seeds are being stored by various state and non-state bodies; the most spectacular example being the Svalbard Global Seed Vault. Seeds have also become vehicles for political protests, such as the guerilla gardening movement, seeking to make cities greener by throwing so-called seed bombs or "greenades" with seeds of native wildflowers, and other plants, into vacant plots or unused urban spaces. There is a large distrust of the state, agro-industry, and global institutions in being caretakers of the common seed heritage, and under the rubric of "seed sovereignty" there are a number of different initiatives around the world that build alternative platforms for exchange and storage of seed (Kloppenburg 2014; Shiva 2016).

Seeds, we argue, call for conversations across disciplinary boundaries and across already formed debates and battle-lines. The aim of the symposium was to allow for a meeting between different epistemologies, as well as between political and affective registers. A starting point for the conversation was to reflect on the seed itself, its constitution and material properties, usually containing an embryo, a protective shield, and a nutritive tissue. A seed is alive; it germinates and turns into a plant when suitable conditions emerge. This process is critical for the continuation of life on planet earth, and something worth paying close attention to.

In the remainder of this introduction we will return to some of the issues mentioned above as well as introduce the different contributions to the book. We begin with the complex question of what it entails to store, or preserve, seeds.

SEED ARCHIVES

Seed are stored in a number of large and small facilities around the world. In storage it is a matter of keeping the seed in a stage of dormancy – slowing down the metabolism – usually by keeping a low temperature, preventing the seed from being exposed to water and sunlight, as well as providing protection from insects and rodents. Under the right conditions seeds can survive in this stage for long periods: the oldest known seed to germinate is supposedly nearly 2,000 years old. Sprouted in 2005, the seed has grown into a thriving date palm (cf. Hanson 2015, 85–89). The oldest seed yet germinated in Sweden is a 150-year-old Egyptian *Acacia* seed that agronomist, and contributor to this book, Matti Wiking Leino, found in a museum collection and managed to grow (Leino 2011). Such endeavours, however, are arduous, uncertain, and involve a large measure of care. Much can go wrong. Having seeds in storage should, hence, not be conflated with having access to the very plants that generated those seeds. Plants thrive in particular places and under certain conditions. They are place-based beings that co-evolve with their surroundings; with other plants, fungi, microbes, insects, and other animals, and with weather and wider ecological conditions. Yet, paradoxically, the seeds themselves are mobile and can travel by wind, along rivers, and over sea, or carried by birds, other animals and, not least, by humans.

Environmental anthropologist Kay Evelina Lewis-Jones points to this capacity of seeds. They can be detached from a place and circulated, as well as stored *ex situ*, and hence outside the relations that contemporary scholars within critical plant studies take as a central attribute of "the ecology and ethos of plant-being" (2019, 5). Furthermore, she continues:

> While much of the theoretical engagement with plants has emphasized an inherently relational and entangled ontology, however, seeds embody an alternative mode of plant-being. Seeds present the dialectic between place and suspension, which I propose can help us to interpret the more subtle work that the seed bank does, which in itself might be of value in the Anthropocene. (Lewis-Jones 2019, 5).

Lewis-Jones came to this insight through her work on the Millennium Seed Bank Partnership in the United Kingdom, which stores seeds of wild plants. This is the largest collection in terms of different plants with as many as 37,600 species from all over the world. The seed bank is intended to be a back-up for species survival in the current times of extinction. If a species disappears in the wild, stored seeds offer a possibility for research and eventual reintroduction (Lewis-Jones 2019, 3).

EXTINCTION

Today extinction is a major threat to human livelihoods all over the world. Concerns over biodiversity loss, such as the possible extinction of iconic animals such as tigers, rhinoceroses, gorillas, and elephants have often been dismissed as an élite concern. Indeed, the establishment of nature parks and wildlife conservation areas usually impacts negatively on the lives and livelihoods of local communities. They are typically either displaced or lose crops, or cattle, to marauding wildlife. Yet, as the agricultural frontiers move into the last remaining pockets of dense forests, marshlands, mountains, and savannahs, unique habitats and the species thriving there are at risk of extinction. A recent UN report states that as much as three quarters of the land-based environment on the planet has been significantly altered by human action. This is a major cause behind the reported threat of one million species facing extinction.[2] The report points especially to the expansion of large-scale agriculture into tropical ecosystems of exceptionally high biodiversity. It mentions the massive conversion of forests into cattle ranches in Latin America and to oil palm plantations in Southeast Asia.

Anthropologist Tania Murray Li, researching large-scale oil palm plantations in Indonesia, points to how these destroy local ecosystems, as well as the livelihoods of indigenous communities and subsistence farmers (Li 2017). The expansion of plantations is part of a global land-grab triggered by the soaring prices of food stuffs in 2007–2008, which led to large investments by financial actors and corporations. In the case of Africa, this has led to a massive transfer of land from local subsistence farmers and pastoralists to agro-industrial conglomerates. It has also led to a change of agricultural system; a shift towards intensive cultivation of biofuels and high-yielding food crops that depend on usage of pesticides, fertilisers, and irrigation. The high level of agro-biodiversity that existed in the small-scale subsistence sector is thus commonly replaced by an agro-industrial monoculture. While monocultural plantations and industrial agriculture dominate present food systems, there are critical sites of resistance. One such site is the food sovereignty movement that emerged in Latin America in the 1990s in opposition to WTO-enforced agricultural liberalisation, and that has grown into a global movement to empower small-scale farmers and indigenous peasants (Martínez-Torres & Rosset 2014). The opposition against genetically modified plants is another related area of resistance, as are the widespread attempts around the

2 The report is by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). A summary of the 1,500-page IPBES Global Assessment Report was made public on 6 May 2015, see https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/.

world to return to heritage plants and vernacular varieties that have travelled with and been refined by growers and local breeders over generations (Lapegna & Perelmuter 2020; Aistara 2014). Expansion of organic farming and the interest in locally produced food and the related concern for nutritious, slow food, are also important (McMichael 2009). Here one also thinks of less explicitly political actions such as home gardeners and allotment owners who exchange seeds, tubers, bulbs, and cuttings among friends and neighbours, bypassing market regulations and breeders' rights (Ellen & Platten 2011). These evasions of commodification, standardisation, and corporate control of germplasm ultimately speaks to larger political and ethical issues of how to foster sustainable and just futures.

THE BOOK

Most of the contributors to this volume participated in the symposium in Stockholm. Jack R. Kloppenburg, Kay E. Lewis-Jones, Jens Heimdahl, and Cecilia Gustafsson gave presentations but were unable to take part in the book project. Their input has, however, been very valuable. Jack R. Kloppenburg was one of the keynote speakers and his assertion that "seed sits at a critical nexus where contemporary struggles over technical, social, and environmental conditions of production and consumption converge and are made manifest" (Kloppenburg 2004, xiv) resonates in many of the other contributions. Dolly Kikon, L. Jamila Haider, and Rebecca Öhnfeldt could not participate in the symposium, but were able to be part of the book project, for which we are grateful. Finally, Guntra A. Aistara graciously accepted to write an afterword to this volume.

The authors come from different disciplines and have come to an engagement with, and for, seeds by different routes. Some have a background in agronomy or plant genetics, others have come to seeds by way of research in environmental issues, resilience, or political ecology. One of the authors, Rebecca Öhnfeldt, describes how she first became aware of the importance of traditional seeds when she tasted, in a restaurant in Stockholm, a delicious lentil reintroduced as a heritage plant.

The authors also look at seeds and the human-seed relationship from a variety of perspectives. Sometimes the seed is in focus, sometimes human beings, and sometimes the institutions binding them together, or setting them apart, are at the centre of the story. All, however, share a deep concern about the lives and ways of seeds. We have divided the volume into four sections, *Biopower*, *Agrobiodiversity*, *Circulation/mobility* and *Seeds and their caretakers*. The themes in the different sections cannot be neatly separated, but rather, overlap to a great extent. Power relations, for example, expressed as inequalities in access to material and immaterial resources – whether between coun-

tries and regions, global corporations and individual farmers, state officials and local communities, or between people in local settings – are analysed in all chapters. So are efforts to overcome these inequalities through political struggles, activism, and alliances between farmers and scientists. The cultural entanglement between people and seeds through myths, rituals, and storytelling is also a prominent theme in many of the chapters.

The first section of the volume includes two contributions. While Birgit Müller focuses on one Canadian canola farmer and his struggle against the powerful Monsanto company, Rami Zurayk takes a bird's-eye view of the links between seeds and war, particularly in the Fertile Crescent. Müller describes how, from the late 1990s, the Canadian farmer Percy Schmeiser became embroiled in a legal battle with the seed company which claimed he had infringed on their patent rights of a gene-modified canola. Unknowingly, Schmeiser stumbled upon the herbicide-resistant Monsanto seeds at his roadside and replanted them with great success. A jealous neighbour reported him to the company which immediately told him that they had the property rights to his seeds, and that he should either stop reseeding them or pay a licence fee. Schmeiser refused, claiming that since the gene-modified seeds had escaped to his property, it was his right to use them as he pleased. A costly, eight-years, legal battle ensued, which Monsanto eventually won.

Müller describes the protagonist not so much as an activist hero but more as somebody stubbornly clinging to his sense of right and property rights. This case attracted lot of attention and Schmeiser was morally and financially supported by many individuals and organisations, particularly outside Canada. He was invited abroad to speak of his struggle and, through that process, he developed into an activist resenting and resisting gene-modified seeds and companies patenting, in essence, life. Müller's text draws our attention not just to the power of contemporary seed companies, but also shows how resistance to that power can emerge, and perhaps of particular importance, highlights activism and alliances formed and maintained among people whose sense of right has been injured.

Through the case of the Canadian farmer we see the link between a single stubborn man and the global power of contemporary intellectual patenting. In Rami Zurayk's text we are exposed to the travel, theft, and appropriation of seeds in time and space through the analytical lens of war. Zurayk uses this concept not only to cover armed conflict but as a multifaceted form of violence. He reminds us that food production can be a highly violent activity. Soil, seeds, and water have been domesticated, harnessed, and even tamed and subdued through the history of agricultural development. Human labour in agriculture has been – and still commonly is – heavily exploited and subject to everything from unfair treatment to slavery. Today the link between labour

and seeds is distant or opaque, especially for urban people in the global north, accentuating the commodification of food production.

The Fertile Crescent was a key region in the development of farming more than ten millennia ago, and thus important for the diffusion of seeds indigenous to the region. The region has also acted as a corridor for seed movement from other parts of Asia to Europe and the Americas. Not only seeds and crops were involved in this movement, but, as we know, people were enslaved, killed, and moved on both sides of the Atlantic in this exchange. Moving to the contemporary period Zurayk describes how Iraq, in the wake of the US-led invasion in 2003, was penetrated by global agricultural companies. Indigenous wheat varieties have been banned and new gene-modified varieties have been forcibly introduced. The inherent political nature of seeds is stressed by Zurayk, and the link between seeds and the land may serve colonial projects, as in the case in occupied Palestine. But, as he underlines, seeds may also become tools of resistance where historical memories are used to claim rights to farming and to land.

The three contributions in the second section of this volume, *Agrobiodiversity*, traverse vast spatial grounds focusing on seed diversity, seed uniformity, as well as struggles over seed control, and agricultural development. In Ola Tveitereid Westengen's text maize, the most-produced crop in the world and a marker of the Anthropocene, is the main protagonist. His chapter covers the long and complex history of maize and human interactions. He joins those challenging the theory of a single domestication event of maize, arguing instead for a co-evolutionary perspective where humans and the plant genetically change and develop together. In this development, Westengen contends that cultural practices and culinary preferences must be taken into account. To gauge the maize-human relationship many perspectives and academic disciplines are needed. Maize, he argues, can be understood as a political economic agent deeply implicated in the different food regimes which have developed in the last millennium and intensified in the post-WWII period. Today most maize is not cultivated for human consumption but for fodder, thereby fundamentally changing our relationship to the crop and its relationship to human society. Traces of maize can now be found in meat eaten across the world.

Matti Wiking Leino discusses the history of the disappearance of so-called landraces – locally cultivated, preserved, and produced plants – in Swedish agriculture in the 20th century. Seed control and legislation was introduced in the 1920s leading to the rapid shift to new homogeneous and commercial varieties. Leino investigates, in written sources, the traces of Swedish landraces and farmers' attitudes to, and cultivation of, them. Landraces display heterogeneity even within the same field, making yield more secure but not maximised. But landraces are also distinctive, Leino argues, clearly identified by farmers cultivating them. Agricultural conditions differ greatly between

the north and south of Sweden and different landraces have developed to take different climatic conditions into account. Although 19th-century Swedish farmers were not cognisant of inherited traits they were still, through observations and practice, able to make use of such traits. They were also well aware of the difference in the taste and general performance of different landraces. Only in the 1970s did a more co-ordinated effort to preserve landraces come about. Landraces will not be exchanged for all new high-yielding varieties. However, it is important – in Sweden and elsewhere – to preserve such seeds in seed banks as a vital genetic resource. But it is equally important, Leino argues, to cultivate them *in situ* to preserve knowledge of their cultivation and the emotions they invoke.

Dolly Kikon's text is situated in Nagaland in north-east India. She has followed three groups: subsistence farmers using a great variety of seeds, agricultural field assistants, and officials promoting "modern" agriculture relying on uniform seeds. Official policy in Nagaland is based on trying to make farmers – who constitute the majority of the population – shift from the traditional slash-and-burn practice to modern market-orientated agriculture based on hybrid seeds and commercial fertilisers. But some government employees were critical of this plan and claimed that it was not feasible in Nagaland. Those propagating the new seeds and new practices, however, claimed that the "unscientific" methods of the farmers stood in the way of development and progress. For the farmers their seeds instead represented memories and the local community and through them, they were able to trace links to others in both time and space. Recently local initiatives to preserve indigenous seeds and the stories associated with them have emerged to combat the loss not only of seeds but also of the memories and cultural practices that are intimately intertwined with them.

Agricultural field assistants form the link between official policies and the farmers, and they are trained for two years before taking up their jobs, ideally by moving to villages. Kikon, however, following student training, found a great gap between the goal of the programme, its implementation, and the aspirations of the students. Most of them joined the programme in order to become employees with a steady salary, rather than through any interest in agriculture or in farms and farming. They struggled with learning the scientific names of seeds and their learning was disconnected from the ways of the local communities they were to serve. Seeds in Nagaland are thus of very different kinds and speak to officials, field assistants, and slash-and-burn farmers in very different ways.

In the third section of the volume, *Circulation/mobility*, Bengt G. Karlsson writes about the complex history of domestication, the colonial trajectory and the subsequent global expansion of tea. In particular, the chapter focuses on the travel of the tea plant between Assam in India and Kenya. The British, trying to avoid importing

tea from China, established large plantations in Assam after the discovery of tea grown and processed by the indigenous Singpho people. As it turned out the Assam tea plant with its larger leaves than the Chinese variety proved to be especially suitable for large-scale production. British settlers brought seeds and plants to the new colony in eastern Africa, and after a century tea is now one of Kenya's most important industries. Besides the large, corporate-owned plantation sector, tea is today grown by half a million small-hold farmers. Kenyan tea researchers have previously aimed to improve high-yielding clones, but in the last decades have shifted focus to develop varieties which tolerate climate change and pests. Diversity, rather than uniformity, has thus become essential, in a paradoxical change of earlier plantation logic.

In the next chapter Roy Ellen questions the hegemony of the seed and its purported agency and reminds us that roots, tubers, bulbs, and suckers also have a social life. There is worldwide interest in the preservation of seeds, and they figure in many metaphors about life and development. The higher standing of seeds, he argues, can be linked to the low status of roots and tubers compared to cereals. The latter are also easy to reproduce, exchange, and consume, and thus have been pivotal in the development of industrial capitalism. But we should not forget the enormous reproductive versatility of plants and the importance of non-seed propagules in human cultivation for staple food. Potatoes, cassava, sweet potato, yams, and plantain are among the most important, superseded only by maize, wheat, and rice. Ellen focuses on bulbs, suckers, and stem cuttings and underlines how time is compressed in the reproductive system of such plant material since the seed stage is removed. He uses material from his research among allotment cultivators in southern England and Nuaulu and Kei villagers on islands in eastern Indonesia, and shows how cuttings and suckers are exchanged along lines of friendship and kinship.

Exchange and circulation of both seeds and people is the topic of Kaj Århem's chapter. In the last contribution to this section, it is not the genetic capacities of seeds or their cultivation or consumption that is in focus, but instead their ritual significance. Århem examines a number of patrilineal societies in Southeast Asia where marriage is commonly accompanied by the ritual transfer of plant seed from the group giving away a bride to the group receiving her. This is symbolically likened to an exchange of fertility expressed as the "flow of life". In the societies discussed by Århem there is a hierarchy between the kin groups giving away and receiving brides, where the former are regarded as superior to the latter, because they provide the means of reproduction, which is also conveyed by the giving of seeds. As he elaborates further, also discussing a matrilineal society, the same cultural logic can be extended to other forms of ritual exchange of life-giving substances. Århem ends his chapter by drawing a parallel to the earlier practice of head-taking among indigenous communities in Southeast Asia.

The ritual and symbolic importance of seeds is further scrutinised in *Seeds and their caretakers*, the last section of the book. L. Jamila Haider starts her chapter by describing a yearly spring ritual in the Pamir Mountains of Tajikistan. A porridge made from *rashtak*, an old and indigenous wheat variety, is central to this ritual, in which the new year is celebrated. The Pamir Mountains region is well known for its biodiversity and has – for more than a century – been frequented by researchers collecting seeds. Haider compares one Tajiki village in which *rashtak* is still cultivated, to another where the agriculture has all but disappeared due to migration of the young. In the latter the spring porridge, however, still plays an important cultural role even if its ingredient has to be brought in from the outside. She argues that for biodiversity to be maintained, it is not enough to save seeds. In the village still growing *rashtak*, agricultural practices are embedded in rituals, underlining their role in the intimate connections between nature and culture.

A small group of Scandinavian farmers who cultivate heritage seeds is the topic of Rebecca Öhnfeldt's chapter. She does not frame her discussion in terms of ritual but underlines the deep connection and care her interlocutors express when talking about their seeds. The quality and the particular history of the seeds used was highlighted in the interviews. Öhnfeldt found that the soil was equally important to these farmers. Taking care of the soil is a slow process and a long-term commitment, they argued, going against the logic of most contemporary market-orientated and profit-maximising agriculture. Since 2009, a number of heritage seeds in Sweden have been placed on a list of varieties worth preserving, and their trade is regulated just as that of highly commercial ones. Non-regulated heritage seeds can, however, be given away or exchanged through formal or informal networks. Some of the farmers Öhnfeldt talked to wanted more heritage seeds to be officially listed, but regularisation means that traits need to be more homogenous. This, however, would negate the inherent diversity they appreciated and strove for. These farmers cultivating heritage seeds might appear as nostalgic, looking only to the past for inspiration and agricultural practices. But this is not at all the case, as shown by Öhnfeldt. Rather, they are orientated towards the future in their care for soil and seeds, and they are not against using innovative and highly modern technologies.

In the last chapter of this volume Tracey Heatherington uses the ancient myth of Demeter and her daughter Persephone as a point of entry to discuss the connections between people, plants, weather, and soil. Demeter was the goddess of fertility, grains, and harvest and when her daughter was abducted and taken to the underworld her grief was enormous, leading to the failure of crops and hence threatening the survival of human society. Through the intervention of Zeus, Persephone was allowed to return periodically to her mother above ground on the condition that she also dwelled

with Hades in the underworld. Once again Demeter let agriculture prosper. The perambulation of Persephone represents, among other things, the passing of seasons and the deep link between processes above and beneath the soil. Heatherington uses this story to argue for the need to take seeds and fertility seriously. Agriculture is, and has always been, an activity involving multi-species partnership and in the chapter she brings out farmers, scientists, and organisations such as the Global Crop Diversity Trust, engaged in, and collaborating for, and learning from each other.

SEED FEARS

"Seeds are scary", Dolly Kikon notes at the beginning of her chapter. She recounts the story of the boy who swallowed a seed which then sprouted in his body. Seeds can indeed be scary. They are powerful symbols, and in their miniscule forms embody great generative potential. They also can be potentially harmful or dangerous gene-modified organisms, creating fear in many people. With drought, floods, and other environmental hazards we also fear that seeds can no longer generate or even *be*, or able to *become*, and thus develop their potential. This *fear for seeds* leads to efforts to protect them through seed banks and *in situ* preservation, which has been discussed in many of the chapters. Seeds are also everywhere these days – or at least talk about them is. There seems to be an enormous surge in seed stories and a sense of urgency in the way they are told. The contribution Interlude is a case in point. In her short piece, Annika Rabo retells a story of the missing seeds in Syria: how she has come to ponder why, over several decades of field research in Syria, she didn't pay attention to seeds.

Life in the Anthropocene is more fragile and uncertain, and as scholars and humans we are called upon to reflect on what it entails to inhabit the world in a more responsible manner. In this book we are trying to do this, using seed and plant life as our point of departure. Thinking through seeds requires us to slow things down and be attentive to the temporal frame of vegetal life. In recent work within critical plant studies, scholars such as Michael Marder, Monica Gagliano, and Natasha Myers ask us to engage plants in a new way, to be more attentive their particular mode of being in the world. Myers suggests a new "planthropology", aiming to "document the affective ecologies taking shape between plants and people" (2015).

At the time of writing this introductory chapter a coronavirus disease is spreading across the globe, making Myers' suggestion exceedingly urgent. Without a vaccine or a remedy, measures to halt the spread of the virus have so far focused on limiting the mobility of human beings. Most countries in the global north have been able to close effectively their borders against the arrival of travellers. This, however, has directly affected the agricultural sector which relies on seasonal workers. Who will harvest the

crops? If borders are closed, how will agricultural products reach the consumers? Such critical questions are now being raised in many parts of the world. Seeds, agriculture, and "home-grown" take on new meanings as they address the fundamental question of food security and the right to seeds and plants. In such a situation there is an obvious risk of increased nationalism and chauvinism. But this pandemic also opens an opportunity to take the rights of migrant agricultural workers seriously. With this volume we ultimately seek to salute all those that care for the land, and with their sweat and labour sustain our lives.

The editors would like to thank the participants in the symposium and the contributors to the volume. We also thank the staff at the Academy who so effectively helped organize the symposium, especially Kristina Lund and Staffan Eriand Isa. In preparing this book we have had the great fortune to work with Jenni Hjohlman, press editor, and Rebecca Montague as proofreader. Natha Wahlang carried out the first round of editing of the manuscript and Mats Widgren gave initial inspiration and support to the project. A heartfelt thanks to all of you. Finally, we would like to thank the Royal Swedish Academy of Letters, History and Antiquities for making it all happen.

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PART I
BIOPOWER

BIRGIT MÜLLER

Affect and power in seeds – sensorial and political engagements

Agricultural seeds are political and social objects that tie the farmer into multiple relationships with soil organisms, bacteria, and fungi, and expose them at the same time to multilayered political powerplays. Following controversies over the patenting of seeds in Canada and globally within the Committee for Food Security (CFS), I will explore how sensorial engagements with seeds gave the impulse for political resistance in different political arenas. I will then look at how collective action emerges and sustains itself.[1]

In capitalist society individuals are compelled to be self-directing, while they are losing their power of decision-making. This becomes particularly obvious when grain farmers voluntarily and in large numbers adopt genetically modified patented seed varieties and subscribe to Technology Use Agreements that make the re-seeding of the crop illegal and allow agents of the seed company to access their fields and silos for years after the crop has been harvested. They become subject to, and may come to internalise, a social order that is itself disguised as a necessity to which they must adapt. Many farmers experience this order as the law of market competition, and adopt the most recent biotechnology to compete with their neighbours or distant strangers for land and for the best crop. Is there a way to regain their freedom from the realm of necessity?

In this article I want to explore the exceptional drive to resist born out of the mundane practice of a farmer reseeding grains found in his field. I will analyse a situation where spontaneous individual resistance received the support of others and evolved to become political. In a third step, I will then show how coordinated collective strategies are most successful when connected to lived experience.

1 This research was financed in part by the ACI 'Mesures de la mondialisation' of the CNRS.

EIGENSINN
OR IMPULSE TO ACT ACCORDING TO ONE'S OWN MIND

Political action and reflection can grow out of an embodied stubbornness—in German we say the *Eigensinn*[2] of an individual. This happened in the well-known patent infringement case that opposed in the 1990s and early 2000s the Canadian arm of the multinational agricultural corporation Monsanto to the Saskatchewan farmer Percy Schmeiser (Müller 2006). I would like to go back to the case, in order to explore the political actions that evolved from Schmeiser's *Eigensinn.* The German term *Eigensinn* designates the ability and the need of individuals in a relationship of domination to perceive reality and grasp a situation as well as to act according to their *own* perception and interpretation no matter what (Lüdtke 1993). An inchoate sense of unease with the way things are links up with a dawning sense that they could be otherwise. Over the years of my fieldwork in Saskatchewan, I followed the Schmeiser case from 2003, interviewing Schmeiser, his lawyers, supporters, and opponents, analysing hundreds of pages of court material, and attending the Supreme Court trial.

It all began 1997 with the quotidian routine of the grain farmer Percy Schmeiser cleaning the ditch of his roadway by spraying the broad-spectrum herbicide, glyphosate. After he sprayed the ditch, Schmeiser drove past the spot a few days later and saw that most of the vegetation had wilted but that a considerable number of canola plants had survived his treatment. He was intrigued to have found the quality of herbicide resistance in a canola just at his roadside. A year before, in 1996, a genetically modified (GM) oilseed, canola, rendered resistant to glyphosate had been authorised and marketed in Canada for the first time. The canola seed was patented by Monsanto and Schmeiser had found it too expensive to buy. He thus happily collected the plants by his roadside to use them for seed the following year. Proud of his feat, he described his discovery to his neighbours. Jealous, one of his neighbours denounced him to local agents of Monsanto monitoring the fields of canola producers to enforce their intellectual property rights. When a Monsanto agent approached Schmeiser in 1998 warning him, either not to reseed this canola he had found, or sign a licence agreement for using what he claimed to be Monsanto's patented canola and pay a fee, Schmeiser refused. He maintained that he owned all the seed that had grown from plants in his field, and that he would use it for seeding as he wished, because it was his property. Monsanto filed a complaint against Schmeiser for infringement. Schmeiser admitted in court to seeding the canola found by the wayside, but insisted that he had been in his right.

Unlike hundreds of farmers accused of infringement by Monsanto who settled out

2 Adjective of *Eigensinn* is *eigensinnig*, stubborn.

of court, Schmeiser and his wife risked their personal savings in these extremely expensive trials through all legal instances. "The lawsuit cost me 400,000 dollars plus six years of my time, when I did do nothing else but fight the case." (Interview, 2005). Schmeiser was ordered to destroy his entire stock of canola seeds that he prided himself in having selected over a 50-year period, because it contained some seeds with a gene that Monsanto claimed as its own. *Eigensinnig* though, for eight years from 1996 to 2004, Schmeiser defended himself against the accusation of infringement in a series of trials up to the Supreme Court of Canada (Müller, 2006).

Two conceptions of property, or as Sir Henry Maine defines it, two bundles of power (Hann 1998, 8; Verdery 1998, 161) opposed each other. The first conception, that Schmeiser held, referred to the inviolability of land ownership as a fundamental right in a democratic society. This Lockean conception of the institutions of a liberal society saw as its essential function the protection of the property of the individuals over tangible things, their estate, and over intangibles such as "life", "liberty" and "labour" that in turn were the foundation of their material property (Locke 1689, sec.87). Schmeiser's lawyer argued according to ancient British common law that for centuries ruled relationships between neighbouring farmers: the owner of the land could naturally claim property over anything that came into his land, for example to the offspring of a bull that jumped the fence and impregnated his cow. Similar to the bull, the glyphosate-resistant canola had trespassed on his field, Schmeiser claimed: "It's pretty windy here in the prairies. I think, Monsanto is trying to make an example of me, because other farmers have also found unwanted GM seeds on their land. But I didn't watch my grandparents clear the land and build this farm, just to have the profits taken over by a big multinational corporation" (Schmeiser quoted in Bridgland 2000). As Schmeiser owned the land where the canola plants were growing, he claimed the perpetual, exclusive, and inviolate right over the tangible property of his land. Lockean liberal philosophy had become part of his intuitive mind-set. Monsanto's claim offended his sense of right and wrong. "We were seed developers. I never had anything to do with Monsanto. The rapeseed that we were growing for 50 years, all of the sudden did not belong to us any more" (Interview, 2005).

The second conception of property claimed by Monsanto places the right to intellectual property over the right to the private enjoyment (to use the Lockean term) of landed property. Intellectual property rights define a link of identification between producer and product in such a way that while third parties may enjoy the property, and create more property from it, its future use must continue to be to the benefit of the original producer (Strathern 1996, 215). Lawyers for the biotechnology company argued that the plant was nothing but a composition of matter, and claimed that the farmer illegally "used", i.e. stole or better infringed, a patent, when he allowed a ge-

netically modified seed to become a plant in his field. The gene, regardless of where it would appear and for as long as the patent holds, was Monsanto's property. However, the transgenic canola plant was not simply an inert "composition of matter" as the lawyers claimed, but alive, reproducing naturally, spreading and invading, – as were the expanding property claims of the multinational – the private property and thus the privacy and autonomy of the farmer.

In May 2004, the Supreme Court of Canada decreed (with five votes against four) that the chimeric gene that Monsanto had "made", was actually "used" in the canola plant, similar to speciality steel used in a car, or Lego blocks in the construction of a toy castle. Entering in the possession of a patented seed without signing a contract did not erase the intellectual property rights of the "inventor" and the corporation that registered the patent: "Possession does not excuse the breach of a patent" (*Monsanto Canada Inc. v. Schmeiser* 2004, 96). Monsanto could now claim a property right in every canola plant resistant to glyphosate and growing in a farmer's field in Canada regardless of their intent. This judgment set a precedent for infringement cases all over the world, where farmers were persecuted because they reseeded their crop contaminated by transgenic varieties.

In this conflict, Schmeiser asserted his right to the land and all that was in his field. He also claimed his knowledge as a farmer who selects and improves his own seed. Schmeiser's act of collecting herbicide-resistant canola seeds to try them out in his field can be understood as an instance of what Gramsci (1971) called "common sense", the age-old conception of the seed in agrarian practices. The seed was there for the taking. It had the same properties as all this new expensive herbicide-resistant seed his neighbours were raving about. Whether this seed was transgenic or not, Schmeiser did not care. It was in his field; therefore, it was his. Common sense is profoundly inconsistent: some aspects of common sense are inherited and absorbed uncritically and therefore potentially induce moral and political passivity. Other aspects are a consequence of practical experience and carry with them the potential for a ruthlessly realistic view of the nature of power, which Gramsci called "good sense" (Crehan 2002, 98). The *Eigensinn* is a drive or impulse to use common sense.

Schmeiser had never before put into question the patentability of living organisms. To use Gramsci's distinction (Gramsci 1971), his common sense made him happy to find seeds resistant to herbicide for free in his field, while his good sense revolted against the property claim of the multinational. The German adjective *eigensinnig* describes his sense of "wilfulness, spontaneous self-will, a kind of self-affirmation, an act of (re)appropriating alienated social relations [...] by [....], demarcating a space of one's own" (Lindenberger 2014, 1). He spontaneously refused in 1998 to cede to the Monsanto agent and showed extraordinary tenacity of fighting his case in many long and costly legal battles.

This *Eigensinn* alone, however, was not yet political, not yet part of a critical practice of world-making. If the *Eigensinn* is driving the action and it resides in the individuals who act in "the field of societal forces" (Thompson 1978, 151) in terms of opportunities and constraints, how do their actions become political?

EMPATHY
OR GETTING IN TOUCH WITH THE WARMTH OF THINGS

Schmeiser's trial attracted the attention of activists around the world. While his neighbours ostracised Schmeiser, caught as they were in local animosities and in production contracts with agricultural corporations, he received the moral and financial support from thousands of people all over the world whom he did not know and many of whom he would never meet in person. Canadian civil society organisations, however, were in two minds about supporting Schmeiser. It was important to break Monsanto's patent, but they doubted whether Schmeiser, who was not in principle opposed to GM technology, was the right person to carry the case. Media depicted him as the David to bring down Goliath, and he acted indeed more like a lone wolf rather than as somebody who shared enough of their political agenda to carry it forward. For a while, Schmeiser joined the progressive National Farmers Union to secure their support with an affidavit for the Supreme Court hearings, but he never became an active member.

Paradoxically then, the support for Schmeiser grew strong among people far from his particular local context and outside the concrete legal situation in Canada. The thousands of individuals and organisations who financially supported Schmeiser, contributing small or larger amounts to cover his substantial legal fees, were neither impressed by the purity of his moral stand, nor by the type of farming he practised. People became involved with Schmeiser because they "felt" with him, as an email calling to support him shows: "if you feel as strongly as I do about the threat that corporate bullying of farmers and other citizens means to a free society; if you're as sick and tired as I am of watching corporations buy government favor and waltz in and out of key cabinet positions; and if you just feel as I do that Percy Schmeiser has been given a raw deal – both by Monsanto and by the Federal Court in Ottawa – then may I please ask you to call or write him and tell him you support what he's doing?" The author of the email, a consultant from the US with no direct professional connections to biotechnology, but experience with patent law, was a master gardener in her free time.[3]

3 https://www.organicconsumers.org/old_articles/monsanto/percy.php [accessed 29 September 2017].

Supporting Schmeiser was sparked by a gut feeling of empathy and moral outrage. As Adorno would say, reason married a natural impulse (Macdonald 2011, 680).

Seed savers, gardeners, farmers, and other citizens all over the world helped him, because they felt with him and because they reasoned that convicting a farmer of counterfeiting because he reseeded his crop may have corresponded to existing Canadian law, but was fundamentally unjust. Justice was not realised, as Monsanto obtained the right to every seed carrying their proprietary gene that invaded the field of a farmer. To paraphrase Amartya Sen, "whatever the propriety of established organisations, if a big fish remains free to devour a small fish, then this is a violation of human justice, no matter to what the causation of that transgression is traced." (Sen 2010, 37) For Sen the "search for world justice is a central challenge in the world today; not merely because our lives are interconnected, but also because the very presence of our interconnections makes us inescapably interested in and involved with each other" (Sen 2010, 47).

Schmeiser's courage to say "No!" expressed what his supporters felt, and they suffered with him as he pursued to act on that thinking. Although his act was initially not directed towards a larger public – he was not a whistleblower or a hero – he was made into the symbol for a fight that spoke to a collective imaginary (Castoriadis 1975). This imaginary was directly connected to the object of contention, the seed. The simple act of planting a seed is one of the most universal – and certainly one of the most important – of all human activities (Kloppenburg 1988). The impulse to support Schmeiser's act of resistance came out of the sensory and emotional engagement of his supporters with his act of planting which was both social and natural. Marxist theory emphasises human dependence on and co-creation of the environment and suggests that humans and nature form a single "body" (Marx [1884] 1959, 275; Pálsson 2009, 297).[4] This entanglement becomes particularly obvious if we consider the co-evolution between seeds and humans. Seeds bear the traces of humans, but humans also bear the traces of their plants, not in the least because human bodies have to physically absorb plants in order to live. Seeds are simultaneously a meaningful part of the daily practice of many people, the cultured inheritance of vital commons, and mediators of power and control, as they act as carriers of national and international food and agriculture policies and as instruments for imposing corporate control in the field of the farmer. Schmeiser was profoundly attached to the canola seeds he and his wife had selected over a 50-year period. His identity as a farmer was "co-created" and "co-emerging" with his seeds (Haraway 2008, 236). When the patented plant technology arrived in his field, it fundamentally changed his existence

4 "Man presents himself with respect to natural matter as a natural force himself. [...] But while he is acting on nature as something exterior and is modifying it, he modifies also his own nature." (Marx [1867] 1977).

(Schraube 2005, 79). In tearing away from the farmer the object of his production, here the seed, he is estranged not only from external nature, but also from his own body and from the spiritual, the "human" aspect of his work (Marx [1884] 1959, 275). This estrangement means concretely for the farmer that his skill and judgement is invalidated and his caring relationship to the seed ruptured.

By helping Schmeiser, his supporters were not only in touch with "the warmth of things", but acutely aware of the mechanisms that destroy that warmth (Macdonald 2011, 680) incorporating "all innervation and experience into the contemplation of the subject matter" (Adorno 2005, 130). Real understanding Adorno maintains is not achieved by cold rational thinking alone but by "emphatic thinking" that requires the courage to stand by one's convictions (Adorno 2005, 132). Many of Schmeiser's supporters reflected on the immense power that a multinational would acquire if it could claim ownership of all patented transgenic seeds and the plants growing from them, wherever the wind carried the seed.

For some years after the verdict, Schmeiser was invited to give speaking tours in Europe, Asia, Latin America, and Australia. He became a symbolic figure of the anti-GMO (genetically modified organism) struggle. He told his story again and again and gradually his speech became more refined. When I interviewed him in 2005, his discourse had integrated some of the arguments of the civil society groups that supported him: "Going to the Supreme Court meant for us we would be able to bring the whole issue to the largest public: Can you patent a gene? Who can patent a gene? Should anyone be allowed to patent a gene? Who owns life?" (Interview, 2005) Once Schmeiser felt that others supported him, the political implications dawned on him, or to say it with Gramsci, the protest potential of the ruthless realism of good sense (Gramsci 1971) became possible.

With the help and the nudging of his supporters, he began to doubt the patenting of life in general and began to think strategically in terms of alerting the larger public to what he conceived as a profound injustice. He assisted other Saskatchewan farmers, who wanted to return to "conventional" canola varieties and were menaced by Monsanto with infringement claims, because "volunteer" GM canola plants had regrown on their field and intermingled with the conventional canola. He discovered that the power structures that were attached to patented transgenic seeds were not only corporate, but also sustained by the Canadian government. He explained: "The Department of Agriculture was found out in 2000 that it was co-financing the development of the GM technology. The regulatory approval for GM canola in 1996 was given for the unconfined release into the environment. So, the government gave permission. So, who is responsible? It's the people, the taxpayers? The government was sold on by the words that this new technology will feed the world, is at the cutting edge of world

technology" (Interview, 2005). Schmeiser felt that the government had been blinded by the promises attached to GMOs and that its public regulatory agency had lost the neutrality required for evaluating the new technology.

While Schmeiser had early on in the trials claimed all the seeds in his fields as his property, he now started to resent GM seeds as invasive and contaminating: "The way to further the introduction of GMOs is to contaminate, take people's choice away. Whatever I hear from the biotech industry. The best way to promote GMOs is contamination." (Interview, 2005). He affirmed that Monsanto should be at least responsible for the contamination they caused if they could claim the property of every single canola plant. He was vindicated to some extent in 2008, when he succeeded in getting Monsanto condemned in a small claims court to pay 640 CAD for hand-rouging his 50-acre mustard field from invading GM canola. He hoped this judgement would set a precedent allowing all farmers whose fields were contaminated by GM seeds to claim for the physical removal of the plants. His discourse also started to shift from the defence of his individual property to the defence of collective farmers' rights. He began to argue and plead in his public speeches for the "farmers' right" to save seed that had been enshrined in the International Treaty for Plant Genetic Resources for Food and Agriculture entering into force in 2004.

For those farmers able to resist the logic and the tentacular grip of the corporations, seed saving can become an act of everyday rebellion (Phillips 2013). Farmers in France (Demeulenaere 2014) refused stubbornly to obey the law of 1970 forbidding them to reseed, and some continue to do so today even though more restrictive enforcement measures are in place. Not all seed savers asserted explicitly the right to their own vision of and being in the world, as did the French farmers involved in the French seed saver network Réseau Semences Paysannes (Demeulenaere 2014), but they drew from the direct sensorial relationship to the seed and the soil, or the earth, as Patočka (1998) would have it, the energy and impulse to act and reflect on the technological constellations, the shared knowledge and long history of practice that are contained in the seed.

If individuals are drawn to one another and to the world surrounding them through empathy, how can they develop a common political strategy? How can opponents to seed patents act intentionally and collectively on the field of social, political, and economic forces invested by multinational seed companies? "To federate causes is one thing; to institute them is another" (Chateauraynaud 2017, 544). How to move from mobilisation around a specific case to impacting the legal frame that allows multinational seed and chemical corporations to extend their grip over agricultural practice and the global food chain?

STRATEGY
OR BUILDING A SPACE FOR STRATEGIC ACTION

Political action emerged in the Schmeiser case out of collective support for his counter-conduit and from the everyday attachment of his supporters to saving seeds; however, in order to have a lasting effect, institutional change is needed. The corporations owning seed patents operate in the global sphere where intellectual property rights over living organisms have received international recognition.[5] Some of the civil society organisations that wrote affidavits for the Schmeiser case therefore moved on to the international arena, attempting to use the human right to food as a lever to compel governments to stop enabling multinational corporations and to respect the legally binding nature of human rights as the foundation for their decision-making. Instead of presenting hunger as an ethical problem to which technical solutions could be found, governments ought to pay attention to the inequalities in power and access to resources that *cause* hunger and poverty. The alternative forums to the World Food Summits of 1996 and 2002 that were organized by civil society groups outside the official multilateral arena helped to launch the concept of "food sovereignty" that evolved into "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It put those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations".[6]

"Food sovereignty" refers to the legal systems that emerged in Europe and North America in the 18th and 19th centuries and allowed for a democratisation of sovereignty and the emergence of public law based on the principle of collective sovereignty (Foucault 2001, 189). It contrasts and coexists with a "mechanics" of power that emerged with global capitalism and disciplines people through regulation and surveillance, so that they act on their own accord, as they ought to act. This new type of power is supported by a powerful regime of experts to which the Committee for Food Security of the United Nations (CFS) is both subjected and of which it is an integral part. The call for food sovereignty targets precisely this type of discipli-

5 In paragraph 27.3 b of the TRIPS agreement regulating on the international-level Trade-Related Aspects of Intellectual Property Rights (an annex to the Marrakesh Agreement of 1994), signatory countries committed to instituting intellectual property rights over living organisms.

6 Declaration of Nyéléni, 27 February 2007, http://www.globalagriculture.org/report-topics/food-sovereignty.html [accessed 3 October 2017].

nary governance without sovereign authority, which interferes with national and local food politics. Food sovereignty is a call for politics as critical democratic practice.

Before the creation of Food Sovereignty Forums, in parallel to World Food Summits, civil society participation in food and agriculture policies of the United Nations (UN) had been mostly tactical. Tactics operate in the space of the other in which one insinuates oneself without being able to step out of its logic – as in Foucault's *dispositif* which continually draws in new actors engaging them with forms of calculation, technical reasoning, human "capacity building", and with non-human objects and devices, such as genetically modified organisms (Foucault 1975, 218). If a person cannot count on a space of his or her own, or cannot maintain a clear boundary to distinguish himself or herself from the other as a clearly visible totality, then that person can only make "tactical" moves (de Certeau 1990, xvi). Then actors must constantly play with events in order to transform them into opportunities for making an impact that may not last. Thus, the "rural poor" who were the particular target of UN policies that aimed at "improving the welfare of the urban and rural poor," were encouraged to participate in "field work and policy dialogue" (FAO 1999, 5) *within* the terms of the UN administration.

The parallel forums extracted themselves from the space organised by the dispositive of depoliticization, maintaining a space of their own from which they could engage in critique and develop a strategy. Strategy, the "calculation of power relations", became possible from the moment when subjects with will and power of their own had "a space that became the basis for managing their relations with a separate externality" (de Certeau 1990, xvi). In this space they were able to debate, allow for internal controversies, and make sense of external constraints and opportunities. Moreover, they were consolidating their "good sense" – to use the Gramscian notion – breaking with inconsistencies and imposed passivity (Thomas 2009, 374), advancing criticism and collective demands (McKeon 2009).

After its failure to come up with solutions during the world food crisis of 2008 the multilateral Committee for Food Security was reformed. The civil society space that had existed informally in parallel to the UN system was integrated in 2009 to become a Civil Society Mechanism. The declared objective was to give a voice to the food insecure populations themselves. However, revealing the polarizations underlying the multilateral system, associations of business enterprises obtained their own Private Sector Mechanism to "balance" the influence of civil society. In the reformed committee, civil society and private sector organisations discussed with representatives of governments and made proposals about food policy issues. Voting was the reserve of the Member States. The ultimate accountability and responsibility for Committee for Food Security decisions remained with governments. (Kay 2015) The stifled diplomat-

ic atmosphere of the Committee for Food Security was clearly shaken by the presence of civil society organisations challenging the state representatives to prioritise human rights, and by private sector representatives calling for the compatibility of all principles with international and bilateral trade and investment treaties. Open controversies entered the arena of negotiation.

Civil society organisations actively campaigned for a multilateral process in the realm of the United Nations to obtain guarantees from governments that they would rein in global companies that invested massively in land, promoted biotechnologies, and imposed seed patents. They also wanted clear constraining guidelines giving precedence to human rights over the proliferation of trade and investment treaties that affected agricultural markets, state grain reserves, marketing boards, and enforced intellectual property rights over seeds.

When Principles for Responsible Investment in Agriculture and Food Systems were debated from 2012 to 2014 in the consensus-orientated arena of the Committee for Food Security, members of the Civil Society Mechanism were allowed and even expected to bear witness, but they had to fall in line behind one common civil society voice when the actual negotiations started. To achieve this feat of co-ordinating the work of the often more than 30 civil society organisations present, they formed four well-prepared negotiating teams of three members each for each negotiation round. This internal organisation of the negotiating team adopted a strict discipline, the institutional language and references of the United Nations, which allowed for coherence in statements, but also took away spontaneity and edge from the interventions. Nevertheless, glimpses of the real world became vividly apparent, when farmers, fisher-folk, or indigenous peoples ignored the constraints of official procedure and spoke passionately about their real-life situations.

Civil society negotiators obtained the mention of important principles such as farmers' rights to seeds in the text; however, in the final text the member states sought to "balance" human rights principles with international trade and investment rules. "Agro-ecological approaches" were mentioned in Principle 6 but only to be followed immediately by an emphasis on "sustainable intensification", a euphemism created by the biotechnology industry and its allies to promote genetically modified proprietary seeds as a "package of desirable and appropriate technologies" (The Montpellier Panel 2013, 21). Hidden behind the two terms agro-ecology and sustainable intensification, two opposing models for the future of agriculture thus "balanced" each other, a corporate-led model favouring agro-biotechnology and a model building on the creativity and ingenuity of small-scale producers supported by participatory plant breeding. The states manoeuvred in between these two models (McMichael & Müller, 2014). The outcome corresponded to a mere association of contrary views that were, to paraphrase Simmel, "not only empirically un-

real, but did not participate in processes of real life" (Simmel 1908, 187).

The outcome of this balancing act was profoundly unsatisfactory for civil society. The text of the principles remained unclear about what type of investment, made by whom and for whom, was deemed "responsible". The members of the Civil Society Mechanism had negotiated up to the very end in order to ameliorate the text as much as possible, but then the organisations decided on their most political move yet. Reading the final text against the real-life situations back home, a majority of social movement representatives rejected the principles that they had worked so hard to negotiate, outright. To quote from the final declaration of the Civil Society Mechanism: "We are disappointed to say that for the constituencies of civil society – peasants, fisher-folk, pastoralists, landless, urban poor, agricultural and food workers, women, youth, consumers, indigenous peoples, and NGOs – the document is not useful."[7] This rejection dissociated the Civil Society Mechanism from the implementation of the document. At the same time, it allowed the civil society organisations to guard their autonomy preserving a strategic position (de Certeau 1990) with respect to the Committee for Food Security, challenging its decisions and governance practices, while continuing relentlessly to make their voice heard.

COLLECTIVE ACTION

Schmeiser's *Eigensinn* was necessary but not sufficient to sustain an effective opposition to the institutional and economic structures of appropriation he confronted. In order to become able to effectively resist, he needed others to take the step and go beyond their individual interests and help him. It was the exceptional generosity and empathy of ordinary people from all over the world, who gave Schmeiser financial support, that helped him to sustain his resistance and maybe, more importantly, helped him understand the global implications of the injustice he had resisted.

In many ways, citizens active today in networks around agriculture and food give their own meaning to official procedures, transforming law courts into political forums, and stubbornly defending their seeds and holding on to different ways of growing food. A critical practice thus asserts itself. Collective resistance emerged in the Committee for Food Security, because Civil Society Mechanism members understood each other's concrete suffering, and the economic and political structures that defined the conditions of possibility for their political action (Thomas 2009, 373–380, 435–436). Because they were able to draw on empathy and reflexive knowledge collectively, the members of the Civil Society Mechanism were able to step out of the constrain-

7 https://www.youtube.com/watch?v=7_FksAaUje0 [accessed 2 October 2017].

ing institutional frame of the Committee for Food Security. They affirmed their own strategic stand refusing to endorse the Principles for Responsible Investment in Agriculture and Food Systems. This refusal allowed them to remain a lively political force inside the international arena.

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RAMI ZURAYK

Of seeds and wars: A political ecology of seeds in the formerly Fertile Crescent

> Food, next to life itself, has become our greatest common denominator. Its availability, quality, price, its reflection of the culture it feeds and its moral and religious significance make it quite literally history's "staff of life". Today, in the never-ending worldwide struggle to determine who will control its production, quality and accessibility, food is no longer viewed first and foremost as a sustainer of life. Rather, to those who seek to command our food supply it has become instead a major source of corporate cash flow, economic leverage, a form of currency, a tool of international politics, an instrument of powe – a weapon!
>
> A.V. Krebs, *The corporate reapers: The book of agribusiness*

PREAMBLE

This article is about seeds and wars, about how they are organically connected. It is a story about how seeds travel with wars, and about how they are used as weapons in wars, to subdue nature, and to subjugate people. It shows how seeds can be a tool of colonial conquest, occupation, and control. But it is also a story about how seeds encapsulate life, culture, traditions, and everything that is dear to the human heart, and how they can bring about a liberating sovereignty of the spirit even when the body is in bondage.

WAR AND SEEDS: SETTING OUT THE THEORETICAL STAGE

In this paper, I consider war in the "*sens large*" of the term. I define it as a form of conflict and confrontation involving violence. This would include conquests, occupation, siege, embargo, sanctions, slavery, exploitation, and dispossession. The rural world is rife with such "wars". The dispossession of the peasantry by the ruling class and the expulsion of the producer from the soil are processes of "primitive accumulation" necessary for capital formation and expansion. They involve tremendous violence exerted

onto the rural masses as well as on nature and ecologies (Nichols 2015 and references therein). The production of food can be infused with tremendous violence throughout the value chain, as food production is often predicated on a systematic assault against people, animals, and environment. The damage is intensified by industrialization and capital penetration. The reason we are not always aware of this violence is that it is artfully camouflaged by false images from advertising and also because many among us have become estranged from the natural systems that produce the food we eat, in what Marx termed the metabolic rift (see Moore 2000 and references therein). The privatization of land and of life (seeds) creates a division between humans and nature, and town and country. Food (the product of the interaction between seeds, water, and soil) often has to be grown thousands of miles away from the place it is consumed. Waste is not returned to the soil, contributing to its impoverishment. In the same way that there is no return of the waste to the soil that has produced it, there is no return of the seeds to the land that has produced them.

There is, worldwide, a recrudescence in interest regarding the relationship between agriculture and conflict. This was reignited by the food crisis of 2008, when the confluence of droughts, increased oil prices, the production of biofuels in the Americas, and financial speculations caused a sudden increase in cereal food prices, which in turn resulted in rioting and violence in Africa, Asia, the Middle East, and Latin America. The food crisis was perceived as one of the articulations of the global geopolitical crisis associated with the tension between center and periphery following the dismantling of post-colonial states. This is especially relevant to the Arab world where most of the world's oil is produced and which is the world's largest importer of food amidst what seem to be endless conflicts. In a recent edited volume (Zurayk *et al.* 2018) dedicated to studying the relationship between agriculture, conflicts, and crises, the authors explore the theories of agrarian transformations and associate class-based struggles, as well as geopolitical aspects of food and conflict.

War and seeds are connected in multiple interacting ways. In his book *Against the grain* which traces the history of agriculture, grain-farming, and its relation to the creation of the first city-states in Mesopotamia, James C. Scott shows that grain production was "imposed" as a means to create an easily taxable surplus, as the harvest times are known and the crop can be estimated with relative ease (Scott 2017). Thus grains (seeds) are inextricably linked with the process of exploitation and accumulation that forms the basis of capital formation and reproduction. Arturo Warman's book, *Corn and capitalism*, shows than the circulation of plant material such as seeds cannot be separated from wider processes of colonization and settlement (Warman 2003). The suicide of 300,000 farmers in India, the occurrence of which has been linked to the deadly synergy between Bt cotton (Monsanto's genetically modified cotton) and free-

market neoliberalism, stands witness to the human devastation that can accompany seeds driven by capital's power (Thomas & De Tavernier 2017). Monsanto's domination of the Indian cotton seed market may not be a conventional war, but its victims are none the less people who chose to take their own lives under the pressure of capital's relentless war with farming livelihoods. Rosa Luxemburg (Rousseas 1979) and then István Mészáros (2010) both theorized the links between capitalism and war, aptly captured in the words of Ali Kadri (Kadri 2018):

> Militarism and its sub category of war are both subcategories of accumulation by waste, as the ever-expanding nature of capital requires it to destroy and reconstruct to replace the same commodities over and over again, a way to break through boundaries imposed by the limit of consumption. Capital accumulates by means of war and war itself is a sphere of production not only in the making of weapons but also in the provision of foods, among others.

Seeds are also interesting in that they are both capital goods and consumption goods. Farmers invest labor in the production of more seeds from seeds, but they also invest time, knowledge, and effort in selecting and storing seeds. Seeds are biologically reproductive structures, and are essential to the process of economic reproduction associated with farming. A sovereign economy requires the ability to produce consumption goods that can be consumed or exported, also known as sector 2 of the trade economy (machines that make goods). It also requires the ability to make the machines that make those goods, known as sector 1 (machines that make machines).[1] Failure to align both sectors creates dependency on the countries that produce the machines that make the machine that make the goods. This is why countries that produce goods and trade them, but do not produce the machines that produce these goods, are dependent on countries that produce the machines to make the machines that produce those goods. Seeds can be construed as machines that make goods (sector 2), as seeds produce food that is the good that is consumed or traded. They are machines that make machines (sector 1) as they produce the seeds that are saved for producing more food. If the production of seeds is not an integral part of the food production system, both nations and farmers remain hostage to a seed market over which they have no control.

We shall now apply these theoretical considerations to explore the relationship between seeds and war in the region that witnessed the emergence of farming 10,000 years ago: the Fertile Crescent.

1 For an approachable explanation of the Ricardian sector 1 and sector 2 economy please see *Modern political economics: Making sense of the post-2008 world* by Yanis Varoufakis, Joseph Halevi and Nicholas Theocarakis, p. 53 where the authors use the Hollywood movie *The Matrix* to illustrate the concept.

THE FERTILE CRESCENT

The Fertile Crescent, also called the Levant, is located in Western Asia bordering the Eastern Mediterranean (*Fig. 1*). The region is the center of origin of various cereal and grain legume species such as wheat, barley, lentils, and vetch, as well as fruiting plant species, the most famous being olives and grape-vines. The Mediterranean Triptych (Tabak 2008) of wheat, olive, and grape was the basis of the region's subsistence farming. Today the region's plant agrobiodiversity reflects the combined influences of native crop species and of the two major waves of crop diffusion the region has experienced.

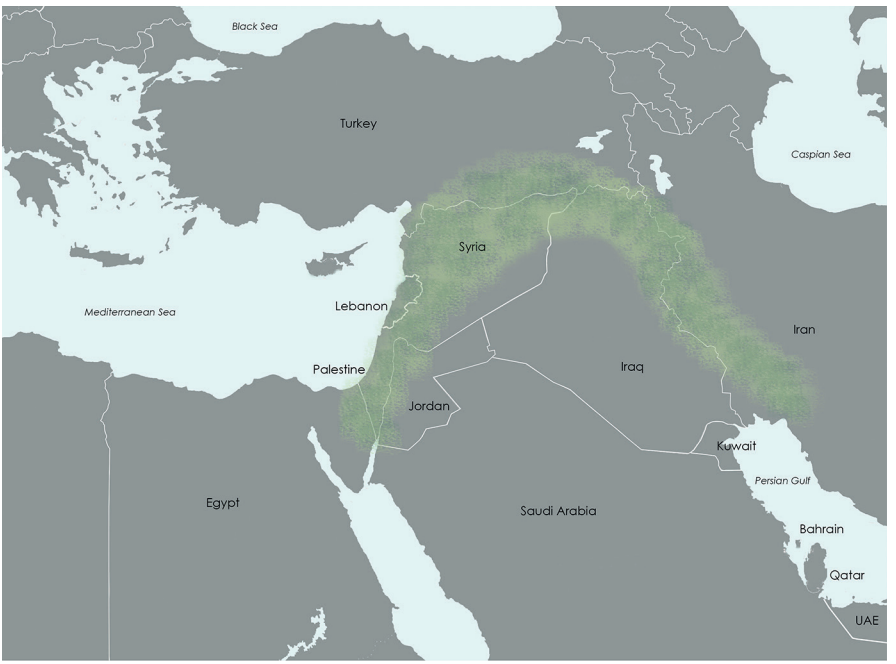

Fig. 1. The fertile crescent. Map by Rim Hazimeh.

The first wave of crop diffusion is commonly dated to the 7th to 8th centuries AD and is usually thought to be contemporary with the eastward expansion of Islam. Watson (1974) in a seminal article asserted that the expansion of Islam towards the East and the creation of a "polity spanning from Eurasia to the Indian subcontinent" ushered the first Green Revolution, by promoting the intensification of agriculture based on

a package of new crops (seeds), irrigation techniques, and soil stewardship. Watson lists 17 crops that were brought from India to the Fertile Crescent and from there traveled to Europe during the 7th to 11th centuries AD. These include Asiatic rice, sugar cane, cotton, banana, plantain, lemon, lime, durum wheat and sorghum; in addition to watermelon, aubergine (eggplant), spinach, and artichoke. All these have a significant importance in our economic life. They were grown where they thrived best, in the water-rich plains and deltas. They attracted farmworkers and migrant laborers from the mountains, which resulted in a contraction of terrace farming accompanied with a reduction in the maintenance of the soil conservation structures. However, the thesis of a precise dating of the introduction of these new seeds (the spread of Islam) has been challenged on the basis of archaeological evidence by Decker (2009). It appears that many of these crops (Decker focuses on durum wheat, rice, sorghum, and artichoke) were present in the Fertile Crescent region before Islam (i.e. pre-7th century AD), and that Watson's linear seed diffusion model fails to account for earlier transmission predating Islam, as the trade connection between the East and West was always present, and that Arabs themselves were in pre-Islamic times an important link in the trading logistics (Decker 2009). It does therefore appear that such seeds made their way towards the Fertile Crescent and then to Europe as cargo of Arab caravans and then via Genoese ships, although Persian, Sassanid, and Hellenistic conquests probably also contributed to the initial movement of seeds between Eastern Asia, the Levant, and Europe.

The Columbian Exchange, which refers to the widespread transfer of people, plants, animals and ideas between West Africa, the Americas and the Old World in the 15th and 16th centuries, is a totally different matter, as there was no significant contact between the Old World and the New World prior to the voyage of Christopher Columbus in 1492. The purpose of these "explorations" was to serve the interests of trade and economic growth and supremacy: militarism at the service of mercantilism using violence, war, and an array of biological and conventional weaponry. Unlike conquest to the East, the Columbian era ushered the colonization of new lands by the decimation of the original inhabitants and the appropriation of wealth in all its forms – material and biological, lands, minerals and seeds – in a process of primitive accumulation by annihilation.

Nunn and Qian (2010) note that the magnitude of the depopulation accompanying this period will remain unknown, but quote a figure of 80–95 percent of the Native American population decimated within the first 100–150 years following 1492 (Nunn & Qian 2010). Agriculture boomed on the newly acquired lands, as Old-World seeds made their ways on galleons to the new fertile and deforested lands: sugar, cotton, coffee, soybean, oranges, and bananas, to name but a few, were industrially planted with

great capital ventures. This in turn elicited a violence of a different kind, the transfer of millions of slaves from Africa to provide free labor and therefore increase profit margins. Potatoes, tomatoes, tobacco, cocoa and vanilla made the opposite journey, carried by merchant ships to usher a new farming system in the Old World or in colonies, one of intensification, exploitation of land, water and labor, enclosed properties, and capital penetration into local food systems. Large quantities of maize were needed to feed the captives on their journey to the Americas. Maize plantations, the seeds of which had been brought from the Americas, flourished in West Africa, wreaking havoc on indigenous farming systems. By the early 18th century, maize had become one of the key staples in West and Central Africa (Carney 2001).

IMPACT OF THE COLUMBIAN EXCHANGE ON THE FERTILE CRESCENT

The farming systems of the Fertile Crescent remained economically successful until their cultivation expanded to the Atlantic regions. As their culture moved, new crops brought by the Columbian Exchange appeared. They made their way into Ottoman lands where potatoes, used as feed, for instance replaced the more easily taxable wheat and contributed to the decline of taxation and to the revival of mountain farming and of mobile pastoralism. Nomadism, anathema to the Ottoman state which perceived the mobile pastoralists as potential rebels, brigands, and tax evaders, was strengthened by these changes.

Scientists and environmental historians are starting to unravel another impact of the conquest of the New World. A team led by Richard Nevle (Yirka 2011) studied charcoal remnants and reported that Native Americans practiced regular burning of forests in order to clear areas for farming. As the population was decimated, land was abandoned, leading to the regrowth of forests which reduced the amount of CO_2 in the air by 6–10ppm between AD 1525 and 1600. This created a "global cooling" which led eventually to the Little Ice Age of the 16th century. Scientists speculate today that this ice age killed off diversity in much of the Northern Hemisphere, leaving a small center around the Mediterranean (Lanchester 2019). Sam White's book *The climate of rebellion* links these events to the weakening of the most powerful fiscal military state of the 16th century, the Ottoman state, opening the way to pushing the empire from center to periphery (White 2013).

In the wake of this tragic war waged on nature and humanity for the purpose of capital expansion and accumulation, seeds travelled with the victims too. The enslavement of African captives and their forced transfer to the Americas contributed to another, lesser known, transfer of seeds and crops. Carney (2001) traces the travels of the "red"

African rice *Oryza glaberrima* (quite distinct from the Asian *Oryza sativa*) and its establishment in South Carolina. Here it was probably planted in small garden plots by African slaves accompanying the early European settlers, who were more interested in planting the European desirable white *O. sativa*, which was grown in large-scale plantations. Carney's work serves to dispel the commonly held view that Africa did not contribute significantly to intercontinental plant exchange, summarized in Orlando Ribeiro's (1962) statement (cited in Carney 2001): "Brazil supplied maize, beans, cassava, cashew, papaya and pineapple; India, rice, coconuts ... Africa ... provided nothing important". It also demonstrates the relevance of food preferences to the livelihoods of the meekest; and shows that, with this little act of resistance, the African slaves were exerting some agency over a life in which their bodies belonged to them no more. This goes to show how seeds, which can be a tool of domination and control, can also be a means of resistance by those who have no refuge left but to keep alive an entire heritage encapsulated in a seed.

THE RUSSLAND-SAMMELCOMMANDO

When the Nazi army moved towards Leningrad in 1941 in Operation Northern Lights, its commanders had set their goals on the strategic city, but also on the 380,000 samples of seeds that were stored in the seed bank of the Vavilov Institute. These had been collected from 1894 onwards by a cadre of explorers that included Nicholai Vavilov, who travelled the globe collecting seeds, tubers, roots, and bulbs. Vavilov was the only man on earth to have collected seeds from five continents, doing so over 115 research expeditions. The Nazis were keen to control this seed legacy in part because of their interest in eugenics, and also because they saw its potential for plant breeding. A special SS tactical unit, the Russland-Sammelcommando, was created during the planning phase of the invasion in order to take control of the seeds, which were to become the heart of the new German industrial agriculture renaissance. War and capital were once again making good bedfellows. The Nazi invasion offered an opportunity for primitive accumulation driven by destruction and occupation. However, Stalin and his staff were not of this mind: they considered this repository to be "bourgeois science" and even imprisoned Vavilov for dilapidation of state funds during the war as he was seeking to protect the collections. Nabhan tells us in his wonderful book *Where our food comes from*, which retraces some of Vavilov's travels, the story of those committed seed bank staff who preferred to starve during the siege rather than consume the seeds under their protection. By 1944, 700,000 people in Leningrad had died from starvation, including nine of the Institute's staff (Nabhan 2008).

IRAQ: PAUL BREMER AND ABU GHRAIB

Let us fast forward to the 21st century and the US invasion of Iraq, where the invasion and the dismantling of the Iraqi state offered excellent opportunities for capital penetration and accumulation. The destruction of Iraq began in 1980, when former US minion and Iraqi dictator Saddam Hussein invaded the nascent Islamic Republic of Iran with the support and blessing of Western powers, and with the funding of Arabian Gulf countries. The Iraq-Iran war came to an end in 1988 after up to two million casualties, and in 1991 Saddam Hussein invaded Kuwait to replenish his coffers that had been drained by the war. This action reframed him as a villain for most Western nations, and his army was driven out of Kuwait by a US-led coalition. Trade and financial sanctions were imposed for 13 years during which Iraq's agricultural sector was devastated due to a combination of food aid, systematic demolition of agrochemical factories accused of manufacturing weapons of mass destruction, and an embargo on materials and technology required for agriculture under the pretense of "dual use". The infamous "Oil-for-Food" program, created and administered by the UN to allow the Iraqi regime to sell oil for the sole purpose of buying essential food items, was mired in corruption and bribes. It made Iraqis dependent on food aid for years, and has led to the death of at least 227,000 children between 1988 and 1998 (Garfield 1999). Other estimates put the figure at 500,000.

The devastation was completed with the invasion of Iraq in 2003, the dismantling of the state, and the destruction of all its services and much of its infrastructure, the pollution of soil and water with depleted uranium, and the subjugation and humiliation of the Iraqi people. As a result of the destruction of nature, state, and society, the region that saw the emergence of one of the earliest agricultural civilizations, the country with the fifth-largest proven oil reserves in the world became a basket-case dominated by corruption and income disparity: a dream destination for war-driven capital. What better place for US agribusiness to expand? Daniel Amstutz, a former Cargill executive, was appointed in 2003 by the US invading forces' administration to oversee the reconstruction of the Iraqi agricultural sector. Cargill has recently been named "the worst company in the world" by former US congressman Henry Waxman, on the basis of its human-rights and environmental record in a recent extensively detailed report (Waxman 2019).

Paul Bremer, the former managing director of Kissinger associates, became the first de facto ruler of invaded Iraq and when he departed from the country in 2004, he left behind 100 orders. The purpose of these orders was to facilitate the entry of global corporations into Iraq and re-mould it as an economically dependent entity from which tremendous profits could be achieved. In its paragraphs 51–79, Order 81 expanded

on the need to apply Intellectual Property Rights (IPRs) and seed patenting in Iraq, in order to legally protect corporate business. Iraq's 1970 law, which predated the occupation, did not allow seed patenting, and according to the Food and Agriculture Organization of the United Nations (FAO), more that 90% of Iraqi farmers planted their own seeds. Bremmer changed that, paving the way for US seed imports and for genetically modified organisms (GMOs), in a process that did not result from free negotiations, but that was imposed from above by an occupying power. What "freeing Iraq" really meant for the US-led coalition appears to have been "freeing the Iraqi economy" and throwing it at the mercy of multinationals (GRAIN 2004).

Moreover, the sole requirement in the process of registering seed patents was to "describe" or "characterize" them, in total disregard of their origin and of the thousands of years or farmer-led selection. The new law replaced the 1970 law in the Iraqi legal code. It offered protection to breeders who describe varieties, regardless of where these varieties were collected. Details of the mechanism of corporate occupation of the Iraqi seed sector can be found in a report jointly issued by Focus on the Global South & GRAIN (2004). This effectively ended what farmers usually consider to be a universal right: the right to save seeds and replant them, which contributes to completing the socio-natural metabolic cycle. Over the years, many countries in the South were compelled to adopt similar laws on seed patents through bilateral agreements (GRAIN 2005). This drove Iraqi farmers towards the modern varieties-irrigation-agrochemicals tryptych that has to be purchased every season as they became trapped in a high-cost cash-crop economy. The aberration reached new levels when US agrotechnology companies provided just six wheat varieties for Iraqi farmers to grow. Three of these were for pasta, which is not usually consumed by Iraqi people, nor is it produced in Iraq (Smith 2005). Meanwhile, by 2006, according to UNICEF, 33% of Iraqi children suffered from chronic malnutrition (UNICEF 2006).

By 2009, my own personal field observations of Iraq's agriculture sector led me to believe that there were few farmers left in Iraq. Farmers had been physical victims of the war or had fled their villages and fields to become internal refugees. The reconstruction of the sector proceeds slowly to this day, led by corporate agents. Through the United States Department of Agriculture (USDA), many US universities received grant money from the Bush administration to train Iraqis to go back home and work for subsidiary companies like Monsanto and Pioneer collecting local germplasm and producing new varieties under the strict control of the US research and development (R&D) divisions. Iraq has been purposely colonized, not democratized; it was destroyed and never reconstructed. Even before they became major figures in the Bush foreign policy team, David Wurmser, Richard Perle, and Douglas Feith predicted in 1997, as members of the "Project for the New American Century", an influential Wash-

ington neoconservative think tank, that a post-Saddam Iraq would likely be torn apart by sectarian conflicts, but advocated that the US "expedite" such a collapse anyway (Smith 2005).

Prior to the war, Iraq had its own seed bank housed in a vault at Abu Ghraib where, since the 1970s, seeds of important native crops such as wheat, barley, dates, and pulses were stored. Abu Ghraib's collection was enriched with samples that had been salvaged from Afghanistan's national seed store that had been looted in 2002 as the country sank into vandalism and pillage and the influence of local warlords. Not long after that, the Abu Ghraib vaults were themselves pillaged and their contents dispersed, but Iraqi scientists, before the US invasion, had sent a "black box" of seeds to the seed bank of the International Center for Agricultural Research in the Dry Areas (ICARDA) in Tell Hadya, near the Syrian city of Aleppo (Nature 2015a). It wasn't very long before Syria too came under assault, and the 131,000 seed samples of the food crops originating from the Fertile Crescent were once again under threat from war and pillage. Stories of daily heroism have been told about the ICARDA staff protecting the seed bank at Tell Hadya (Nature 2015b). The seeds were then withdrawn from the ICARDA seed bank and moved to the Svalbard Global Seed Vault in Norway, before some were moved again to Lebanon and Morocco in 2015.

SEED BANKS FOR WHOM?

The learned community applauded the agility with which the seed treasure remained one step ahead of the war, being moved with celerity from bank to bank and from vault to vault. But for the ordinary farmers, these seeds are still inaccessible. There is no place here for a critique of the seed bank concept, but it does appear to be akin to wealth of any other kind, piled and accumulated out of the reach and the control of the farmers whose labor produced it (GRAIN 2002). What is presented to us as the patrimony of humanity is safely tucked away in gene banks located in the North or managed by CGIAR (formerly the Consultative Group for International Agricultural Research) centers in a trusteeship system that has been criticized by civil society as being biased in favor of the seed industry (GRAIN 2002) Thus, the genetic wealth of the farmers, produced laboriously by generations of empirical amateur scientists selecting the best performing varieties and favoring diversity against uniformity, is taken from them and locked away in distant locations without any clear mechanism for their access. How does a farmer get to use the seed varieties that are not in the market? Who do peasants reach out to in order to reclaim varieties that they are told are theirs but they can never see? How can they systematically and democratically have a say in variety improvement and access the products? How can the banks work for the

farmer rather than for the corporations? This seems to be a question asked by many, about seeds as well as about other forms of wealth.

SEEDS IN THE SETTLER COLONIAL PROJECT

Many may not know that Israel is one of the world's largest cucumber seed producers. It specializes in the Beit Alpha cucumber, described by seed traders as a Lebanese cucumber that has been mainly bred in Israel.[2] Cucumbers originated in India and reached the Levant as part of the first wave of crop diffusion (Decker 2009), and have been grown there ever since. In 1922, Jewish settlers created a kibbutz near the Arab village of Beit Ilfa. One of the kibbutz members, Hanka Lazarson, engaged in the selection and breeding of local crops especially garlic and cucumber, and the Beit Alpha cucumber was named after the local Arab village. This product of biopiracy became a main export of the Israeli seed industry, and no benefits fell to the local Palestinians who had selected it and grown it for centuries.

The deep complementarity that exists between science and the settler-colonial project has been recently explored by Omar Tesdell, a geographer working from Bir Zeit University in the West Bank. Tesdell (2017) painstakingly traces how Aaron Aaronsohn (1876–1919), an agronomist and resident of a Jewish colony in Ottoman Palestine, lobbied the US to establish Palestine as a region for colonization through research on the ancestors of wheat (Tesdell 2017). Aaronson sought US funds to establish a research station in Palestine, arguing that this would also benefit dryland farming in the American West, emphasizing the analogies between the two areas. This research station would breed new varieties of crops that would benefit both the Zionist settlers and American settlers in the West and drive the colonization of new areas. Aaronson's taxonomic work was criticized by other breeders, as he classified the wild relative of wheat, *Triticum dicoccum dicoccoides*, as a subspecies of the domesticated emmer wheat, *Triticum dicoccum*,[3] and brushed over the fact that the samples he used were found near Mount Hermon close to Rashayya in what is today's south Lebanon rather than in Palestine. But Aaronson's goal was primarily political: his essential claim was that wheat is native to Palestine, but not to Palestinians. It is an outcome of the landscape and was preserved in spite of the local farmers. According to him, wheat needed to be preserved in its landscape, a landscape where there are no people, thus offering a justification for the colonization of Palestine. In this seminal paper, Tesdell offers insight into how research practices participate in the process of colonization, and also to

2 https://www.superseeds.com/products/beit-alpha-f1-hybrid-52-days.

3 Cultivated emmer wheat is now known as *Triticum turgidum* subsp. *dicoccoides*.

question the role of nativeness and how place-based relations between seeds and people do not necessarily bring about a botanical decolonization, as places themselves are "constituted by flows of material and knowledge from wider colonial encounters and conquests". In this claim, the nativeness of wheat to Palestine is precisely the mode by which the plant and by extension the land is appropriated.

This process of cultural appropriation is directly linked to settler colonialism, and goes on in Palestine to this day. Heritage Grain Conservancy (http://growseed.org/) is a project to collect and "save" old wheat varieties. Tucked away in one of its internet pages is a report dated October 2008 titled 'Israel-Palestine Seed Conservancy'(https://growseed.org/IPSC.pdf) about a project that brings together Israel's Gene Bank with a group of Israeli researcher and a couple of Palestinian and Jordanian scientists. The tone of the collaboration is set clearly in the conference on seed exchange that took place on 29 November 2007 where "four Palestinian farmers" brought a display of landrace[4] wheat and seeds to share. All participants were recognized by name, including the French National Institute for Agricultural Research (INRA) scientists who appear to also collaborate in the project, except for the four Palestinian farmers who remained nameless. All 30 accessions of the collection presented in the conference bear Arabic names and were collected in Palestinian villages.

The Heritage Grain Conservancy project recreates place to suit the colonial mindset: Wadi Fukin, a Palestinian village is presented as an enchanting place, where farmers and Israeli researchers have created an idyllic place to conserve seeds and save the area from "urban encroachment". In this bucolic heaven, Israelis and Palestinian join forces to conserve traditional seeds. The reality is brutally different: The Palestinian Localities Study, carried out by the Applied Research Institute – Jerusalem, in 2010 (ARIJ 2010) shows that 93% of the total area of Wadi Fukin is classified under Area C according to the Oslo 2 Agreement of 1995. Area C designates that the land is directly under Israeli military rule and as such is used as the main area of illegal settlement expansion[5]. Area C covers 61% of the West Bank. There are two settlements in Wadi Fukin. There are two settlements in Wadi Fukin (not shown on the pictures of the website) and a Segregation Wall that cuts across its land. Clearly "place" has a different meaning for the colonizer and the colonized. Here too, concepts like "nativeness", "indigenous", and "origin" take different meanings depending on who is using them. Seed conservancy is framed differently in the eye of the colonized than it is in the eye of the colonizer where it contributes to the colonial goal of accumulation by dispossession.

4 Landrace varieties are local, traditional varieties of a cultivated species that have been cultivated by farmers and adapted to a specific local environment.

5 See http://www.passia.org/maps/view/75 for an illustrated explanation of the territorial division of the Oslo 2 agreement.

SEEDS OF RESISTANCE

If seeds are tools of occupation, they can also be tools of resistance. The Palestinian Heirloom Seed Library is an organization in the occupied West Bank that aims at collecting, saving, and using heirloom seeds. For the Palestinian farmers who participate in the project, and in the words of its founder, Vivian Sansour (2017) this is an act of resistance, a way to stand up to thousands of acts of war every day, to confront the banality of daily violence. It is a statement against the theft of identity, a way to affirm their agency over their lives and their world. The symbolism of the seeds and the symbolic act of collecting and preserving them as a dynamic collection helps the oppressed and the occupied address issues of identity, an identity that has been eroded by decades of occupation, settlements, and colonialism. Instead of being defined by the oppressor, seeds allow Palestinian farmers to reclaim their self-worth, and to freely grant the world their agronomic heritage. No place here for big business and corporate agents, who prefer to be associated with power.

The biggest achievement brought about by those simple heirloom seeds, according to Sansour, is that children who would have otherwise been born and raised in subjugation can now lift their heads high and declaim: we do not deserve to be oppressed; echoing the African slaves who conserved a part of themselves through the seeds they grew in America, and which sustained their lives and their spirits.

CONCLUSION

The story of seeds and their travels is too large to be captured in a single chapter. It is the story of life, of civilizations, of farming, and of food. It is also the story of war, exploitation, subjugation, and oppression. For seeds are food as well as the precursors of food, and control over them paves the way to domination over the entire food production system. The metabolic rift that defines our current food system is expressed in terms of human estrangement from the food that is produced. But is there a rift more poignant than the separation of seed from land? The food we consume today is largely grown from chimeras born not on the land, but on the laboratory benches of corporations that control our sustenance, our life, the integrity of the global ecosystems, and the livelihoods of billions of farmers. Seeds have become the shackles that hold farmers hostage to the technological package of agrochemicals and irrigation, a package that produces tremendous profits for a few, but continues to destroy the planet's ecosystems.

For this is the true war that is being fought in every house and in every field: the

war by predatory capital on nature, and the resulting planetary scale ecological and social destruction. Capital obeys a single profit logic, a logic that is modulated by waste and destruction so that it may grow and reproduce. Seeds, as an integral part of the agribusiness package, are today a weapon in a growing arsenal. The ruin brought about by this war is all around us and is reaching global proportions: the fires that have devastated the Amazon between January and August 2019 have been unequivocally linked to deforestation (Escobar 2019) driven by agribusiness's urge to produce more (Arruda *et al.* 2019).

István Mészáros (cited in Clark & Bellamy Foster 2010) puts it clearly: the current system has created a rift not only in the natural metabolism, but also in the social metabolism between humans and nature. These rifts must be simultaneously sutured as a matter of human survival. Deepening our knowledge of the interaction between the social sphere and the natural sphere is a critical step on this long journey.

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OLA TVEITEREID WESTENGEN

Of maize and men

We have entered the Anthropocene. Geologists are now searching for *the golden spike*, the fingerprint in the geological record that signals the beginning of the new epoch.[1] The front-runner for the title is the radionucleotide deposits from the first nuclear bomb tests, while other contestants are deposits from plastic pollution and synthetic fertiliser use, and chicken bones: The world now consumes more than 60 billion chickens annually and remains from this feast will be defining fossils from our time. All these golden spike candidates are of post-World War II origin and consequently the majority vote in the International Union of the Geological Sciences' working group on the Anthropocene recommends that the beginning of the epoch is set to the mid-20th century. There is however a minority vote opposing this position, arguing that humans have been a geological force for a much longer time. According to the "early Anthropocene" proponents, agriculture with its domestication of plants and animals, clearance of land for cultivation, soil erosion, and the spread of methane-emitting livestock and paddy-rice production made humans a geological force at a much earlier point in the Holocene. The debate on the timing of the onset of the Anthropocene and its associates golden spike has taken place in the pages of *Science* and *Nature* over the last few years.

In this chapter, I propose a golden spike that marks *both* an early Anthropocene and a post-WWII intensification of the Anthropocene: maize. Not only is the maize cob itself a golden spike, but as I will show, the archaeological traces of maize, like the Bomb, has left isotype fingerprints that will be visible to future geologists. I contend that maize has played a profoundly important role in shaping the Anthropocene and that a multidisciplinary approach to study continuity and change in the human-maize

1 The expert working group of the International Union of the Geological Sciences plans to submit a formal proposal for the new epoch by 2021 to the International Commission on Stratigraphy – the body overseeing the official geological time chart.

relationship can help us understand how the maize agri-food system has conquered the world.

A basic premise for my argument is a rejection of the notion that human societies' transition to *agri-culture*, with its domestication of plants and animals, marks a "revolution" – a transition from a past in which people were part of evolution and a new era in which people became "makers of history"' (Ingold 2002, 78). "Agri-culture" is both ecological and cultural and agricultural assemblages of humans and non-human species are as much products of evolution as products of cultural history.

This chapter proceeds as follows. First, I draw on empirical evidence from archaeology, food chemistry, and genomics in a discussion of the role of maize in shaping the Anthropocene. Second, I draw on environmental history and food regime theory to discuss continuity and change in the human-maize relationship from colonialism through the Green Revolution to the current corporate food regime. Finally, I discuss the political ecology of the human-maize relationship in the current ecological crisis phase of the Anthropocene. I conclude with a discussion of possible futures for the human-maize relationship, highlighting alternative evolutionary and governance pathways this relationship could take from here.

THE EARLY ANTHROPOCENE GOLDEN SPIKE

Maize uses a so-called C4 photosynthesis to acquire energy from the sun. This photosynthetic pathway fixes more Carbon-13 (13C) molecules than the C3 pathway used by most other crops. Carbon-13 is a natural, stable isotope of carbon that makes up a small share of the carbon on earth compared to Carbon-12. What makes this relevant to the topic of this chapter is that the Carbon-13 isotope ratio in the plant will impact the Carbon-13 ratio in the tissue of the animals and humans consuming it. Hence, we can say something about the relative importance of maize and other C4 plants in diets by analysing tissue such as flesh, hair, and bones. Since Carbon-13 is a stable isotype, this tissue need not be fresh. Archaeologists use this property of Carbon isotype ratios to determine the relative importance of C4 plants in prehistoric diets (Staller *et al.* 2006; Blake 2016). *Fig. 1* shows a map with archaeological sites in Central and South America from which human remains excavated reveal Carbon-13 ratios at levels that reflect a high share of C4 plants in the diet far back in the Holocene. It is important to note here that maize is not the only plant in American prehistoric diets that would result in a high Carbon-13 ratio and that diets rich in marine food will give similar patterns (Blake 2016, 57). Keeping these caveats in mind, high Carbon-13 ratios are nevertheless, together with other archaeological and genetic lines of evidence, one indicator of maize having become an important part of the diet. This "golden maize

spike" falls within the research realm of the archaeologists today, but it will also be visible to future geologists studying the strata from this anomalous interglacial period. The spike marks that the two species *Zea mays* and *Homo sapiens* at this point had entered into a co-evolutionary relationship, with humans changing the maize species and maize changing the human species. The layers on top of the spike will tell future geologists that this co-evolutionary relationship was an ecological game-changer. Consolidated efforts by a world-wide consortium of archaeologists recently presented evidence for "a planet largely transformed" 3,000 years ago. This insight "challenges the emerging Anthropocene paradigm that large-scale anthropogenic global environmental change is mostly a recent phenomenon" (Stephens *et al.* 2019). The study shows that emergence and spread of the cultivation of maize and other crops is associated with global environmental changes such as soil erosion, altered fire regimes, deforestation and greenhouse emission, and climate change (Stephens *et al.* 2019). Somewhat counter-intuitive evidence for the earth-system effect of agriculture in the New World was recently presented by the geographer Alexander Koch and colleagues. In a paper in *Quaternary Science Reviews* they suggest that the depopulation of the American continent following the Columbian invasion can explain the decline

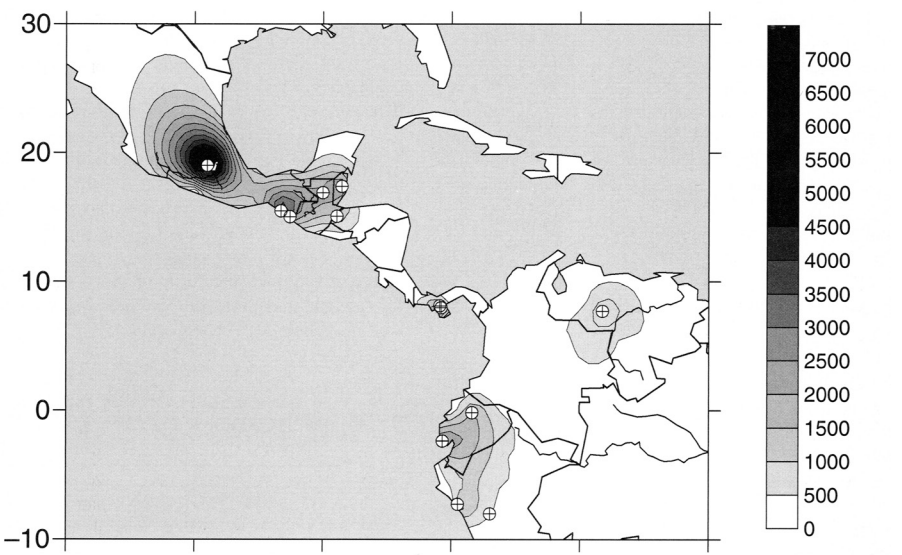

Fig. 1. The early Anthropocene golden maize spike. Carbon-13 isotope values in human bones excavated in Central and South America with origins 500–7,000 radiocarbon years before present reflects moderate-to-high Carbon-13 values in diets. As the authors are careful to note, these values might be due to high maize intake, but can also be due to high intake of other C4 plants or marine food. Radiocarbon years BP. Source: Blake 2016.

in global atmospheric CO_2 concentration and the accompanying lowered surface air temperatures by 0.15°C in the late 1500s (Koch *et al.* 2019). Their chain of explanation is that epidemics brought to the Americas by Old World invaders killed about 90% of an indigenous population that largely subsisted on agriculture. This led to a return of tropical forests in abandoned cultivated land which absorbed so much carbon that it largely can explain the CO_2 down-surge in the decades that followed. The authors illustrate their explanation by referring to the difference in carbon binding between tropical forest and maize cropland, stating that the former has an above-ground biomass of about 161 Mg C ha-1 compared to 11 Mg C ha-1 in the latter.

The dominant narrative about maize domestication is a linear progress narrative in which humans brought the wild grass teosinte into the home and transformed it into the domesticated maize. The genetic studies of maize domestication at first glance seem to support this narrative by offering both a pinpointed domestication site and a diffusion pathway out of this centre of origin.

Based on analyses of genetic markers in teosinte and maize landrace samples from across the Americas, Matsouka *et al.* (2002) concluded that domesticated maize (*Zea mays* ssp. *mays*) originates from the teosinte subspecies *Zea mays* ssp. *parviglumis*. The same study pinpointed the domestication of maize to the Balsas river basin in present day South-Central Mexico and even dated the event to approximately 9,000 years ago (Matsouka *et al.* 2002). Later studies, which included a larger number of teosinte samples and a larger number of markers, indicate that following the initial domestication in the lowlands, maize spread to the highlands from where it dispersed south and north on the continent after crossing with another teosinte subspecies *Zea mays* ssp. *mexicana* (van Heerwaarden *et al.* 2011).

CO-EVOLUTIONARY PROCESS

The well-supported story of the single domestication event is compelling and no genomic studies in teosinte and maize have explicitly challenged it. However, in recent years a body of domestication literature, based on genomics and archaeology, has challenged the notion that crops typically evolved from a single domestication event. Rather than monophyletic origins, genomic studies of several crops have found evidence of either polyphyletic origin and/or extensive introgression from wild populations (Allaby 2015). Archaeological studies have furthermore shown that for some cereal crops, domestication has been a protracted process that has taken hundreds, if not thousands, of years, rather than being a rapid process of fixation of the "domestication syndrome" (Fuller *et al.* 2014). This research is mainly done on wheat, barley, and rice and the case for maize might of course differ, but it might also be worth consider-

ing the genomic evidence in maize in light of the new framing this "protracted model of domestication" offers. After all, all interpretation of empirical data, also molecular data, depends on theory and perspective.

Considering how different the maize cob is from the small hard-seeded teosinte ear, it seems highly unlikely that it was the outcome of a conscious process. No one could possibly foresee the enormous transformation. Thus, rather than looking at this as a unilateral evolutionary project from the side of the human, it makes more sense to consider this transformation of the teosinte ear as the outcome of a co-evolutionary relationship. This view of the domestication process as a more symmetrical relationship between humans and certain plant species has roots back to Darwin's foundational work on domestication, *The variation of animals and plants under domestication* (Darwin [1868] 2007), and to Rindos' seminal thesis *The origins of agriculture* from 1984 (Rindos 1984), but it is only in recent years that this perspective has risen to become a real contestant to the asymmetrical "Neolithic Revolution" perspective, through the work of palaeobotanists such as Dorian Fuller and domestication geneticists such as Robin Allaby and Michael Purugganan. In a recent review, Purugganan summarises the new perspective on domestication arising from a "synthesis of plant genetics, genomics, and archaeobotany" in terms of four new insights: domestication has in general been a protracted process; unconscious (natural) selection has played an important role; interspecific hybridisation plays an important role in diversification and spread of some crops; and similar genes and traits across crop species show parallel/convergent evolution (Purugganan 2019).

In evolutionary biological terms, co-evolution is a process in which two species impinge a selective pressure on each other which leads to genetic change in both species. The genetic and morphological changes in maize are well studied and continue to be the subject of intensive research. Evidence for change in maize in the human-maize co-evolution abound and in addition to fundamental domestication traits shared by all domesticated maize, landraces of maize display a myriad of local adaptations related to the crop's diversification into new agro-ecologies and new cultures. Maize's most dramatic adaptation to life as a crop is, as already discussed, the transformation of the small hard-seeded female inflorescence in teosinte into the large soft-seeded maize cob. This characteristic together with a few other major morphological changes in the plant architecture constitute the "domestication syndrome" in maize. The conventional view is that a few major genetic loci accounted for these changes; however the last decade's massive advances in genomic methods have shown that there are very few examples of simple single gene-phenotype associations of this sort and that for most traits a large number of loci are involved (Larsson *et al.* 2013; Romero Navarro *et al.* 2017). Several recent studies of maize domestication and diversification have included

ancient DNA and the evidence from these studies also shows that maize evolution was probably a protracted and gradual evolutionary process rather than a rapid event (Ramos-Madrigal *et al.* 2016) and that the crop actually spread into South America as a "semi-domesticated lineage" (Kistler *et al.* 2018) with convergent adaptation of such traits as adaptation to highland climates underpinned by different genetic bases in Mesoamerican and South American maize (Takuno *et al.* 2015).

While the domestication syndrome today is fixed across all traditional landraces and modern varieties of maize, there is still a tremendous amount of diversity and local adaptation in maize. According to Ed Buckler and collaborators, the genetic difference between two random maize lines is about as large as the difference between chimpanzees and humans (Tian *et al.* 2009). Understanding the genetic basis for adaptation to agro-ecological variables is of course of significant interest for maize breeding programmes of all kinds, and large sums of research funding is directed at this very applicable type of fundamental genetic research. For example, the international agricultural research centre with the international research mandate for maize, International Maize and Wheat Improvement Center (CIMMYT) in Mexico, recently launched a programme titled the *Seeds of Discovery* initiative which includes genotyping and phenotyping of the large international germplasm collection in the centre's gene bank. One of the first studies to come out of this initiative was Romero Navarro *et al.*'s (2017) study of flowering-time adaptation in maize landraces. Flowering time is an important trait, for example for escaping drought, and other studies from *Seeds of Discovery* have explicitly framed their rationale in terms of their relevance for climate change adaptation (Gates *et al.* 2019). The local environmental adaptations in landraces have of course come about in farmers' fields and are thereby the result of both natural selection and "artificial" selection undertaken by farmers. Compared to the number of studies addressing agronomically important traits, there are few studies addressing diversification traits associated with cultural preferences. A notable exception is the large ancient-DNA study presented in da Fonseca *et al.* (2015) which showed that maize in the Southwestern United States cultivated about 2,000 years ago was undergoing selection in genes important for the sugar/starch ratio, a pattern that makes sense in light of the relatively high prevalence and preference for sweetcorn among Native American groups in this part of the Americas (da Fonseca *et al.* 2015).

While a typical asymmetrical perspective on domestication might be suitable for identifying how maize and its domestication traits have evolved as a response to human selection pressure, the co-evolutionary perspective opens up several interesting research questions related to how humans have evolved in response to the maize diet and the selection pressure that represents. The higher Carbon-13 level found in excavated human remains is of course not evidence of an adaptation in itself, but it is rea-

sonable to hypothesise that human populations relying on maize rich diets evolved adaptations to high-starch-content diets. Indeed, global scale association studies have shown that Central American populations like other high-starch diet-eaters have higher frequencies of alleles associated with ability to digest starch (Hancock *et al.*, 2010). While there are probably also other biological adaptations to the maize diet it is even more interesting to consider how culture has evolved in relation to maize cultivation and maize diets.

In their book *Not by genes alone*, the cultural evolution scholars Peter J. Richerson and Robert Boyd put forward the following definition of culture: "Culture is information capable of affecting individuals' behavior that they acquire from other members of their species through teaching, imitation, and other forms of social transmission" (Richerson & Boyd 2008). Richerson and Boyd operate with an analogy between genetic variability and cultural variability, suggesting that some cultural information is likely to persist while other disappears. Over the long run this "cultural selection" can explain patterns of cultural variation. Cultural evolution, they contend, has made it possible for human populations to "evolve fancy adaptations to changing environments rather more swiftly than is possible by genes alone" (Richerson & Boyd 2008, 7). Writing in the same tradition, Joseph Henrich (2017) uses a maize-human relationship story as an example of cultural evolution: across the Americas where maize has been a staple for thousands of years it is common to prepare maize with an alkali (a base) either obtained from certain rocks, or from burning seashells or certain kinds of wood (Henrich 2017). In Mexico this process is called *nixtamalisation* (from the Nahuatl language). Nixtamalisation makes it easier to grind the maize and enables formation of a dough for preparation of tortillas, and today we know that it also reduces mycotoxins and releases vitamin B3. A diet heavily reliant on maize will be low on vitamin B3 which is nutritionally unavailable from maize for humans unless it is prepared this way. Unfortunately, this part of the maize culture was not transferred alongside maize as it was transferred to the "Old World" cultures. Henrich (2017) reports that the vitamin B3 deficiency condition known as pellagra caused millions of deaths as late as the 1940s in the United States because the menus in orphanages, prisons, and sanitariums were dominated by cornmeal and molasses prepared without nixtamalisation. Thus, the cultural knowledge about nixtamalisation and its equivalents is an excellent example of a cultural adaptation found among human populations that have co-evolved with maize.

If the human-maize relationship indeed can be called a co-evolutionary relationship it should be possible to find evidence for co-variance between patterns in maize diversity and patterns in human cultural diversity. Studies of maize landrace diversity in Mexico have shown that maize indeed is morphology differentiated between eth-

nic groups and associated this with culinary and other cultural preference differences (Benz *et al.* 2007; Brush & Perales 2007; Perales *et al.* 2005). A more recent study was able to detect such ethnolinguistic group differentiation at the local scale using genetic markers (Orozco-Ramírez *et al.* 2016). These patterns can probably be explained by differences between management practices and preferences between communities and ethnic groups. In other crops, it is shown that there is an association between ethnolinguistic groups and the crop's population structure (Stemler *et al.* 1975; Westengen *et al.* 2014). Such associations in sorghum have been identified across geographic scales from continental language family scale to between villages and ethnic groups (Labeyrie *et al.* 2016; Westengen *et al.* 2014). These studies have shown that the factors maintaining diversity not only should be understood as commonly held individual preferences within groups, but also as collective institutions.

In maize, the literature abounds with evidence of the importance of collective action and institutions in maintaining diversity. In present-day Mexican campesino agriculture, landraces of maize are still widely grown and managed as a commons (Bellon *et al.* 2018; Perales *et al.* 2003). These cultural institutions have deep historical roots and have manifested themselves in the symbolic expressions of maize in art, folklore, and religion over much of maize's pre-Columbian homeland. The cultural significance of maize shows that it is not merely a metaphor when several native Central American cultures have identified as "people of maize".[2]

THE POST-WWII GOLDEN SPIKE

We still are what we eat. Maize production and consumption have surged since the Second World War, a pattern very much in line with the other socio-economic and earth-system trends characterising "the Great Acceleration" which the proponents of the post-WWII Anthropocene sees as "the most rapid transformation of the human relationship with the natural world in the history of humankind" (Steffen *et al.* 2015). The statistical database of the UN Food and Agriculture Organization (FAO) shows that maize has become the most produced crop in the world, both in terms of area planted and in terms of total production. In 2017, the world devoured more than 1.1 billion tons of maize (FAOSTAT 2019). While most of the maize produced in developing countries is consumed directly as human food, most of the production in the Global North is used to feed livestock and for other purposes such as biofuel and

2 An example is the *Popol Vuh*, the mythology of a Guatemalan Maya group, which says maize is "both the material from which humans are formed and the material that provides nourishment to that form" (Huff 2006). The Guatemalan author and Nobel Prize winner Miguel Ángel Asturias wrote on this theme in his 1949 novel *Men of maize*.

other starch and sugar products. The fertiliser and pesticide consumption of maize agriculture will undoubtedly leave a mark that will be visible for future geologists, but just as with the rise of maize "agri-cultures", this transformation will also leave a Carbon-13 golden spike visible in the remains of those consuming all this maize. Two independent studies of Carbon-13 levels in contemporary populations illustrate this. Valenzuela and collaborators (2012) compared stable isotype ratios of human hair sampled in 13 Western European countries with hair collected in the USA. The hair sampled from North Americans showed significantly higher Carbon-13 content compared with the levels in hair sampled from Europeans (*Fig. 2*). The authors of this study attribute the isotope difference to "the pervasive use of corn in the American diet" (Valenzuela *et al.* 2012, 6). Another, somewhat older study, offers an explanation of the mechanisms involved. Jahren and Kraft (2008) sampled servings of hamburgers, chicken sandwiches, and fries across the USA. The map in *Fig. 3* shows Carbon-13 levels in the sampled chicken meat and the authors concluded that 100% of the samples had values consistent with an exclusively corn-based diet (Jahren & Kraft 2008). Even for the beef in the hamburgers, only a small percentage had Carbon-13 isotype ratios at levels indicating that the animals possibly could have been fed any other food than maize. The authors did not examine the beverages served, but laconically note that in the USA these are also dominantly sweetened by corn syrup. As we saw in the study of prehistoric human tissue, the bodies of people consuming this diet will be built with the same carbon. A closer look at the source of the chicken meat in this study revealed that it all came from one company: Tyson Food Inc. (Jahren & Kraft 2008).

I am not the first to point out the paradox that the Carbon-13 isotypic ratio in pre-

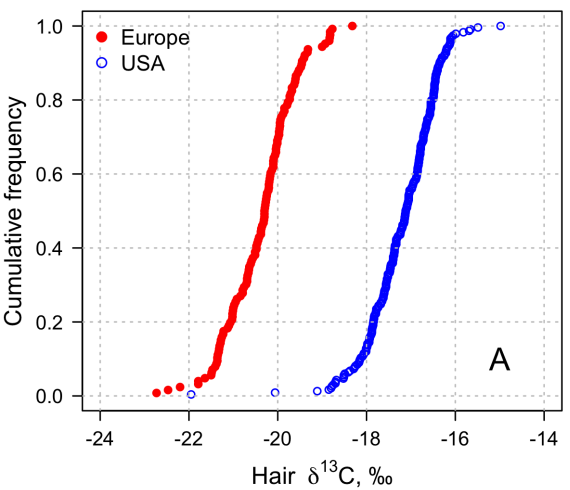

Fig. 2. Carbon-13 isotype ratios in hair samples of modern-day Europeans and Americans show that the latter group has significantly more maize-based diets. Source: Valenzuela et al. 2012.

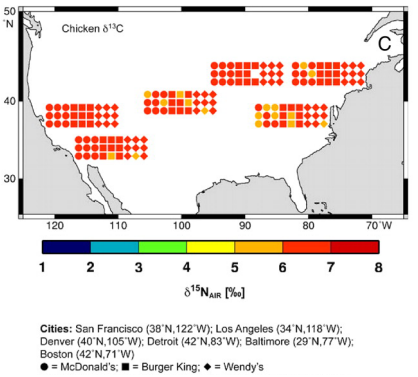

Fig. 3. Carbon-13 isotype ratio in chicken meat from three fast-food chains across the United States reflects high share of maize in poultry diets. Source: Jahren & Kraft 2008.

sent days American consumers actually is higher than in the indigenous people who traditionally have identified as "people of maize". In his bestseller *The omnivore's dilemma*, Michael Pollan writes that American consumers have become "walking corn" (Pollan 2009).

The biological and evolutionary perspectives discussed in these first sections are important in order to understand the profound significance of maize in the great transformations that both the early Holocene and the post-WWII Anthropocene represent. The French historian Fernand Braudel called maize one of the three "plants of civilisation", together with wheat in Eurasia and rice in East Asia (Braudel 1977). Braudel asserted that maize's productivity and ease of cultivation was the physical basis that enabled the rise of the great pre-Columbian civilisations in the Americas. The surplus maize production fed the workers in the urban centres and fuelled the construction of their great monuments. This points to the role of maize as a political-economic *agent* – a perspective we shall return to at a later point. But before we venture there, we shall consider what human political economic projects maize has been part of from colonial times to the present. Biological and evolutionary perspectives do not suffice to explain maize entanglement in the so-called industrial grain-oilseed-livestock complex (Weis 2013) that has come to dominate the global food system in this phase of the Anthropocene – an epoch many say should rather be called the Capitalocene (Moore 2015).

THE POLITICAL ECONOMY OF THE HUMAN-MAIZE RELATIONSHIP

Maize reached the "Old World" as part of the first wave of the "Colombian Exchange" of crops, livestock, and diseases across the Atlantic (Crosby 2003). The journey of maize into Europe, Africa, and Asia has to a certain extent been mapped using genetic

methods (Westengen *et al.* 2012), but a rich historical record deposited in archives, captured in artwork, documented in prose, etc. underpins a rich historical literature on the significance of the introduction of maize in these new lands. Two masterful accounts of the history of maize as it travelled across the Atlantic are Arturo Warman's *Corn and capitalism* from 1988 (Warman 2003; English translation) and James McCann's *Maize and grace* from 2005 (McCann 2005). These books document how maize, following its first foothold in West Africa in the late 15th century, arose to become the most-produced crop in Africa. It talks about how maize's productivity made it an important agent in the colonial project. Maize flour was for example first used to feed the slaves brought westwards across the Atlantic and later to feed the miners in the African colonies – stories that resonate with Braudel's account of the importance of maize to feed the workers that constructed the monuments in the pre-Columbian American empires. The continuity that these authors point out is also what led Michael Pollan to call maize a "protocapitalist" crop (Pollan 2009). Warman and McCann are great guides to the history of maize from early colonialism to late capitalism, and in their detailed historical accounts some political economic structural patterns become visible. They show how maize has been used both materially and discursively in the grand "development" projects of the Western world in Africa in the past centuries. However, rather than recounting these accounts, I will engage another political economic perspective to be our cicerone in the post-WWII Anthropocene.

If evolutionary theory can elucidate the early Anthropocene transformative role of maize, I suggest the political economic theory of food regimes (Friedmann & McMichael 1989; McMichael 2009) is useful to understand the crop's role in the late Anthropocene. The food regime concept "brings a structured perspective to the understanding of agriculture and food's role in capital accumulation across time and space" (McMichael 2009, 140). Two important ways of undertaking food regime analysis are to study patterns of circulation of food and to study the politics of food within both stable and transitional periods in the world economy. Scholars within this tradition largely agree that we have seen at least two distinct historical/political food regimes under capitalism, and the debate is ongoing about food regime developments since the 1980s.

McMichael offers the following definition of the first food regime:

> The first food regime (1870–1930s) combined colonial tropical imports to Europe with basic grains and livestock imports from settler colonies, provisioning emerging European industrial classes, and underwriting the British 'workshop of the world'. (McMichael 2009, 141).

This is thus the historical period in which food and other agricultural products flowed from the colonies to the colonial powers. The role of maize in this global circulation of

primary products was primarily to feed the labour force on the plantations and in the resource-extracting industries. The high productivity and relatively easy production of maize compared to other grain crops adapted to rainfed dryland agriculture made it an ideal source of calories in a system of capital accumulation that relied heavily on cheap manpower.

The post-WWII agri-food system was fundamentally different:

> The second food regime (1950s–70s) re-routed flows of (surplus) food from the United States to its informal empire of postcolonial states on strategic perimeters of the Cold War. Food aid subsidized wages, encouraging selective Third World industrialization, and securing loyalty against communism and to imperial markets. 'Development states' internalized the model of national agro-industrialization, adopting Green Revolution technologies, and instituting land reform to dampen peasant unrest and extend market relations into the countryside. (McMichael 2009, 141).

This period is thus marked by the impacts of agronomy and agricultural policies in increasing agricultural production in the Global North to a level of overproduction. Parts of this overproduction were exported as food aid, but an even more consequential export was the promotion of the scientific agricultural modernisation efforts represented by the Green Revolution. The plant breeding and agronomy that had enabled the modernisation of agriculture in the Global North was in this period exported and applied to crops and cropping systems in the Global South. A key political aspect of agri-food system development in this period was the central role of the state. While philanthrocapital bodies such as the Rockefeller Foundation, and the most powerful capitalist countries (and later the World Bank) were the donors behind the international research centres that did much of the scientific groundwork, the national agricultural research organisations and the national extension systems in the "recipient" countries played an absolute key role in adapting and disseminating the technology and "the message" in the countries. The message disseminated on the farm level was about the importance and benefits of adopting the improved varieties and technologies and techniques that helped realise the full potential of the new seeds. The message on the international policy scene was a "feed the world narrative", perhaps reaching its apex when Noman Borlaug, often called "the father of the Green Revolution", was awarded the Nobel Peace Prize in 1970 for "staving off mass hunger". Borlaug was himself a wheat breeder, and although maize saw a steady production increase together with the other major grain crops globally in this second food regime, it was first in the early 2000s that maize became the world's most-produced crop. Part of the explanation for this might be found in the power relationship between the public and the private sector in the Green Revolution. As the new technologies were part of public sector-led projects they were treated as public goods. For example, the international maize research centre in Mexico – CIMMYT – up to today calls the freely available

seed samples from its gene bank "global public goods". In the current food regime, this status is under pressure. Again maize plays a key role.

In 2007, just around the time when the world witnessed a global food price crisis, the Bill and Melinda Gates Foundation in collaboration with the Rockefeller Foundation announced that they would launch a grand new programme for a Green Revolution for Africa. A major difference between the first Green Revolution and its new version is not only the geographic focus on Africa, but also a difference in emphasis of the role of the public and the private sector in its implementation. The new Green Revolution is focused on enabling a private sector-led agricultural development. A conglomerate of development actors, including the philanthropic foundations mentioned above and regional trade organisations such as the Common Market for Eastern and Southern Africa (COMESA) and the Southern African Development Community (SADC) have launched a suite of programmes and instigated a number of regional and national policy reforms with the objective of making the frame conditions more favourable for development of a commercial seed sector. As was the case with the original Green Revolution, this development is also modelled on seed system development in the Global North. More precisely, the model seems to be found in a development that started with maize in the USA. The sociologist Jack Kloppenburg in his 1988 seminal book *First the seed* pointed out that the increasing commodification of seeds went hand in hand with a change in the social division of labour between public and private plant breeding (Kloppenburg [1988] 2005). Commodification and privatisation were enabled both by policy and law and by the biology of the maize plant. The legal provision came first with the US Plant Variety Protection Act from 1970 which made it possible to get Intellectual Property Rights (IPR) on genes and plant varieties. The biological condition enabling commodification of maize varieties was the emergence of hybrid breeding as the major approach to crop improvement in maize. Briefly explained, hybrid breeding comprises approaches to breeding that utilise a particular biological phenomenon: the crossing of two distinct inbred lines results in "hybrid vigour" in the offspring. This hybrid vigour is lost in subsequent generations. Since there is a "yield penalty" for farm-saved seeds of hybrid varieties, farmers wanting the same high yield must return to the supplier to get new seeds every planting season and refrain from using farm-saved seeds. Together, IPRs and hybrid breeding provided a protection that enabled a lucrative private seed business. And indeed, maize evolution is now entangled in capitalism. It has gone through Polanyi's "Great Transformation" and become commodified (Polanyi 1944).

Today, hybrid breeding is joined by technological advances in biotechnology and the Plant Variety Protection Act (PVP) is joined by other legal provisions such as patent law and contract law protecting Intellectual Property Rights (IPR). Most com-

mercial seed companies, especially in the US, apply a layer of contract law on top of the patent: when you buy a bag of proprietary seeds there is a bag tag saying that opening the bag constitutes an agreement not to save or replant seed. Thus, the farmer does not own the seed they have bought, they merely "rent" them. The multinational company Monsanto calls this a "Technology/Stewardship Agreement". This stewardship is not a stewardship over the seed common, but a stewardship over Monsanto's seeds – or rather, what used to be Monsanto's seeds: the company behind "Roundup-ready" GM maize and other technologies and approaches that have caused much public debate over the last decades, was in 2016 acquired by Bayer (Howard 2018). Thus, the company that had become the very symbol of the consolidation in the industry was itself swallowed by a bigger fish. The same happened with Syngenta, acquired by ChemChina the same year. What used to be the "Big Six" has now become the "Big Four", controlling an estimated 60% of all commercial seed sale in the world (Howard 2016). The consolidation of market power in the hands of a few multinational corporations seems to be a good example of what McMichael and others say constitute the third food regime – *the corporate food regime*. In the words of critical agrarian scholars and activists: "The third, corporate food regime (1980s to the present) emerged from the global economic shocks of the 1970s and 1980s ushering in the current period of neo-liberal capitalist expansion. During the 1980s, Structural Adjustment Programs (SAPs) broke down tariffs, dismantled national marketing boards, eliminated price guarantees and destroyed national agricultural research and extension systems in the Global South" (Holt Giménez & Shattuck 2011, 111). Other food regime scholars are more sceptical about whether the developments since the 1980s actually warrant status as a new regime – arguing that there is more continuity than change from the US hegemonic second food regime to the current situation (Bernstein 2016). This is not the place to enter into that debate, but when it comes to seeds, there is, as I have outlined above, a clear difference between the first Green Revolution wave of the 1950s–1970s and the new wave as regards the role of the private sector and the status of genetic resources and seeds as private property.

As already mentioned, with an increasing role of the private sector comes an increasing emphasis on IPR. As a counter-reaction to IPRs the major biodiversity legislations in the world have now incorporated so-called Access and Benefit Sharing rules (ABS) which represent a break with the "common heritage of mankind" approach to governance of biodiversity existing prior to the Convention of Biological Diversity (CBD) from 1992. The CBD is today the main international agreement governing biodiversity, signed by close to 200 states, including the EU. There has thus been an enclosure of the gene pool of maize and other crops both on the side of modern varieties *and* on the side of the genetic resources. Breeders, both in the North and the South,

now complain they find themselves caught between the Scylla of Access and Benefit Sharing, and the Charybdis of Intellectual Property Rights (Bjørnstad & Westengen 2019). At this point in the Anthropocene history it seems the human-maize relationship is more asymmetrical than ever. But is the political-economic perspective sufficient to understand the current maize agri-food system? Does not the co-evolutionary perspective also have something to contribute when considering the current state of the human-maize relationship?

RETHINKING THE HUMAN-MAIZE RELATIONSHIP

The food regime perspective on the human-maize relationship brings into focus the power of capitalism and its historical principal actors, from colonial powers to corporations, in shaping the world's agri-food system. This perspective resonates with perspectives of historians about how crops have been used by empires to consolidate their powers. It leaves by the wayside, however, the more symmetrical notion represented by the co-evolutionary perspective on the human-maize relationship. Maize becomes merely an object, a means used by human actors in their shaping of social power structures. Clearly, human actors have used maize for their purpose and shaped maize, but the co-evolutionary perspective makes us ask if it is also the case that maize has used humans? Such perspective on the human-nature relationship has in the last decade or so emerged as an important perspective in what sometimes is referred to as post-humanism, or, depending on disciplinary anchoring, as "multispecies ethnography" or "more-than-human" theory. The author of one of the most-used textbooks in political ecology, Paul Robbins, has argued that it is useful to bring in perspectives on non-human agency in analyses of human-nature relationships: "the central innovations of this way of thinking include the expansion of the polity and the number of parties to a quarrel, struggle, or a collaboration, as well as a continued stress on the (arguably dialectical) relationship between differing elements of the world" (Robbins 2011, 234). In *Wilted: Pathogens, chemicals, and the fragile future of the strawberry industry*, Julie Guthman applies more-than-human assemblage theory to show that material elements such as the fungicides and the characteristics of the strawberry varieties have shaped the strawberry production system – together with political economic factors such as legislations and labour-market arrangements that are working in favour of industry actors. Her argument is that "ecological dynamics" and "political economic limitations" actually "evolve in relation to one another and to human intervention" (Guthman 2019, 25). This notion does indeed resonate with the entangled and entrenched condition of the maize production system in the post-WWII Anthropocene.

Guthman's notion of "evolution in relation to each other" draws on Actor Network Theory from Bruno Latour and perspectives from Donna Harraway, and as such its scholarly roots are very different from the co-evolutionary perspective presented in the first part of this chapter. The similarities are nevertheless striking and this convergence between perspectives from natural science and the humanities could perhaps be seen to represent a bridge between J.P. Snow's "two cultures".

REWORKING THE RELATIONSHIP

The state of the maize-human relationship in the late Anthropocene is not how it has to be. Although I believe nature plays a large role in shaping the social world, I do not believe in biological determinism. We can choose other pathways than the commodified, proprietary maize path we are currently on.

Maize is still a socially and culturally embedded crop, not only in the Americas, but also in its new homelands across the Atlantic. Think about the importance of polenta in Italy, *ugali* in Tanzania, and sticky maize in China. Maize seeds are still to a large extent exchanged as a social good, rather than an economic good, in many places around the world. Seeds of local and traditional varieties of maize are still governed by collective action and cultural institutions rather than by legislative fiat at the local level and by a multilateral system for access and benefit sharing at the global level.

Thus, maize is by no means just a "capitalist crop" today. Moreover, there are many ongoing efforts to chart both evolutionary and governance pathways that lead to alternative destinations than the industrial maize agri-food system. An example of a type of alternative evolutionary pathway is found in participatory plant breeding, a term encompassing different ways to combine local and scientific knowledge in efforts to develop and disseminate locally adapted varieties. To mention two concrete examples, there are public sector-led approaches to participatory maize breeding in Mexico (Willcox *et al.* 2019) and efforts co-ordinated by non-governmental organisations (NGOs) in Zimbabwe (Visser *et al.* 2019). Examples of alternative governance pathways that are being charted include the Integrated Seed System approach to seed system development, an approach which was conceptualised through seed system research (Louwaars & de Boef 2012) that already has become public policy in Ethiopia. Furthermore, the Open Source Seed Initiative spearheaded by plant breeders and activists in the US represents an alternative to application of Intellectual Property Rights (Luby *et al.* 2015).

As these examples show, there are ways to reconfigure our relationship with maize in the many possible Anthropocenes ahead.

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"Primitive" landraces: Swedish farmers' perception of seed traits before the era of crop improvement

At the end of the 19th century, cereal seed produced by systematic plant breeding became common in Sweden. The new varieties were developed in institutions or companies, multiplied, and sold to farmers. They were characterised by high homogeneity and high yield potential, and they responded well to the increased mechanisation and use of fertilisers in agriculture. During the first half of the 20th century almost every farmer in Sweden considered the new material as superior, and so abandoned their previous crops and replaced them with new commercial seed (Börjeson *et al.* 2014). The breeders and seed salesmen of the early 20th century who were marketing the new crop material, i.e. the new varieties, were interested in highlighting the differences with the new plant material compared to the old. A definition of the old crop material was therefore needed, and the term "landraces" was suggested and rapidly adopted (Zeven 1998).[1]

As early as the 1880s, voices were being raised that the traditional crops (landraces) should be preserved both as a resource for future breeding as well as for their value as cultural heritage (Zeven 1996), but no serious efforts were made to preserve landraces for many decades. In Sweden this situation remained until the 1970s, when the Nordic Gene Bank, with the mission to preserve old and modern Nordic crops, was founded (Leino 2017, 248). At present, only a fraction of Swedish cereal landraces, the basis of food supply over thousands of years, remains as extant material. The landraces' value as a genetic resource for breeding new varieties is today acknowledged, and gradually historical plant material is also being considered as part of a cultural heritage (Strese 2010).

As I will argue in this paper, landraces have also other values, by providing an understanding of the long-term interactions between crop diversity, climate, and humans.

1 "Landrace" is also used for animals, where similar distinctions between scientifically bred and local breeds are made. In Swedish "lantsort" [land variety] is used for plants and "lantras" [landrace] for animals.

Both crops and humans adapt to climatic conditions as well as to each other, and thus the three factors are tightly linked in any crop production. For landraces that are based on farmers' saving of part of the harvest as seed for next year's sowing, the interactions become immediate. Over millennia, cereals have had the dynamic ability to adapt to both shifting climates and new agricultural techniques. Equally important has been the tending of the crop by humans. Thus, a better understanding of the crop-climate-human interactions could aid in forming resilient agricultural systems meeting future climatic challenges. Although seed infrastructure and plant breeding technologies in Sweden today are very different from those of yesteryear, many parts of the world rely on farmers' maintenance of landraces and seed exchange networks. This means that the historical cultivation and subsequent loss of landraces in Sweden is of international significance in producing a deeper understanding of mechanisms influencing *in situ* ("on-farm") conservation of crop biodiversity.

As cereal landraces (wheat, rye, barley, and oats) were more or less abandoned in Sweden more than a century ago, they can only be studied through historical sources. Unfortunately, although seed management was a common and practical knowledge, it was seldom documented in written sources. One important source is therefore the ethnological investigations made by the governmental folklore institutes and cultural history museums in the 1920s and 1930s (Österman 1991, 51–52). At that time, ethnologists sent out detailed questionnaires about farming systems, tools, and seed to many hundreds of farmers. As these farmers most often were born in the middle of the 19th century they had the experience both of the era of landraces as well as the introduction of modern varieties. Another source of information is the plant material itself, as the genetic signatures of plants bear traces of how seed has been selected, moved, and co-evolved with man. The studies of plants are not necessarily dependent on living material; the study of old herbaria or seed collections of agricultural plants can also provide valuable information on the traits of the seed (Leino 2010).

THE VIEW OF LANDRACES

When bred varieties became common, basically everything that was not defined as a variety was lumped together as landraces (Berg 2009 and references therein). A professor in plant physiology, Jakob Eriksson, wrote in 1899: "Man skiljer ock mellan förädlade hveten och landhveten. De förra äro resultatet af med konst och efter ett bestämt system utförd förädling och hög kultur, de senare äro ett primitivt jordbruks anspråkslösa barn" ["A distinction is also made between improved wheats and landrace wheats. The former is the result of skilful and systematical breeding and of cultural refinement/development, the latter are the humble children of a primitive

agriculture"] (Eriksson 1899, 106; transl. by M. Leino). Over the decades to come, landraces were referred to either by the obscurity of origin as "primitive", "ancient", "traditional", and "locally selected" or by their heterogeneity as "genetic resources", "evolving populations", "agroecotypes", or "systems relatively open that cannot be well defined" (Berg 2009).

Although the plant breeders' view of landraces is well known, less is known about the farmers' own perception of their crops. In an ethnological survey made in 1949, it is obvious that new plant breeding products and information about them had made an impact. A quote from a farmer in Värmland province illustrates this, albeit obliquely: "Det finns folk som äro så konservativa så de tycker de gamla [lantsorterna] är bäst och säkrast men det är de numera för blyga för att tala om" ["Some people are of the opinion that the old [landraces] are best and most secure but they are too shy to tell"] (quote from Leino 2017, 247). As will follow, older ethnological data paint another picture, where farmers carefully maintained and developed their landraces.

WHAT CHARACTERISES A LANDRACE?

Landraces are locally cultivated populations of plants, based on the farmer's own seed production and adapted to climate, soil, and the farmer's technology and quality preferences (Harlan 1975; Zeven 1996; Camacho Villa *et al.* 2005). Landraces thus contrast with varieties, the latter being created by plant breeding and multiplied and spread to many farmers from seed companies. Today we define varieties by high homogeneity, distinctiveness from other varieties, and stability over generations (Brickell 2009).

A significant attribute of landraces is indeed the large heterogeneity within the populations. Within the same field, plants of different architecture, growth rhythm, and many other traits were cultivated (*Fig. 1*). This heterogeneity within landraces contributed to increased tolerance to climatic variations and to pest epidemics, resulting in higher yield security, but at the cost of not reaching maximum yields. Molecular genetic analyses of historical Swedish cereal landraces have confirmed this within-population diversity (Leino 2017, 64–68). Farmers of the 19th century seldom commented on the within-population diversity they maintained in their crops. A few interesting descriptions could however be noted: in 1927 breeders gathered seed from a farm in Bohuslän, in western Sweden. The farmer grew a heterogenous landrace population of oat, and actively made sure that the different subtypes, visible by kernel colour, should be maintained in the population (Granhall 1938). On the island of Gotland, wheat landraces were observed in cultivation as late as in the 1960s. Here the farmer maintained not only different subtypes of wheat, but also different species of wheat

Fig. 1. A landrace wheat (left) and a modern wheat variety (right). Note the high heterogeneity in the landrace with differences in height, maturation rate, awns etc. among individual plants. The heterogeneity contributes to a high yield security, but at the cost of lower maximum yield capacity and more complicated harvest management. In the modern variety all plants in the field are identical, which enables high yield and efficient harvesting, but at the same time makes the crop more vulnerable to biotic and abiotic hazards. Photograph: Matti W. Leino.

(einkorn, emmer, spelt, and bread wheat) in the same landrace. The reason for cultivating this mixed crop was that it improved the quality of the flour (Hjelmqvist 1966). It is likely that many farmers also observed, maintained, and increased diversity in their crops by seed exchange systems (see below).

If so heterogeneous, were the Swedish cereal landraces just blurs, undefined mixes of seed that happened to be accessible to the farmer? Contemporary observations tell us different stories. The breeder Erik W. Ljung at *Sveriges utsädesförening* in Svalöv wrote in 1907: "Previously the only choice was some old landraces – if you could call these mixtures of many different forms races – with poorly distinguishable traits. The difference in between them was subtle, and usually difficult to define" (Ljung 1907, 8). In contrast, his colleague Pehr Bolin, who performed collection missions in southern Sweden in 1895, wrote that the different landraces of wheat he observed were clearly distinct and variable from place to place (Bolin 1896).

The contradictory descriptions reflect the different views on landraces rather than the true biological status. Landraces have a double nature, being highly heterogeneous, but at the same time distinctive. The American agronomist Jack Harlan, working with extant landraces in many parts of the world, described them as having a certain genetic integrity, being recognisable morphologically and that farmers had names for them and understood them to differ in adaption to local conditions (Harlan 1975).

ADAPTIVE TRAITS

Agricultural land in Sweden covers areas with widely different climatic zones in terms of length of growth season, precipitation, and winter temperatures (see e.g. Fogelfors 2001, 36). Thus, the cereals under cultivation must adapt to the very different conditions. By the recurrent saving of part of the harvest for seed the next year, the genotypes that performed best under the local conditions were accumulated. This local adaptation is evident when comparing Swedish landraces from diverse geographical regions. Winter hardiness is extremely good in landrace rye and wheat, especially in landraces from central and northern Sweden. Interestingly, the best winter hardiness is found in landraces from the central part of the country (Uppland, Sörmland, Västmanland, and Värmland) (Nilsson-Ehle 1906). Here, winter weather shifts between cold and thawing, which greatly stresses the plants and makes selection pressure high. Further north, the snow cover is more constant and the plants are better protected from the cold.

It is also clear that flowering and maturation time is significantly shorter in landraces from areas with a short growing season, i.e. northern Sweden. In barley, a cereal that has been grown in all parts of the country, the adaption effects are most visible. In 1892 plant breeders gathered seed from different parts of the country and test-cultivated the landraces in a common garden experiment. Landraces from furthermost north (Torneå) flowered 58 days after sowing, whereas barley from the southernmost locations took 83 days to flower (Nilsson 1893). The adaption can even be seen in a regional scale. In northernmost Sweden the length of the growth season depends largely on altitude. Common garden experiments performed in Norrbotten province in the late 19th century could directly correlate flowering time with altitude of the origin location for the separate landraces (Hellström 1917, 381) (*Fig. 2*).

These types of adaptive processes appear very obvious seen from today with our contemporary knowledge of natural selection and genetic adaptation. However, the laws of inheritance were unknown in the 19th century and the differentiation between physiological (environmental) and genetic (inherited) properties was quite unclear. Yet the farmers in a practical sense must have noted different traits between seed from

Fig. 2. Barley cultivation in northernmost Sweden (Pajala) in 1913. As the growth season here is short, the barley landrace was adapted and matured very fast. Photograph: Borg Mesch, The Nordic Museum Archives, NMA.0042693.

different locations. The state officer Johan Brauner (1712–1773), who managed an estate in Uppland province, wrote in 1761 that farmers in Uppland often acquired seed from the more northern provinces of Hälsingland and Ångermanland. The barley cultivated from this seed matured earlier that the local type, but it also yielded less (Brauner 1761, 59–60). He, and likely farmers generally, observed the correlation between a longer period when plants remained green (longer photosynthesis time) and yield.

Answers to the ethnological questionnaires confirm the awareness of these relationships. In the north, the farmers were careful only to cultivate cereals with seed acquired locally, or possibly from further north. A rapid maturation was essential to secure harvest. In the southern part of the country, landraces both with rapid and longer maturation time were cultivated. This enabled the farmer to prolong the harvest period and to gain a higher yield from the late-maturing types (Leino 2017, 72–73).

QUALITY TRAITS

To meet the demands from the food industry, modern cereals have to fulfil many quality traits, such as protein content, starch composition, and size uniformity. Such precise demands were normally not the case for 19th-century farmers cultivating mostly for household use. However, this does not mean that farmers were not aware of differences in quality between different landraces. The same farmer could even cultivate several different landraces of the same species to obtain grain with different quality properties for different end-uses. In the ethnological material, many such examples are given (The Nordic Museum archives, questionnaire Nm8; Nm23).

In Småland province, several oat landraces were recognised, each with its own quality (Leino 2017, 98–100; 225–230). 'Spethavre' had small grains and a high proportion of bran, but yielded very good straw and was therefore excellent for fodder. 'Kubbhavre' in contrast had large plump grains, and yielded low in both grain and straw, but was excellent for food as the groats were whitish and sweet. 'Vithavre' or

Fig. 3. Seed samples from 1896 with different types of oats with different quality properties. From left: Kubbhave – oats with large plump grains suitable for groats, Gammalsvenskhavre – oats suitable for bread-making, Ölandshavre and Svarthavre – two types suitable for horse fodder. The last two were also adapted to the dry conditions in eastern Sweden by high drought tolerance. Photograph: Matti W. Leino.

'Gammelsvenskhavre' was the best type for grinding a fine flour and use in bread-baking, sometimes mixed with oats (*Fig. 3*).

Similar differentiation between landraces aimed for different end-uses can be noted for barley. The more large-seeded two-row types were mostly used for groats and food, and the small-seeded six-row types more used for malt and beer production (Leino 2017, 208). Some two-row landraces, such as 'Gotlandskorn', had however very good malting traits and were cultivated for this purpose. Furthermore, the straw properties of the different barley landraces were noted, and some were considered to yield a better fodder than others.

Different qualities of the bread-making cereals rye and wheat were recognised. 'Skånsk senråg', for example, was said to result in a darker and heavier rye bread than the other common rye landrace, 'Larsmässoråg' (Nilsson 1923, 4). Today, wheat and rye landraces are being appreciated for a superior flavour and have for this reason gained a renewed interest among farmers and bakeries (Larsson 2006). Analyses have also shown that the nutrient content, in terms of protein and minerals, in general is much higher in wheat landraces than in modern varieties (e.g. Asplund *et al.* 2013). Although nutrient properties, such as mineral content, were not likely noticed among historical farmers, good flavour likely was. The historical records give only fragmentary glimpses on the appreciation of flavour properties, but more recently gathered information suggests that the importance of culinary traits should not be underestimated. When landrace rye was gathered *in situ* in Finland in the 21st century most farmers stated that the main reason for maintaining a landrace rye, instead of cultivating modern varieties, was the special taste of the bread made from the particular landrace (Heinonen & Veteläinen 2011).

In times of repeated crop failures and constant food shortage, an "anything goes" approach would be expected regarding the use of cereals for food. This might be true, and indeed people used all kinds of less-tasty products, like bark, mosses, straw, and chaff to eke out the cereal grain available (Keyland 1919, 111–113). But this fact does not necessarily contradict a high awareness about the suitability for different end-uses of different cereal landraces. Nineteenth-century farmers worked and lived very closely to their cereals and in contrast to today's farmers, they also handled and used their own produce for food and fodder. It is thus not surprising that they noted and utilised diverse quality traits among landraces.

SEED EXCHANGE SYSTEMS AND BIODIVERSITY MAINTENANCE

Renewal of seed by various methods was practised of necessity when the farmer's seed stock was too small due to crop failures or the quality of his harvest too poor to be used as seed. However, seed renewal was practised systematically by many farmers even when their seed stock was sufficient. Ethnological records from 19th-century Swedish cereal farmers repeatedly give such examples (The Nordic Museum Archives, questionnaire Nm8; examples in Leino 2017, 68): Some farmers always used the harvest from the fields with sandy soil as seed for the fields with clay, others regularly used the harvest from swidden land (i.e. that treated to slash-and-burn farming methods) as seed on the permanent fields and vice versa.

Often part of the seed stock was also renewed by using seed purchased or exchanged from locations that are more distant. In Sweden, a general belief was that the better barley seed could be acquired from the north and better rye seed from the east, i.e. Finland. Again, it is not always clear if the acquired seed was better in terms of genetic or physiological properties as the distinction was not made. In the case of rye seed, we can assume superior physiological properties of the seed. In Finland, in contrast to Sweden, the common practice was to dry the rye seed in heated houses, so-called *rihi* (Talve 1960, 104–107). It is likely that many seed-transmitted fungal diseases were reduced this way and that germination ability of the seed improved as a result. In a unique experiment performed in 1790, the farmer Carl Petter Normelin cultivated Swedish rye and rye from Finland in parallel (Normelin 1830). The first year the Finnish rye had a superior yield. The plots were then harvested separately and the seed sown again the year after. Now the two strains yielded similarly. Normelin concluded that it was the physiological properties and not the inherent properties that explained the difference first observed.

Examples such as the Finnish rye can however not explain the full system of seed replacement that seems to be widespread both geographically and in time. The Dutch agronomist Anton Zeven (1999) has gathered historical references, including antique and medieval ones, from many parts of the world that stress the importance of seed replacement. The common rule seems to be that seed should be acquired from a distant location at regular intervals, but not from a location so distant that the seed would have a too-poor adaption to the new climate. In Sweden seed replacement was suggested in agricultural handbooks of the 17th and 18th centuries (e.g. Rosenhane 1663 [1944], 65). In the 19th century, thoughts around seed replacement shifted, at least among agricultural academics: now they rather criticised the custom and dismissed it as uninformed lay opinions or superstition (e.g. Arrhenius 1879, 6).

Seen from today, seed replacement first appears inexplicable: why acquire new seed instead of using self-produced seed with traits known to work well under the present conditions? Zeven (1999) suggests that biodiversity is the key reason. By repeatedly introgressing new seed (new genes), the heterogeneity of landraces was actively maintained. Although 19th-century farmers did not speak in terms of heterogeneity or biodiversity, they might have observed during long-term experience that heterogeneous populations had a higher capacity to cope with various stress factors during cultivation. From recent studies of regions around the world where landrace cultivation is still practised, it has been shown that seed exchange networks are still a key component for maintaining biodiversity (Pautasso *et al.* 2013).

METAPOPULATIONS AND FIDELITY IN LOCALLY ADAPTED SEED

Farmers' fidelity to seed from their own region seems to have been high. The farmers knew that the locally adapted seed thrived under their cultivation conditions, and thus avoided mixing it with seed from areas with a different climate. Such "foreign" seed would simply not perform very well due to poor adaptation. Thus, any seed exchange or seed replacement must have been performed within a given frame. Within the frames *metapopulations* existed where the landraces cultivated on single farms were the core populations that at regular intervals exchanged seed to maintain biodiversity. Studies of contemporary still-active metapopulations in other parts of the world provide insight in the practice of such populations. In France the population structure of a wheat landrace 'Rouge de Bordeaux' has been studied though genetics and ethnology (Thomas *et al.* 2012). The results show that the backbone of seed production lies with the individual farmers saving part of the harvest as seed for next year. Nevertheless, the farmers perform regular renewal of seed as well, where new seed is acquired from certain farms. The authors call these farms "seed-hubs", from where seed (and diversity) is diffused. By mixing seed from an individual's farm with seed from the hub, genetic drift (random loss of diversity due to small populations) is counterbalanced and high diversity is maintained. In Cameroon, Alvarez and his collaborators (2005) studied a metapopulation of sorghum. In this case, extensive seed exchange was observed and thus the drift in small populations was balanced by migration. The seed-hubs in this case were larger farms managed by older farmers acting as seed sources whereas small farmers managed by young farmers acted as sinks, receiving seed from the hubs and gradually increasing diversity in their seed stock.

Considering the high rate of seed exchange and grain trade over large geographical distances, a likely consequence would be the gradual loss of identity over time when

seed from different sources becomes mixed. This hypothesis has been tested by genetic comparisons of seed from the same geographical areas but from separated time periods. For example: peas from Jämtland province in Sweden gathered in the late 19th century were identical to peas maintained *in situ* in Jämtland over a hundred-year period (Leino *et al.* 2012). Archaeological finds of rye and barley from Skåne in Sweden and Tavastland in Finland from the 17th century are genetically similar to the crops cultivated in the same region 250 years later (Lundström *et al.* 2018; Larsson *et al.* 2019). In the Canary Islands archaeogenetics has revealed that more or less the same type of barley has been cultivated for a millennium (Hagenblad *et al.* 2017). These studies point to an astonishing stability of plant material in certain geographical regions over very long time spans, and conscious avoidance by the farmers of introducing seed too poorly adapted to local conditions.

The size of the historical Swedish metapopulations can only be roughly estimated, but within Sweden genetic analyses of 19th-century herbarium six-row-barley show at least three such metapopulations, corresponding to latitudinally separated geographical regions (Leino & Hagenblad 2010). These genetically identified groups correspond to groups of barley described by agricultural scholars in the second half of the late 19th century (Arrhenius 1879, 114–115; Grotenfelt 1896, 78–79). Likewise, in oats, genetic analyses suggest at least four metapopulations (Nordic white oats, Mid-Swedish black oats, North Scandinavian black oats, and Öland oats) (Leino 2017, 223) that have corresponding literature descriptions (Atterberg 1891, summarised and complemented in Granhall 1938). In other words – the frames of the respective metapopulations within seed exchange seem to have been well established.

THE "PRIMITIVE" LANDRACE?

The cereal landraces were poorly adapted to a modern agriculture when mechanised harvesting, fertilisers, and chemical control measures were introduced in the 20th century. To meet the inventions made in agricultural technology a new type of plant material was required, and resulted in the first varieties produced by plant breeding. In this "modern" agriculture landraces were considered as "primitive" (Börjeson *et al.* 2014). But the landraces were by no means primitive, when used in the agricultural systems in which they had evolved. In an imaginary experiment, modern varieties would surely perform equally poorly in a historical agricultural system.

Doubtless, plant breeding, together with technological development, contributed to increase yields dramatically in the 20th century. If the yield advancement of new plant breeding products was one contributing factor to the abandonment of landraces, seed legislation was possibly another. Sweden was one of the first countries in the

world to introduce seed control and seed legislation in the 1920s. The objective was to protect farmers from purchasing poor quality seed, but seed companies also aimed to increase use of certified seed to get value from their plant breeding efforts (Kåhre 1990). In terms of increasing seed purity and germination ability the legislation was very efficient, but likely came at the cost of a strong reduction in crop biodiversity.

Are there lessons to learn from historical farmers' cultivation of landraces? Unaware of the theories of evolution, laws of inheritance, and mechanisms behind adaptation, farmers in the 19th century – and earlier – still appeared aware of the properties of their crops. Based on their own seed production, landraces were locally adapted to climate and soil as well as to technology and quality preferences. This does not mean that farmers practised active selection in their plant populations, such as the case with "folk varieties" described in e.g. Ethiopian barley (Berg 2009). A better description is that farmers observed and utilised the differences between landraces formed by natural selection.

Furthermore, an active system of seed exchange and replacement of seed clearly existed. This helped to maintain a high diversity in the plant populations, that in turn contributed to yield security, and thus to food security. Long-term experiments with autumn wheat, performed over 40 years by a Swedish plant breeding company, show that landraces on average yield less than modern varieties, but in contrast to modern varieties still result in some yield even in the years with poor conditions (Åkerman 1948). Although the systems of seed exchange and replacement are frequently expressed, the links to biodiversity maintenance are seldom described in words. Nineteenth-century farmers often spoke of *degeneration* of seed (e.g. Zeven 1999; Leino 2017, 68), but it is unclear if this referred to poor physiological properties of the seed or changes of genetic properties. One possibility is also that it actually meant loss of diversity within the plant populations. Again, the lack of uniformity and distinctiveness, looked upon as primitive traits by 20th-century plant breeders, was to the contrary a property aimed for by the farmers.

By definition, large monocultures of homogeneous plants predispose the crop to biotic or abiotic hazards of large-scale proportions. This type of "genetic vulnerability" has repeatedly resulted in crop disasters throughout history (Damania 2008). For example, in the autumn of 1971 more than 15 million hectares were sown with the same winter wheat variety, 'Bezostaja', in Ukraine. The following winter was harsh and as the variety proved to have insufficient hardiness, the harvest loss was enormous. Heterogeneous landraces can, at least partially, diminish such risks. The cultivation of heterogeneous crops also enables the coevolution of crops and pathogens. Rau and his colleagues (2015) could show, in an experiment with on-farm conservation of landrace barley, that the frequency of different resistance genes in the barley crop reached

a balance with virulence factors in the net-blotch fungal pathogen. In large-scale experiments with rice in China it was shown that introduction of heterogeneity in the rice fields decreased the damage caused by the rice blast fungus to such an extent that use of fungicides could be omitted (Wolfe 2000). These modern examples explain the resilience experienced with the historical Swedish landraces.

Today landraces are considered as valuable genetic resources for future breeding and are maintained *ex situ* in gene banks worldwide (e.g. Tanksley & McCouch 1997). Maintenance and use of landraces also *in situ* – on-farm – would have several positive effects. Their use could contribute to a more resilient agriculture, as described above, but recent research has also demonstrated that cultivated biodiversity has a direct impact on biodiversity in general (Sirami *et al.* 2019). In this report it was shown that biodiverse fields have a strong positive effect on multitrophic diversity and that crop heterogeneity is an effective means to mitigate the otherwise negative effects of agriculture on biodiversity.

Unfortunately, only a fraction of the Swedish cereal landraces has been preserved to present day, but these constitute both a unique genetic resource and a cultural heritage. Although a return to a 19th-century cultivation of landraces is neither realistic nor desirable, there are indeed interesting lessons to learn from historical landraces. We can understand the nature and dynamics of them only to a limited extent, as the farmers once cultivating the landraces no longer exist. In parts of the world where landraces are still maintained *in situ,* it is vital to preserve both the plant material and the farmers' knowledge and practical management of their crops.

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DOLLY KIKON

Seed stories in Nagaland. The entanglement of farmers, state agents, and agricultural students

Seeds are scary. Once a small boy swallowed a seed and it sprouted in his stomach. Soon his body became unwieldy as the roots and branches grew from his stomach. The end. The fate of the boy and how he manages to go on with his life is left to one's imagination, but the moral of the story is about the perils of swallowing seeds. Of course, seeds are part of our diet as consumers, and a popular one at that. More than food items, there are many parallel connections with seeds that connect us with a rich textured meaning of life and practices. Seeds as container of life (offspring as seeds in the womb), as metaphors of moral lives (good seeds and bad seeds), and as key to new ideas (germination of thoughts). There are many ways to connect with seed stories.

In this chapter I follow a particular set of seed stories by first analysing conversations with officials from the Department of Agriculture in Nagaland, secondly highlighting cultivators' accounts about seeds and their mistrust of state agencies involved in seed distribution, and thirdly discussing the anxieties of a new generation of teachers and students training as Agricultural Field Assistants (AFA) at the Integrated Extension Training Centre (IETC) in Medziphema. Drawing from the fieldwork I carried out between 2009–2011 along the foothills of Nagaland, the three sections of this chapter highlight the visions and challenges of promoting a commercially viable agriculture in the uplands of Nagaland. By juxtaposing interviews with agricultural officials, reflections of subsistence cultivators, and of students training to become Agricultural Field Assistants, this chapter explores how the vision of the government is often in contrast with the community way of life on the ground. The seed stories I offer in this chapter capture – perhaps – the success and failure of a grand commercially viable agriculture in Nagaland today.

Focused on the promotion of commercial agriculture in Nagaland, a state where 70% of the population is involved in agriculture, cultivators on the ground are encour-

aged to diversify and adopt new crops that will generate higher revenue.[1] Founded on a deep tradition of *jhum* – slash-and-burn cultivation – Naga cultivators today across the rural landscape of the state are encouraged to transform themselves into progressive farmers and associate themselves with the market: to remain authentic and attractive Nagas, culturally relevant as talented artisans and artists, but to become ambitious entrepreneurs.[2]

Today, conversations about commercial cropping practices rest on the mechanisation of agriculture and on high-yielding crops in the state. Large sections of upland communities savour plants and herbs as food and consider a rich plant-based diet as a symbol of diversity and delicacy, yet these items are categorised as "Underutilised Edible Crops" (UEC). Scientists argue that upland governments in Nagaland and its neighbouring states need to promote the market accessibility and the economic potential of these crops (Deb *et al.* 2016). For instance, the state of Mizoram aims to motivate farmers to diversify from traditional to commercial crops,[3] while in Meghalaya agriculture and horticulture are promoted as priority or "thrust areas".[4] In Nagaland, the Department of Agriculture's mission seeks to implement an economically viable agriculture and to increase crop production and productivity in the state.[5] These visions of transforming agriculture remain incomplete without a discussion about seeds.

What are seeds? They are living and thriving embryonic plant organisms that germinate into plants. Part of an ecology of the material world, they are the harbingers of our past, present, and future. Across the uplands of north-east India, the presence of seeds reveals rich histories of marriages, conflicts, alliances, and migration. This is also true of other indigenous cultures around the world: for instance, Aboriginal communities in Australia consider seeds as an integral part of their diet (Isaacs 1987; Harwood 1994).

Thus, seed stories allow us to trace farming projects and challenges in human societal transformations in the uplands of north-east India.

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1 For details about the aims and objectives of the Department of Agriculture, follow https://agriculture.nagaland.gov.in/introduction/ [accessed 25 November 2019].

2 There is a growing focus on entrepreneurship and business models. The target audience is youth and unemployed citizens. Farming including horticulture and floriculture are promoted by upland states across the region as profitable livelihood avenues. Refer to https://www.easternmirrornagaland.com/training-held-on-entrepreneurship-development-through-agriculture-extension/ [accessed 25 November 2019].

3 http://agriculturemizoram.nic.in/ [accessed 25 November 2019].

4 http://www.megagriculture.gov.in/ [accessed 25 November 2019].

5 Refer to https://agriculture.nagaland.gov.in/introduction/ [accessed 25 November 2019].

The question I am drawn to in this essay is similar to Hugh Raffles' enquiry about stones and their presence in our lives. He poses the question: "What can stone do?" to highlight the fascinating story of stones across human history (Raffles n.d.). I pose a similar question in relation with seeds: *What do seeds do?* They contain life and have transformed histories and politics (Guppy 1917; Bennett 1995). Seeds and plants travel across continents and transform relations and landscapes. Humans have played a significant role in diversifying and dispersing plants and seeds across continents over the centuries (Kull & Rangan 2008). This trend continues, Kull and Rangan note, through research organisations and corporations in the name of development, profit, and as commodities (Kull & Rangan 2008).

Seeds are a contentious matter for cultivators and students being trained to become the next generation of Agriculture Field Assistants in Nagaland. For Naga cultivators, seeds are special. They carry sentimental memories and collective histories of traditions, migration, and community. While the AFA students are annoyed that they have to undergo the tedious process of memorising the names of new seeds, a process that erases existing knowledge of and stories about local seeds. How do we locate these experiences – the sentiments and anxieties – that are often omitted in the dominant narrative of state policies and visions? Policy documents from the state government in Nagaland to transform agriculture includes zoning the hill state and its eleven districts into monocropping sites alongside *jhum* cultivation and other seasonal crops. These images are meaningful because they indicate a vision of the state and invite us to see the future of these hill states.[6]

More importantly, these initiatives flatten out a rich ecological environment and produce a knowledge that opposes existing diversity of crops including seeds and shoots. The connection between ecological knowledge and lived reality is integral for societies that emerge from violence. For instance, in post-apartheid South Africa, part of envisioning a new future for the country also meant defining new environmental politics and policy changes (Comaroff & Comaroff 2001). A similar transformation is taking place in Nagaland. Against the backdrop of the Indo-Naga ceasefire which has been in place since 1997, development programmes have focused on entrepreneurship and an economically viable agriculture. Yet, redefining the focus of agriculture for upland indigenous communities in Nagaland means addressing divergent cultural and political perceptions about agricultural practices.

This means, among other things, that conversations about agriculture on the

6 James Scott draws our attention to the politics of state governance and notes how grand schemes of the modern nation states often fail. Asserting the importance of locally grounded knowledge and practices, Scott describes how state planning places its faith in science and authority, erasing the interdependence of grounded practice and state schemes (Scott 1998).

ground is often polarised. Government agencies glorify *jhum* practices in Naga society as cultural symbols but condemn them as unscientific methods with low productivity yields. In contrast, the government initiatives to promote commercial cropping within the state are promoted as scientific and market-friendly projects. As an anthropologist tracing the government's vision for a commercially viable agriculture in the uplands of Nagaland, I came across cultivators, officials, and students training to become Agricultural Field Assistants, who all invoked seeds to underline different kinds of grievances and anxieties. These different and conflicting stories are seldom visible in government brochures and agricultural expositions organized by the state. By adopting seed stories through the voices of these different groups in the following sections, this ethnographic essay elaborates on what Kull and Rangan call "associated bundles of knowledge" – that are indicative of a larger political worldview (Kull & Rangan 2008, 1261).

LINKING SEEDS AND CROPPING

Crop zoning is a state policy in Nagaland. This initiative was introduced to transform the agricultural economy of the hill state. When I interviewed an official in the Department of Agriculture in 2010, he explained the crop-zoning programme as follows:

> Crop zoning has come up in the state. Earlier for example, 20 or 30 years ago, things were different, but now crop zoning manages the districts. We see how districts in Nagaland are suited for different types of crops. Accordingly, the Department has made a zone system. This has gone on for the last ten years. This crop zoning is driven to transform from *jhum* to commercial cropping. Suppose I distribute seeds to district X, which is not useful for that soil and altitude, then it is no use. So, according to the crop type and places where the level of farmers can come up to certain level, the Department makes a programme to distribute seeds.
>
> There are no particular officers who are in charge of this, but this is a policy of the Department of Agriculture. The District Agricultural Officer and the Sub-Division Agricultural Officer, based on the district and areas, are suggesting to the Department what are the good crops in their respective districts. The District Agricultural Officer knows what is best for the district, so he makes a decision. Take *kholar*[7] (beans) for example. There are two seasons, one is February and the other season is in August. After we buy *kholar* seeds from the *kholar*-growing villages, we do not re-distribute the seeds throughout the districts. We only give it free of cost to Mokokchung, Kiphire, Longleng, Zunheboto, and Phek districts because the crop needs a high-altitude climate. There is no point giving it to farmers in the foothill areas.

7 There are various types of kidney beans known as *kholar* beans grown across the uplands of Nagaland, recognised as an indigenous food item. They are grown abundantly in Tuensang Kipheiri. https://thesentinelnews.wordpress.com/2014/02/04/kholar-beans-that-bind-nagaland-together/ [accessed 18 January 2020].

The crop-zoning policy to develop commercial agriculture was dependent on seed distribution activities across the eleven districts of Nagaland. While these plans were neatly drawn up at the department level, they were not implemented on the ground. An agricultural officer described the current seed distribution activity as "unsatisfactory", and said:

> It is not carried out well. The central government gives us seeds for distribution, but maximum agricultural activities are carried out in the hilly areas; around 70% in the uplands, and only 30% in the low-lying areas like the foothills. You cannot use those hybrid seeds in the uplands, so cultivators have to go for the old seeds. Seed distribution is just in papers.

When I was conducting interviews with cultivators and officials from the Department of Agriculture, the seed distribution programme in Nagaland faced several challenges on the ground but appeared as an organised policy in the departmental manuals and guidelines. Some officials were critical of the hybrid seed programme. Beneath the stories of seeds and elevations, there were other concerns. An agriculture officer noted that hybrid seeds and fertilisers were economically viable only for big states like Maharashtra and Punjab which were invested in large-scale commercial cropping. In Nagaland, the land-holding system – a mix of communal and private ownership – would not allow for commercialisation of agriculture unless the communal land-holding system was converted to individual land ownership. But others in the government ignored the land-holding system and the different cultivation calendar, and blamed the failure of the hybrid seeds programmes on the lack of scientific knowledge among the cultivators. Complaining about the existing conditions, one of the officers said, "These (referring to the scientific methods of cultivation) are not new. Farmers know it but they are not willing to adopt it. They say, *itu alchi ase* (This is boring)". He went on to describe how cultivators did not connect with the Department's initiatives such as training programmes, support networks, and awareness workshops. This disengagement, according to him, was due to the cultivators' lack of knowledge about scientific cultivation. He said:

> See, for example, in cases of wet rice cultivation, when farmers are transplanting the crop to a fresh portion of the field, if we don't teach them how to do it, they might put eight or nine seedlings there – that is according to their will. That will spoil the crop. That is not the scientific way to do it. If we don't guide the farmers they will plant their crops in [a] haphazard manner; one here, one there; here and then there.

Drawing invisible grids on the table to illustrate a scientific rice field, he explained the unscientific method of farming in the hills. His hand curled up into a fist, it hopped and skipped all over the table making a *thok-thok-thok* noise to demonstrate how the

current methods of cultivation were chaotic and without any order. The purpose of the hybrid seeds was to "defeat" the local seeds. Pitched as high-yielding, they were capable of producing three-fold more than the local seeds. But unlike the hybrid seeds which required scientific care and supervision, the local seeds were wild and unruly.

Far from the haphazard and confused pattern of cultivation, a female cultivator from Yimpang village believed that the slash-and-burn method of cultivation was highly organised. She took me to her granary and explained that *jhum* cultivators followed a system of planning centred around seasons and sustainability of the crops. Like many cultivators, at the beginning of the *jhum* cycle she carefully selected different seeds, mixed them up on the palm of her hand, and sowed them in the fields. What appeared as chaotic in the eyes of the official described above, was in reality a synchrony of different seasonal crops (Scott 1998). This farmer described how cropping cycles in the *jhum* fields sustained many families in her village:

> For most of the year, we get everything from the field. Starting in the summer season and continuing until winter, different vegetables and fruits sowed at the start of the cycle become ready for harvest, so that there is plenty of food until December and January. Even after the *jhum* cycle is over and the cultivators start to clear other patches of land for cultivation, they continue to visit the old *jhum* sites to collect remaining vegetables and fruits. Actually, people buy vegetables in the market only between March and April. During this time, the kitchen garden (where beans and vegetables are grown) also provides food.

It appeared that the local seeds in the *jhum* fields often became representatives of the cultivators on the ground. Officials, for instance, drew analogies of the low-yielding *jhum* seeds with the perceived low-understanding capacity of the cultivators. This was not unusual. Portraying cultivators as people lagging behind development and progress was a theme that emerged in government schemes and projects focused on agriculture and livelihood (Kikon 2015). But officials I met during my fieldwork praised the hybrid seeds as harbingers of science and progress. Technicians, scientists, and resources from the Department of Agriculture were employed to supervise the cultivators on the ground. The future of agriculture, as officials in the Department professed, was not only high-yielding seeds but also the mechanisation of agriculture. The benefit from such projects, officials noted, was to move away from subsistence cultivation. "With a *pharwa* (spade) and *dao* (machete), one can sustain a family, but we need mechanisation of agriculture for surplus production", one official said. The government of Nagaland gave out numerous subsidies to buy tractors and other machines for agriculture. According to another official, the agricultural activities such as workshops, training, and awareness campaigns to promote hybrid seeds failed to have an impact because, "People have to see the practical aspects. It is like this. Some are willing to follow Jesus only by looking at the photo. But others will tell me, 'Show

me the Bible verses and explain the miracles, and then I will follow.' Until then they might not be convinced".

SEED STORIES

Seed stories are centred around "government seeds" and "our seeds". Villagers of Anaki Yimsen, an Ao village with 165 households in Mokokchung district, described how the quality of rice was poor because of the high limestone and sand content in the soil. So they concentrated on rubber, yams, and seasonal vegetables. In 2009, the Department of Agriculture sent an official letter to the village instructing them to collect hybrid beans and maize seeds from the district headquarters. The villagers refused. A village elder explained, "The seeds are all mixed with chemicals, that is why we do not take them. We keep our own seeds. Whatever we produce, we keep aside a portion of the seeds for the next season."

When I visited villages in Wokha and Mokokchung districts, residents invited me to their homes and showed me their seed collections. Wrapped up in old newspapers, stored in bamboo baskets, smoked and dried above the fireplace in the kitchen, dried and strung together from the ceiling above their beds, spread out on wooden chairs in the storage room behind the kitchen, stored in empty whisky and rum bottles, and lined up on the kitchen cabinets: seeds stored in every possible way. Different colours, sizes, and shapes of seeds all stored away for the appropriate season of sowing. Seeds travelled with people and communities. Tales of migration, marriages, friendships, and reconciliation all contained seeds. Clan members and kin groups carried seeds with them when they migrated to new settlements. During a discussion about agriculture I had with the pastor of Yonlok village in Nagaland, he said: "We have stored seeds from the very beginning. When we came to start the new village, we brought our seeds from our hilltop village." Knowledge about seeds, people, and farming all travelled together.

The connection between seeds and the people was perceived as a moral and ethical relationship that was connected to regeneration, mobility, and security. The emphasis "from the very beginning" was an assertion that Naga villagers had lived and cultivated long before modern state institutions like the Department of Agriculture came into their lives. The resistance against the introduction of hybrid seeds and against doing away with the old seeds must be understood in this context. A dialogue is needed to recognise community histories and local knowledge about seeds. Gradually movements on the ground have developed where communities invite government departments to share and listen to their stories and to recognise the disappearance and loss of indigenous seeds at an alarming rate. Since 2017, the Sustainable Development Fo-

rum Nagaland, an alliance of stakeholders in Nagaland, has organised the Heritage Seeds and Cultural Festival in Mokokchung district. Advocating diversity, unity, and resilience, the festival calls for the co-production of knowledge and envisions a future where stakeholders and policy-makers recognise the multiple practices of agro-biodiversity primarily focused on seeds. The theme of this festival focuses on seeds as keepers of culture and history, and connects the indigenous community's heritage with seeds. An organiser of the festival believes that the loss of seeds leads to the loss of knowledge that is associated in keeping and managing the seed. This in turn leads to the disappearance of language and words that are associated with the management

Fig. 1. Diversity of corn in the Heritage Seeds and Culture Festival in Mokokchung district. Photograph by Amba Jamir.

Fig. 2. Diversity of seeds in the Heritage Seeds and Culture Festival in Mokokchung district. Photograph by Amba Jamir.

of the seeds. More than that, organizers reminisced how elders and participants in the Heritage Seeds and Culture Festival invoked neighbouring villages and communities as they traced the stories of seeds (*Figs. 1* & *2*). In other words, seed stories highlight histories of community ties and relations.

On the ground, as sensibilities around seeds and histories emerged, officials tried to attract cultivators towards hybrid seeds by underlining how the characteristics of hybrid seeds were similar to the local seeds. When I encountered an official from Wokha district in Nagaland at a meeting with cultivators, he said: "Once we distribute the high-yielding variety and you start using it in your own soil and climate, it becomes almost like the local seed." But this was not attractive enough to cultivators. A woman from a Lotha village told me: "We got some soya bean seeds from the government and planted them, but they did not sprout. We heard the same story from our neighbouring fields." She connected the story of failed hybrid seeds with corruption and bad governance. Just like the personalities of corrupt and dishonest government officials and politicians, the hybrid seeds were considered as chemically generated entities that would contaminate the local soil and agricultural practices. Those who re-

sponded to the Department of Agriculture's call to collect hybrid seeds were a group of villagers from Yimpang. According to them, the nearest seed collection office was an eight-hour walk through the mountains from the village. It was located in the town of Bhandari, a sub-division headquarter in Wokha district. When the Yimpang cultivators arrived in Bhandari, they found that the seed distribution office was closed, so they returned home empty-handed. On their second visit, they learned that the seed distribution officer-in-charge had gone off to the next town for some work. Since the journey to and from took up so much of their time, they eventually gave up on collecting the government's seeds.

When I asked an official why most cultivators were left out of the seed distribution system, he explained that a particular day was fixed for training and demonstration, and whoever made it on that particular day, received the seeds. "What happens in case there is no proper communication in an area, and they do not get the message?" I asked. The official replied: "Information in the form of a letter is sent to all the village councils, addressed to the village secretary or maybe the village headman. Not even a single village is left out. The village will send someone to collect the seeds. Sometimes, when they don't turn up it means they don't want the seeds. We don't discriminate against any village or any farmers."

It might seem that cultivators were given a choice to use or reject hybrid seeds, but there was a strong pressure, almost a moral obligation, to accept the hybrid seeds given by the state. For any state subsidies or agricultural projects/grants, the cultivators were obligated to adopt the state vision of implementing commercially viable agricultural projects on the ground. This meant, among other things, embracing the hybrid seeds and rejecting the old ways of sowing and storing local seeds. But the logistical challenges of distributing hybrid seeds and the absence of mountain infrastructure in the state was a real issue. Yet, the most convenient official explanation about the existing state of agriculture was a cultural one. "Naga people are very resistant to new technology and knowledge the state is trying to give them through the Department of Agriculture. They want to stick to their culture and tradition. Our culture and tradition revolve around *jhum* cultivation," an agricultural official said. The cultivators' rejection of hybrid seeds and other cash-crop initiatives were interpreted as a refusal to give up a "cultural" practice. Yet, in reality what these stories highlighted was a deep failure of the state agencies to deal with broader issues of indigenous knowledge systems and the absence of adopting cultivators as stakeholders. The issue was not about taking a position for or against the use of hybrid seeds, but rather to consider how cultivators who had switched to hybrid seeds were extremely anxious because they were unable to sow the seeds again in the fields. Although the high-yielding seeds delivered a rich harvest, the cultivators became increasingly dependent on buying hybrid seeds from the market.

The cultural explanation, furthermore, overlooked the history of militarisation, charges of corruption levied at state officials, and the absence of schools and infrastructure across the districts. There were no paved roads in many villages across the hills of Nagaland. Cultivators walked for several hours to sell a basket of yams or papayas in the weekly *haats* (markets). I also learned that subsides, grants, and other schemes were distributed by politicians as gifts to their supporters and seldom distributed fairly to cultivators in the villages. It was peculiar how cultivators were made to shoulder the responsibility of progress but were simultaneously identified as culprits resisting development and progress. The cultivators' resistance to give up *jhum* cultivation was more than a "cultural thing". *Jhum* cultivation practices were connected to the larger social and political history of their village, neighbours, friends, and families, and defined them as a group and people. Pushing them to give up subsistence agriculture and embrace commercial farming was equivalent to asking them to embrace different moral standards and economic habits. Agricultural projects in several villages failed because the seasonal calendar of the cultivators clashed with the standardised two-season crop cycle in India – the *kharif* (summer crop) and *rabi* (winter crop). In order to address these challenges, the Department of Agriculture focused on imparting scientific and technological training to the next generation of farmers in the state. The team who would represent the state and work with the cultivators in this great agricultural transformation would be the Agricultural Field Assistants.

AGRICULTURAL FIELD ASSISTANTS

During my fieldwork in 2010, an official at the district headquarter in the town of Mon defined the relation between the Agriculture Field Assistant (AFA) and the cultivators as a "seed-to-seed" bonding. He said:

> Even after the farmers get the seeds and sow them and the seeds germinate, the AFA and the farmers will stay in constant touch. This is the concept of "seed-to-seed". After the farmers are given seeds, the seeds germinate, and there is a harvest. After that, the post-harvest technology is implemented. [Throughout these processes] the connection between the AFA and the farmers will be there. Any time the farmers need help and training, we (AFA and the Department) provide it. In the wet rice cultivation system, even during the transplantation system, we teach them how to sow the seeds, and tell them how many kilos of seeds are to be sown.

The Agriculture Field Assistants are employees of the Department of Agriculture and described as the link between the Department and the cultivators. The official continued:

> The AFAs work at the village level, so they are supposed to be based in the village. They are the connecting poles. They are the connection between the farmer and the Department. So any kind

> of important information about seeds and agriculture, or any important activity that is to be held in that area, is the responsibility of the AFAs to communicate to all the villages under his [or hers] jurisdiction. Based on the household and the area, they are given responsibilities – according to the size of the village and households. As humans, there are discrepancies and loopholes in the way we function, but 90% of seeds are reaching the farmers.

Described by officials from the Department of Agriculture as the bearer of information, seeds, and technical support, the AFAs lived in the villages and worked closely with the cultivators. They conducted workshops and training and were known to the cultivators. Yet, when I enquired about the presence of the AFAs in the villages, cultivators laughed. They said, "We do not know where they are." When I tried to meet with a group of AFAs in Mon, they enquired, "What do you want to know? Why do you want to talk to us?" Sounding anxious, they interrogated me before making an appointment. The following day they failed to show up for the appointment. When I called up an AFA on a mobile number he had given me, he sounded inebriated. He apologised and said, "There has been an accident, so we are all in the hospital." I heard riotous laughter in the background as he spoke to me. He too began to chuckle and muttered "Sorry, sorry," before hanging up the phone.

Curious to find out more about the AFAs and their job profile, I made a trip to the Integrated Extension Training Centre in Medziphema. Established during the formation of the state in 1963, the objective of the Centre was to impart training to field workers, officers, and farming communities across Nagaland. Enrolled in a two-year diploma course, the AFA students at the Centre were required to equip themselves with aptitude, knowledge, and skills.[8] The Centre shared the campus with the School of Agricultural Sciences and Rural Development, commonly known as the Agriculture University of Nagaland. The Centre was part of the Department of Agriculture and the Department's officials were often sent to the Centre as teachers. According to the teachers, only the brightest students who scored top grades were qualified to apply for a government job in the Department.

During my visit in 2010–2011, teachers at the training centre said that a large number of students training to become AFAs had completed only high school. I learned that many students joined the AFA training programme with the hope of securing government employment. Across Nagaland, as in many parts of India, government jobs are highly coveted because they are regarded as prestigious and secure. Every AFA student I met had a similar aspiration. Sharing a classroom with their fellow students, many students shared stories about poverty, and the pressure from their respective families to secure government employment. There were limited seats at the training

8 https://agriculture.nagaland.gov.in/ietc/ [accessed 25 November 2019].

centre and often parents and relatives requested politicians and bureaucrats to exercise their influence to get their wards into the AFA training programme. Employment was the primary goal and everything else, including agriculture, came into the picture later, I gradually learned as I spent time with the students and the teachers.

LEARNING INSIDE THE CENTRE

"Twenty years ago, there was less interest in becoming an AFA. Who would want to become an AFA? But now there are so many people who want to study and become AFAs. Even graduates want to apply for this course now," a teacher at the training centre said. During their two-year training, in a programme designed by the Department of Agriculture, the students are taught about scientific agriculture systems. The programme is taught in English and focuses half on theory and half on practical fieldwork. For the practical sessions, students are allotted individual patches of land and provided with seeds to grow different kinds of vegetables. Each patch is marked with the student's name, the name of the vegetable, and the student's enrolment number. They were all judged according to who grew the best vegetables, who sowed well, which student was best in weeding, and the best applicator of fertilisers.

During my visit to the IETC in Medziphema, two teachers organised an interactive session one weekend. Eight students joined us for a conversation about the programme. After we introduced ourselves, I asked them how they learned about the programme and what motivated them to become AFAs. "Are your parents cultivators? Is that why you want to be AFAs?" I enquired. "Some students have diplomas," one teacher commented. A female student described her diploma. "I was trained as a beautician, but now I am doing this course since I also took a diploma in entrepreneurship. I find it interesting, but I am not used to farming. I have never done it before, so it is hard. I am learning how to make gardens," The second teacher interjected: "If these students do not get jobs after this course, they have to do their own business such as floriculture, poultry, piggery. They can become big farmers, progressive farmers, and become businesspeople." When I returned to the IETC campus in 2019 to visit the new batch of AFA students, their aspiration remained the same: all of them were interested to secure government employment. The 2019 fieldwork visit to the AFA campus was interesting because my conversations with the current batch of AFA students led me to reflect on my earlier fieldnotes. Approximately ten years earlier, I had written down a detailed interaction with the students. For instance, when I enquired how students learnt about the course, they took turn and shared:

Student 1: "I have an interest in business so I am here."

Student 2: "My parents put me here. The training is difficult."

Student 3: "My parents asked me if I was interested and I was happy to join this course."

Student 4: "Parents."

Student 5: "My father is in the Department of Agriculture, so I heard about it from him."

Student 6: "Parents. I am a graduate."

Student 7: "Parents got me here."

Student 8: "My uncle got me here."

"He is a Korean star. She is a model." Students in 2010 teased one another about their clothing and hairstyles as they discussed their lives. They were aged between 18 and 25 years and they wore jeans, colourful shirts, scarves around their necks, and leather bracelets. The girls carried colourful bags and wore makeup. Some students had tattoos on their arms and highlights in their hair. As the teasing continued among the students, one of the teachers commented: "It is a disciplined life here." She appeared annoyed with the behaviour of the students. Soon, she began to moderate our discussion and stressed how the programme was designed to transform lives of the AFA students, just as hybrid seeds were to transform the future of the Naga farmers. Referring to the fashionable appearance of the students in the room, she illustrated the untamed nature of recent entrants and described the challenges of disciplining the students:

> They come to the institute quite wild. They have been out of school for quite some time, and they are used to freedom. Once they come here, at least, I make it an effort to also guide them along a spiritual path. You see, it is all about disciplining them. The AFA training is an intensive two-year course, and it is actually a life-changing course. We make sure they go out to the field and clear the jungle, weed the farm, and learn how to use the tools and implements. As teachers, we know that the students really suffer, but they have to learn that way …the AFA is a wholesome training process.

The "wild nature" of the students and their limited academic qualifications also posed challenges for the teachers. "[I] have a Master's degree in Agricultural Sciences," a teacher said. She continued:

> See, the Bachelor of Science students [at the University of Agriculture] are easier to handle. At least they have [a] science background in their 10+2 education. They understand the science terminology we use, so we are not starting from scratch. But in the case of the AFA trainees, we have to bring them to zero, and then teach them everything from the beginning.

The dedication of the teachers towards the students was inspiring. However, when I enquired as to why the training centre accepted students with limited academic quali-

fications, the teachers explained that it was the Department of Agriculture's policy not to take any graduate students for the programme because of "bad experiences". One of them said it was due to a "clash of interest" and explained:

> Imagine the Agricultural Field Assistant and the Sub Divisional Officer are both graduates. The AFA will try to show that he or she is an equal, or at least that their educational qualifications are same. We consider graduates overqualified for this work. The AFA should be able to take instructions and follow orders of the Deputy Agriculture Officers and the Sub Divisional Agriculture Officers.

More than the issue about authority and hierarchy, what transpired at the IETC campus was the challenge of training AFAs about scientific methods of farming. If the teachers found it extremely challenging to handle the students because they had to spell out every single word and constantly write explanations on the blackboard, the students equally struggled to learn about scientific methods, seeds and agriculture. During my visit to the campus in 2019, the instructor informed me that many students came from the social sciences, and struggled with the science subjects. A male student commented, "I do not fit here. I am not interested in this course but I am here because of my parents".

In 2010, I followed students to their allotted farms. Once the teachers were out of sight, the students began to discuss the challenges they faced. Daisy, a 21-year-old first-year student, showed me her allotted farm and said that after six months she knew the scientific name of only one vegetable, *Raphanus sativus*. "What is that?" I enquired, and she replied "radish". Why would the scientific name of radish or for that matter any other vegetable become an integral part of the AFA programme? I wondered. Another female student replied:

> It is very difficult. In the hostel we joke around and invent scientific names for our daily activities. When we have a headache, we say that we have headachology, when we are bored we say we are dealing with borology. What is the difference? If we add an "(o)logy" to all our activities, they immediately sound scientific.

I had the opportunity to interact with female students regarding their curriculum in 2010, and again during my visit in 2019. Almost a decade apart, yet their experiences were similar, although there had been a significant transformation in terms of the infrastructure of the campus. In 2010, for example, boys and girls lived separately in simple dormitories made from old, converted government quarters. The rooms were sparsely furnished except for a bed and table for each student, and the students cooked their own food. "See, the funds are very limited, so last time we gave them corn seeds, and with the production of maize there was good harvest. In one harvest, they sold maize worth 2,000 rupees (40 USD). With that money, we bought them a satellite

television," a teacher told me. The Department supplied seeds for their practical sessions, and the teachers sold the harvest from the experimental farms to improve the facilities of the students. The Centre did not aim to generate any revenue, but was taking up these projects to teach the students how to value agriculture and also recognise that their hard work did not go in vain.

By 2019, in contrast, there were concrete buildings and the hostels had proper study and living areas and recreation spaces, as well as proper toilets and shower areas with water supply (*Figs. 3* & *4*). Yet, the hostels appeared to be overcrowded. The AFA training programme was in high demand, and the current batch of approximately 80 students was the highest in the last decade. In addition, the Department of Agriculture had removed the requirement for students to have basic knowledge of natural sciences in their high school curriculum. The majority of the students spent time reading, but their favourite part of the programme was sketching agricultural tools and implements. Many of them also spent time finding ways to adapt to the AFA student life.

Fig. 3. Hostel corridor. Photograph by Dolly Kikon.

Fig. 4. Hostel dormitory. Photograph by Dolly Kikon.

During my fieldwork in 2010, I asked some young women how they spent their leisure time in the dormitory. They described it was difficult to apply any makeup and to maintain clean nails. "We had to switch to darker shades of nail polish since we have to be very active in our model farms for our practical classes. A dark shade of nail polish – but we made sure to apply two to three coats." Applying two to three coats of nail polish kept the nail polish intact for longer, and hid the dirt and cracks. Although students were serious about the AFA programme, their focus was not on agriculture but rather on the employment opportunity that came with the programme. Every study table was stacked with books, and on the wall above each table was pasted hand-written timetables and lists of scientific names of seeds and plants, meant to help prepare for weekly quizzes. "It is all about memorising and memorising," one student commented. Many had beautiful pencil sketches of farming tools and machinery on their notebooks. The notebook of one female student had neat charts and beautiful diagrams of plants and seeds with descriptions about the functions of the machines. When I enquired about her diagrams, she said "My village does not own such ma-

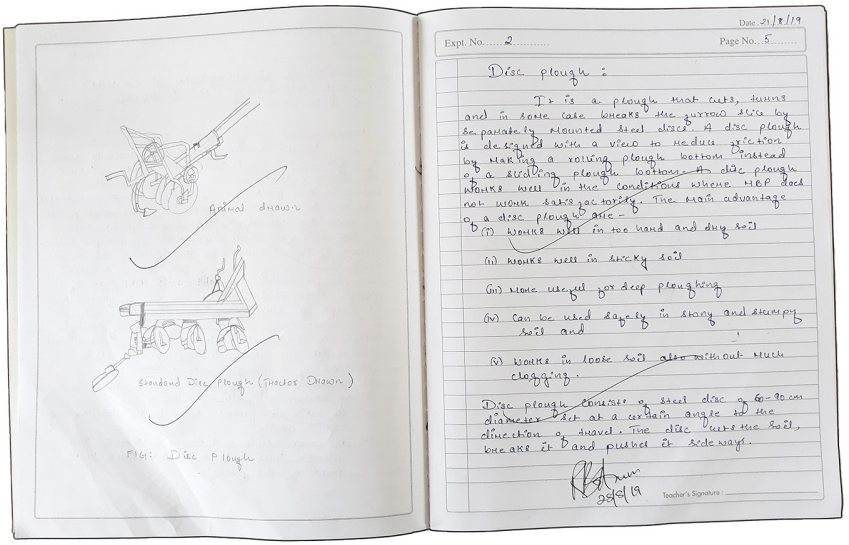

Fig. 5. Student notebook with diagram. Photograph by Dolly Kikon.

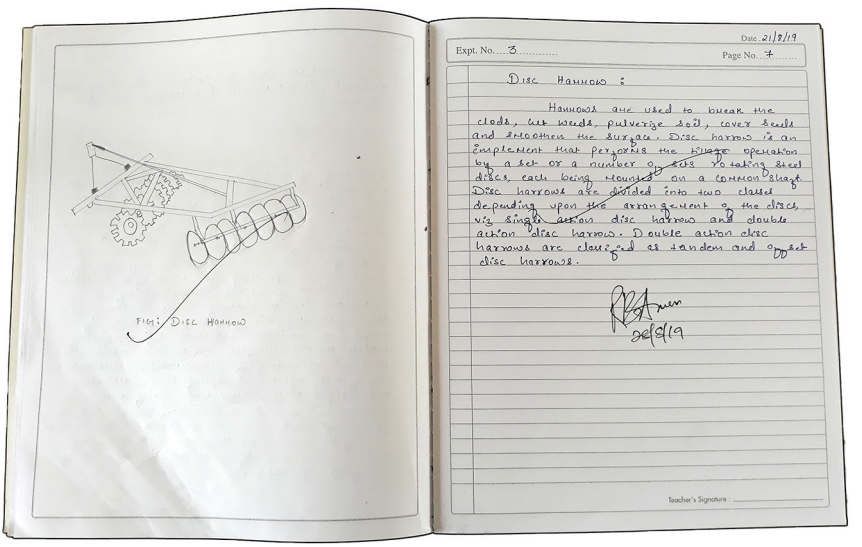

Fig. 6. Student notebook with diagrams. Photograph by Dolly Kikon.

chines". "What do you feel about these heavy agricultural machines?" I continued. She replied: "Aliens." (*Figs. 5* & *6*).

There was a disjuncture between what the technical programme offered and how the students absorbed the training. But the magnitude of the gap between the classroom courses and the students surfaced when students talked about the seasons. Rather than referring to them in the language of the agricultural cycle of sowing and harvesting, the students instead talked about the manner in which the seasons brought about various kinds of bodily ailments. Their bodies suffered as they worked in their allotted farms during their practical class. January and February were difficult seasons since it was windy. They also suffered from all kinds of allergies. During this season, after every practical class in their model farms, they always came back to their dormitory with rashes on their bodies. Their routine after working in the field during this season was to mix drops of Dettol solution in a bucket of water and wash their bodies and then take antihistamine tablets.

"See our hands are all sore and swollen." Students showed me their palms with red blisters and calloused skin. While the Department portrayed them as the "link" between the cultivators and the government, the students predominantly came from urban areas and were ignorant about agriculture. Scientific agriculture, binomial names of plants and seeds, and the functions of different kinds of mechanised farming equipment were all part of the curriculum, but were far removed from the lives of students. Local knowledge and names of seeds, plants, and indigenous stories about ecology and worldviews were kept outside the classrooms on campus. In this process of transforming agriculture in the upland state of Nagaland, seeds were something that had become scary and foreign.

NAGALAND SEED STORIES

The stories above, elicited through conversations with government officials, cultivators, and students, draw our attention to the ongoing agricultural transformation and development models in the upland state of Nagaland. As I have illustrated in this essay, among officials in Nagaland, the figure of the cultivator reinforces and valorises colonial and post-colonial stereotypes of a retrograde, primitive, and backward tribal person. I have also tried to depict how seed stories allow us to reflect about human relationships and histories of communities in the uplands of north-east India. More importantly, seed stories highlight sites of contestations and challenges among indigenous communities experiencing agricultural transformation. In that context, seeds are not solely about one's capacity to grow food and practices of interdependence, but also about the role of the state in introducing "scientific methods" of agricultural

practices and focusing on high-yielding crops. The eradication of local seeds, as I have noted in the essay, and the supply of (and resistance to) hybrid seeds invites us to pay attention to concerns that are often dismissed under the rhetoric of *jhum* cultivators as ignorant and lazy communities unwilling to change their way of life. The fears and anxieties about hybrid seeds, the belittling of cultivators by government officials, and the struggles of AFA students to adopt a different epistemology of seeds and agriculture as opposed to an existing practice, reflects how contemporary politics and governance among indigenous communities are entangled with seeds.

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INTERLUDE

ANNIKA RABO

Missing the seeds in Syria

A few years ago I learned that, for the first time ever, seeds were being sent back to Syria. It was during a radio essay on gardens and seeds presented by the Swedish poet Lars Hermansson, who in passing mentioned that the Svalbard Global Seed Vault had, instead of collecting, actually started to send seeds back to Syria for germination. The impact of the Syrian war was so great that the country was in danger of losing its unique agricultural heritage. Listening to this broadcast made me change my perception of, as well as planned comments on, the cultural heritage of Syria for the annual meeting of Swedish anthropologists I was to attend. There has been much lamentation about the destruction of ruins in Syria – particularly from the Aramean and Greco-Roman period – but little concern about the massive destruction of cityscapes and rural landscapes and the many life-forms in them, mainly on the part of the regime and its allies. Listening to the radio essay made me shift my presentation. Instead of complaining about the – from my point of view – limited perspective of many archaeologists, I would talk of seeds from the Fertile Crescent as threatened cultural heritage.

ICARDA

I understood that the seeds in Svalbard had been deposited by ICARDA – the International Center for Agricultural Research in the Dry Areas. ICARDA is one of the 15 international agricultural research centres – the CGIAR – spread across the world and specialising in the development of different crops. ICARDA has a global mandate for the development of wheat, barley, lentils, and fava beans, but mainly serves the Middle East, North Africa, and Central Asia. It was set up in 1977 outside Aleppo, Syria. Initially ICARDA was to have its headquarters and a farm in the Beqaa Valley in Lebanon. But due to the, at the time, on-going civil war in that country, it was instead moved to Syria. In 2012, when armed violence became prevalent in the Aleppo

region, ICARDA's headquarters were moved to Lebanon, with farming facilities in the Beqaa, as well as outside Rabat in Morocco. In 2008 ICARDA started to send seeds to Svalbard, but withdrew about a third of the boxes in 2015 in order to replicate them in their new facilities. Seeds were then sent back to Svalbard in 2016 and 2017.

I had followed the history and development of ICARDA since the end of the 1970s when I undertook my first long-term fieldwork in Raqqa province in the north-east of Syria. I had visited the ICARDA research farm many times, met with staff at conferences, in their offices, and in their homes. As I shifted my presentation for the Swedish anthropological conference from archaeological heritage sites and ruins to heritage seeds and agriculture in the Fertile Crescent, I tried to follow the happenings around the ICARDA research farm following the outbreak of the war.

ICARDA was established in Syria because President Hafez al-Assad – the father of the current president – offered a whole village outside Aleppo as an experimental ground. This "gift" was met with resistance and muted criticism in Syria. I heard that the land had been expropriated with little compensation. In the 1980s there was also frustration among Syrian agricultural engineers and researchers that even if they were able to get jobs at ICARDA, their salaries could not compare to those given to international experts. But eventually its presence was routinised, criticism disappeared, and its activities became appreciated by many farmers who were cultivating rain-fed crops under ICARDA's mandate. Relations between villagers around the farm improved too, because ICARDA provided employment. In 2012, when ICARDA decided to leave Syria, local employees in the seed bank, laboratories, and in the fields tried, for as long as possible, to keep facilities in working order. Villagers adopted ICARDA sheep and even the armed group which had occupied the farm tried to keep the seed bank cooling system going with the help of generators.

ICARDA's seeds are obviously not only from Syria and the larger Fertile Crescent. But in my presentation at the Swedish anthropological conference I focused on the role of seeds from this particular region, underlining that seeds – more than stones and Roman ruins – are truly a universal cultural heritage that we must protect. I underlined that seeds, soil, and humans forge complex ties across both time and space. But after this presentation I started to think more about Syrian seeds and seeds in Syria. What was my own relation to them after decades of fieldwork in, and shorter visits to a rural area in Raqqa province? What did I really know about seeds?

RAQQA PROVINCE

In 1978 I started a two-year fieldwork period in Syria focusing on a newly established huge land reclamation and irrigation scheme along the Euphrates region. This was

Syria's single largest development project, aiming to double the irrigated area of the country and increase agricultural production dramatically. The headquarter for GADEB – the General Administration for the Development of the Euphrates Basin – the public authority in charge of land reclamation and irrigation, was placed in the town of Raqqa, and here I spent my first fieldwork year. I was interested in understanding the relations between the state and citizens in a province generally perceived to be in need of development, and now undergoing rapid change. More concretely, I planned to focus on the relations between employees in GADEB – mainly recruited from more central parts of Syria – and the regional population.

Raqqa and its countryside is part of the Fertile Crescent and has through millennia faced fluctuations in population density and agricultural production typically linked to political stability or instability. This area was for centuries part of the Ottoman Empire and, like the rest of what was to become Syria, became a French mandate after World War I. It was actually only after independence in 1947 that rapid agricultural change took place in the Euphrates region. With the help of diesel pumps, irrigated cotton was introduced along the rivers. At the same time mechanised rain-fed wheat and barley cultivation quickly expanded in the whole of the north-east of Syria. Harvests were very good in the 1950s since the land had lain fallow for such a long time. Investment for this economic expansion came mainly from urban merchants and they, and tribal leaders in the region, made fortunes from agricultural activities. In the early 1960s radical politics ushered in a land reform in Syria. In Raqqa province the land reform did not change the agricultural pattern, but it curtailed the role of tribal leaders and urban investors. The reach of the state and its bureaucracy also continued in the less-central parts of the country. The role of the Ministry of Agriculture was made more visible as national agricultural plans began to be implemented through regional and local offices and with the intermittent presence of extension agents. Agricultural zoning reserved non-irrigated cultivation for land with an average of more than 200 mm of rainfall per year. Zones with less were to be used for grazing only. This pattern of irrigated crops – mainly cotton, but also wheat – along the rivers, and rain-fed cereals in the steppe zone north and south of the Euphrates, have continued since then. With the huge irrigation and land reclamation scheme, sugar beets and some other crops were also introduced as part of the compulsory and highly controlled agricultural cycle, as decided by the Ministry of Agriculture.

FIELDWORK AMONG EMPLOYEES AND VILLAGERS

In my first year of fieldwork I focused on GADEB and its employees. My plan had been to live on one of the 15 experimental state farms which had been established

Fig. 1. Hand harvesting barley in the steppe zone (the crop was not good enough to harvest mechanically). Raqqa countryside, late spring 1980. Photograph by Annika Rabo.

around Raqqa, but I was not permitted to do so. Instead I was given an office in the GADEB headquarters and allowed to go through the many studies and plans of the scheme. I also got to know many different kinds of GADEB employees. I lived in the town centre with a native (*asli/asliin*) family which, like most Raqqa natives, was part of a large clan with strong links to the rural areas, to landholdings, and agriculture. The townspeople were generally very development-orientated and shared the ruling Ba'ath party's vision of agricultural growth and regional wealth. But they were typically very critical of GADEB, claiming that corruption was rampant in the administration.

In my second year of fieldwork, realising I was never to obtain permission to live on a state farm, I instead, with the help of my Raqqa-based mentor, moved to a village about 40 km east of the town. Sabgha, the name I have given this village in my writings to protect my sources, was close to one of the experimental state farms, but GADEB had not yet started to reclaim the land or build a new irrigation system.

In the early spring I moved to the steppe zone with the mother of my village family and her younger children. She and others set up a mobile camp in order to be close to their herds of sheep and goats to supervise the lambing season. The winter had been wet, making for good grazing and fat animals. Milk was plentiful and excess yoghurt and cheese could be sold. Later on, about the time of the harvest of rain-fed wheat and barley, we moved back to the village. Focus in the village shifted to irrigat-

ed agriculture until late autumn and the cultivation, once again, of the rain-fed zone.

The quality and quantity of cereals were – in theory – tightly controlled by the state. Seeds for sowing were provided by agricultural authorities and harvested wheat and barley was bought by the state and stored in silos. Irrigated plots were individually owned, while rain-fed land in the steppe zone was, in general, state land. In order to be able to cultivate wheat or barley in that zone, one had to pay for a permission for a specific area. Areas to be cultivated and thus permissions to be given should be based on the annual rainfall in order to protect the steppe. But everyone knew that by greasing the right hands, areas could be extended, or forbidden zones cultivated, or more seeds for sowing could be obtained. It was with both interest and distress I followed these dealings in Sabgha and in Raqqa itself. It was a public secret that the Damascus-appointed governor profited enormously from these bribes.

CHANGES IN SABGHA

From the early 1980s until the spring of 2011, when I visited Syria for the last time, I have followed developments in Sabgha. Some visits have been quite short, other times I have been able stay longer and more systematically follow agricultural and other themes. Village life changed profoundly in these decades. When I first came to live

Fig. 2. Girl making bread dough in a village by the Euphrates, summer 1980. Photograph by Annika Rabo.

Fig. 3. Villager walking with a shovel to prepare a field along the Euphrates. Raqqa countryside, spring 1980. Photograph by Annika Rabo.

in Sabgha there was no electricity, all household water – including that for drinking – was fetched from irrigation ditches, or from the river itself, a considerable distance from the village. Bread was made at home over an open fire. There was a tarmac road to Raqqa but travel to the town was rather limited. In the middle of the 1980s electricity arrived, allowing the use of television and other modern conveniences. Later tap water was made available. A mosque was built, and the school grew as girls started to attend. Over the years, steppe agriculture expanded and the grazing land of sheep and goats has diminished. Wells have been drilled in banned areas and irrigated agriculture in the zone below the rain-line has been established.

By the turn of the century the irrigated land was levelled and reclaimed, and a new irrigation system set in place. In the same period a modern bakery was built in the village by two entrepreneurial brothers. At that time homemade bread had for years been baked mainly for weddings and funerals. The price of flour was controlled by the state since bread was subsidised. This opened for all sorts of shady business deals and bribes to officials controlling the quality and quantity of bread. Bakeries had access to subsidised flour while citizens in general had not. It made better economic sense for villagers to sell their cereals to the state and then to buy subsidised bread than to keep part of it, mill it, and make their own bread. There was a market for old and stale bread to be used as fodder, but even fresh bread was used to feed animals.

State control over cereals and the subsidy of bread continued even as other economic policies changed. The Ba'ath party, which came to power in 1963, initially nationalised many resources and curtailed the economic power of the private sector. Intermittently there have been bouts of economic liberalisation and increased opportunities in the private sector for profit-making. Economic inequalities have returned, noticeable also in Sabgha, particularly after the turn of the century. GADEB – the irrigation authority – was dismantled and land on the experimental farms was handed over to workers, agricultural engineers, and to administrators. The 21st century not only ushered in privatisation of land in Raqqa province. Rainfall was limited as well and a drought hit the north-east of Syria between 2008 and 2010, halting rain-fed agriculture in the steppe. In 2010 food support was given to almost 200,000 villagers in this part of Syria, and prior to the uprising in 2011 there was a massive migration to the cities and towns in the north-east of the country and even further away. There has been much discussion about the link between climate change, decades of disastrous agricultural policies, and the Syrian uprising.

BUT WHERE ARE THE SEEDS THEMSELVES?

I have followed the trail of corruption, seeds, and steppe cultivation linked to Sabgha over more than three decades. I have listened to a great many discussions about how to plan for the seasonal steppe cultivation, and how to get hold of tractors or harvesters at the right time. I have followed the informal trade in seeds and learned how some villagers profited greatly from this. One summer I often accompanied a villager as he picked up sacks of wheat from others, falsely passing it off as top quality at the local seed assessment and storage centre. This chain of corruption clearly involved a number of people. In these decades I have sat on, leaned on, shared room with seeds. But I never really engaged with the seeds themselves. I have not examined them closely, nor asked about the villagers' relationship to them, except as a bulk commodity and economic resource. Thinking back, I vividly remember one missed opportunity of hearing another kind of seed story. In the summer of 1980 I was sitting in the storage and cooking house of the family I lived with. In a corner there was a sack of seeds and I asked the mother in the family what it was doing there. Why had it not been sold with the other sacks? She told me it was "their own wheat" and kept for special occasions. I must have asked something else because she said that it was "a much better wheat than the government's *meksiki*". Why, why, why did I not ask more at that moment? And why over the years have I not once asked why they stopped cultivating this "better" variety?

I will never be able to really recapture that particular seed story. All potential stories can, of course, never be retold. But now when Syria is in ruins – not least the region where I have spent so much time – and with few signs of reconstruction in sight, I deeply regret my own lack of curiosity for the seed itself those decades ago. As it appears now, the seeds contain the history and the experiences of working the land that I have come to be deeply concerned with, in both Syria and Sweden.

PART III
CIRCULATION/MOBILITY

BENGT G. KARLSSON

Life and death in the plantation: Tea and the travel of seeds, plants, and science across the Indian Ocean

"Where there is PHALAP there is Hope." This is the heading of the information leaflet that our host Mr Manje La hands out. Manje La is the owner of Singpho Heritage Tea, producing the traditional smoky flavoured Phalap tea. His family also runs a community ecolodge to host people like me that are out on the tea trail searching for the origins of Indian tea. The Singpho people to whom Manje La belongs is an indigenous community in Upper Assam, India, and further east in Burma and China. The leaflet recounts how Robert Bruce, in 1823, discovered tea growing in forests belonging to the Singpho people and that their chief Beesa Gaum presented Bruce with tea seeds and plants as an act of friendship. "This incident was the turning point in the discovery of tea in India", the leaflet further states.

The British "discovery" of tea, however, didn't bring much joy to the Singphos. As historian Jayeeta Sharma writes, the initial idea of jointly harvesting tea from the forest gardens was soon cancelled and the British decided instead to annex the land of the Singphos, as their tea tracts were "considered too valuable to be left in native hands" (2011, 41). The Singphos rebelled, but were soon overpowered. As we sit on the bamboo veranda of the ecolodge talking about Singpho tea, Manje La returns to the colonial history and the loss of most of their lands, saying that people even started to cut down their tea trees as a protest. With this I got a chance to ask what, since long, had been on my mind: "Would any of these old tea trees still be around?" There used to be plenty, he said, but as tea trees nowadays are valued as hardwood in construction most of the larger trees have been cut. But he recalled seeing a mid-sized tree in the forest just outside the compound. We all set out and after some time Manje La managed to locate it. The tree was about five or six metres high and had it not been for the beautiful white and yellow flowers I would never been able to identify it. Around the tree we found several smaller tea plants and seeds scattered all over on the ground. With the British discovery of tea in Assam it has been a history of moving the "savage" plant"

Fig. 1. Mr Manje La showing a wild growing tea tree. Photograph by Bengt G. Karlsson.

(Sharma 2011:30) out of the jungle and into the ordered space of the plantation. Left on its own, however, tea obviously could grow quite well in the forest.

In this essay I seek to retrace the movement of the tea plant (*Camellia sinensis* var. *assamica*) from the forest to the plantation, and from Assam across the Indian Ocean to East Africa and the Kenyan highlands. As the plant has moved it has been altered to suit demands for higher productivity, as well as to suit soil and climatic conditions in new locations. One of the more significant results of such plant breeding efforts in Kenya is the release of the tea clone TRFK 306/1, popularly known as "purple tea". Purple tea is a new variety of the plant that Singphos and other indigenous communities cultivated in the Assam forest and adjoining areas of highland Burma and Yunnan, China. My aim here is to explore the interaction of people and plants, and to think about what happens when plants travel. Such movements are usually in the form of travelling seed. How do plants thrive when they land up in a foreign setting, and what is gained and lost in the migration?

This essay is influenced by the "plant turn" and the wider scholarship on interspecies relatedness in anthropology and allied disciplines (Myers 2016; Hartigan 2019; van Dooren *et al.* 2016; Tsing 2015; Galvin 2018; Govindrajan 2018). Much of my earlier work has been about resource struggles and rights to land and subsistence. Recently, however, I have navigated towards questions of how different life forms come together and compete for space, but also depend on and enable others to thrive. I have spent several years in field working with indigenous peoples in north-east India whose lands been turned into tea plantations and forest reserves. I have travelled through, stopping for tea and taking part in popular festivals in the surrounding tea plantations, somehow without thinking more deeply about the entanglements of tea. It was only when I moved with my family to Nairobi in 2014 and by chance came to know that all tea grown in Kenya stems from seeds and cuttings from Assam plants, that I realised it was "time for tea". A small grant allowed me, along with a few colleagues in Kenya and India, to carry out preliminary research on tea with the aim to try to stay close to the plant and to look at the relations, the long-distance travel, the science, and the multispecies entanglements of tea. This story begins with the tea plant turned into a plantation crop.

PLANTATIONS

"The plantation is back", writes anthropologist Tania Murray Li. She continues, "(c)olonial-style large scale corporate monoculture of industrial crops on concession land is again expanding in the global south" (Li 2017, 1). Such expansion has adverse consequences for local communities, livelihoods, and environments, displacing cus-

tomary land regimes and earlier resilient ecologies. In a series of publications on the oil palm boom in Indonesia, Li describes the plantation as a "predatory system" that generates violence and suffering, asking, "what is the actual form of life that emerges in the plantation zone?" (2017, 1). The question is an especially urgent one, she argues, in view of the massive expansion of oil palm plantations that is being rolled out in Indonesia. In a somewhat similar fashion, in a conversation about the Anthropocene, anthropologist Anna Tsing asks: "what makes a plantation?" Donna Haraway responds by pointing to long-distance transportation of genomes, of breeding plants, animals and humans, as crucial to the plantation: people and plants are thereby made into alienated resources. The Japanese anthropologist Noboru Ishikawa pushes the argument further, stating that plantations not only imply the slavery of people but also "the slavery of plants" (Haraway *et al.* 2016, 556), a statement Tsing, Haraway and the others agree with. Plantations, in other words, embody very much of what is wrong in the world. Along with the many conceptual alternatives to the Anthropocene, Haraway and her colleagues suggest the "Plantationocene" to stress the centrality of the plantation system for the present era (cf. Haraway 2016, 206).

A plantation, according to common dictionary understanding, "is a large piece of land, especially in a tropical country, where crops such as rubber, coffee, tea, or sugar are grown" (*Collins Dictionary*). Several dictionaries add that the crops grown there are "for sale in distant markets" (and hence not food or other crops for local consumption) (*Cambridge Dictionary*). In this essay I am concerned with tea, one of the iconic plantation crops that has reshaped landscapes, economies, and imperial histories. With journalist Henry Hobhouse one could say that tea is a plant that has "transformed mankind" (1985, xii). There is vast literature on tea, both scientific and popular, covering all aspects of the history and the production and consumption of tea (cf. Rappaport 2017). Scholars in the social sciences and humanities studying the production of tea usually focus on the highly precarious situation of the plantation labourers, described as a system of "indentured servitude" (Behal 2014, 82). Here I seek to do something different: instead of labour, my focus is on the plant itself. I will follow the Assam tea plant (*Camellia sinensis* var. *assamica)* from the Singpho forest gardens in north-east India into the colonial plantation, subsequently transported as seeds across the Indian Ocean to East Africa to be planted in newly established plantations in the Kenyan highlands. During its roughly 100 years in Kenya, the Assam tea plant has been subject to intensive breeding, turned into various hybrid varieties and high yielding clones attuned to the soils, environment, and climate conditions in East Africa. Here I am particularly interested in the Kenyan Tea Research Institute clone TRFK 306/1, more known as "purple tea" due to the purple, or dark red, colour of the leaves and the tea brewed from them. As with the other new clones, it took the researchers

more than 20 years to, in 2011, have the clone ready for release to the industry. Purple tea is especially rich in antioxidants as well as in anthocyanin, which, as in blueberries and red grapes, is supposed to have important health benefits, such as reducing the risk of cancer, diabetes, as well as cardiovascular and other modern lifestyle diseases.[1] In addition, the purple tea plant is also considered more sturdy and able to survive more adverse climatic conditions when climate change is a major concern for the tea industry globally (FAO 2015, 149). In many ways it seems the perfect plant to thrive in the warming conditions of the Anthropocene.

It is estimated that tea has been planted on close to 200,000 hectares of land in Kenya, and it has further also been planted widely in the other East African countries, as well as in other parts of Africa. This can indeed be celebrated as a great achievement by those involved and that now make a living from the plant. From an evolutionary perspective one might also say that the tea plant has had a remarkable reproductive success. Besides Africa, it has travelled around the world. Wheat has a similar history. Historian Yuval Noah Harari makes this point in his bestselling book *Sapiens: A brief history of humankind*. He writes that "wheat has become one of the most successful plants in the history of the earth", now planted on a total area of 2.25 million square kilometres, roughly ten times the size of Britain (Harari 2014, 90). Indeed remarkable. Yet, in view of the massive loss of biodiversity, the global spread and dominance of a few species is hardly good news. A global overview estimates the total number of plant species on land to around 450,000, out of which about 30% is considered in risk of extinction (Pimm *et al.* 2014, 1246752-6). Land-use change and tropical deforestation are quoted as major drivers of extinction and biodiversity loss (Pimm *et al.* 2014, 1246752-6). As we will see, this is very much the story of tea.

ELIMINATIONS

A tea plantation or a tea garden, as it is popularly known in India, has its particular beauty. Deceptive, some say, but waves of green in different shades rolling gently along a hill side or stretching out as far one can see to the horizon is a striking view.

The sublime beauty of the landscape certainly obscures the violent history of the plantation, the slavery of plants and people about which Haraway and her colleagues speak, in the conversation referred to above. In the case of Assam's tea plantations, hundreds of thousands of indentured labourers were brought from impoverished parts of central India. Compared to the people brought from Africa to work under horrific

1 The health benefits of anthocyanin remain debated, for a general, popular overview, see https://www.bbcgoodfood.com/howto/guide/what-are-anthocyanins-and-why-are-purple-foods-so-healthy.

Fig 2. Rolling hills with tea in the Kenyan Highlands. Photograph by Bengt G. Karlsson.

conditions as slaves on sugar, tobacco, and cotton plantations in the West Indies and Americas, this distance was not vast. Yet many people died during the two-month-long journey, covered on foot and on cramped boats along the Brahmaputra River. The annual death rate on the plantation itself could be as high as 20–30% of the workers in the early years in the 1860s (Sharma 2011, 81). To quote Sharma, "(P)lantation conditions these early years were primitive for white planters and their assistants, but they were almost unbearable for the workforce" (2011, 79).

Before tea could be planted the land had to be cleared of the earlier vegetation, which in the case of Upper Assam commonly consisted of dense forests. "When I first saw the site for the new garden it was just a mass of solid jungle", a British planter recounts in his memoir (Ramsden [1945] 2016, 67). All the trees had first to be felled, "some of enormous dimensions", and after the timber been removed the rest was left to dry and the entire clearing was later burned. Tree trunks, a few fallen trees, and some ant hills, considered best left alone, were the only thing remaining on the land (Ramsden [1945] 2016, 70–71). The process has been more or less the same in East Africa. A manager in charge of establishing new plantations in the region during the 1960s and

1970s told me that they always looked for primeval, tropical forest which – despite requiring hard work clearing the land – had the advantage of sparing the tea bushes from the diseases and pests that were common on lands that previously been cultivated (Interview in Nairobi, 29 January 2019). With tea, the complex forest ecosystems that had evolved under a long period of time, sustaining a multitude of life, were destroyed in a single strike. Such destruction still unfolds in various parts of the world, the oil palm plantation frontier in Indonesia that Li and many others write about being an especially troubling example, not least due to the enormous sizes of these plantations (see further Petrenko *et al.* 2016).

While I share Li's anguish over the expansion of monocultural industrial agriculture, I still feel compelled to ask if there is more to the plantation than death and destruction. Are there other stories worth telling; stories that cannot be subsumed by notions of slavery and the plantation as a "death zone"? I am aware that just raising this question might appear insensitive. But looking for such other stories that revolve

Fig. 3. Smallholder farmers in Meerut, Kenya, growing tea along with khat (miira trees). Photograph by Bengt G. Karlsson.

around the world of the tea plant need not foreclose political action and critism of capitalist agro-industries. To be sure, such criticism is urgently needed. Food crops can be grown in different manners and we need to be aware of the social and ecological imprint of different agricultural regimes. In both Kenya and India tea is increasingly being grown on small-scale family farms (cf. Buch-Hansen 2012). The smaller size allows for flexibility and improvisation, as with the farmers we met in Meerut who grew tea along with *miira* trees or Khat (*Catha edulis*). The farmers said that, depending on season and market prices, they dedicated their time to either of the two plants. Not only was this economically beneficial, but as a result they had inserted larger diversity into their fields.

Indigenous peoples in the Eastern Himalayas still grow tea in traditional forest gardens (as the Singphos did earlier). Biologist-ethnobotanist Selena Ahmed and her colleagues, who have studied such agro-forest systems closely in the Yunnan region, argue that the key idea is to "mimic nature" and maintain diversity in the field. By keeping the tea tree within the forest the surrounding vegetation becomes a natural buffer. In this way the tea crop is protected from extreme weather events (Ahmed *et al*. 2010; 2012). Both small-scale tea farms and indigenous agro-forest tea gardens provide environmentally and economically viable alternatives to the colonial-style tea plantation. But despite this, large-scale corporate monocrop tea plantations will be around for some time to come, begging the question of the life that unfolds – and ends – there.

PLANT LIFE

Li describes how the palm oil plant is killed with poison after its productive life-period of 20 years is over. Tea bushes have a longer productive cycle, usually around 60 to 70 years, after which they yield less and the branches on the bush become too sturdy or stiff, making it harder for the labourers to do the plucking. Old bushes are thus being uprooted and replaced by young tea saplings, often in the form of higher-yielding clones.

Maintaining a productive plantation involves various measures such as pruning, removing infected bushes, spraying, adding fertilisers and, above all, regular plucking. In its natural state, tea is a tree that can grow up to 17 metres high. In the plantation, however, it is kept to the height of about one metre, reaching the waist of the pickers. Tea has beautiful white and yellow flowers, but in the plantation one seeks to prevent the bush from flowering and generating seed. Such measures can be regarded as a form of violence, or in the word of philosopher Michael Marder as, "violent impositions that fail to respect the inherent tendencies of the plants themselves" (2015, 187). Yet, the human-plant relations forged in a tea plantation also involve, as we will see, careful

Fig. 4. Old tea bushes are being uprooted to be replaced by new tea plants in Kericho, Kenya. Photograph by Bengt G. Karlsson.

tending and concerns for the well-being of the plants. And humans are not the only ones forging affective bonds with the tea plant, as this is also the case with a multitude of other living beings, such as insects, fungi, microbes, birds and other animals.

The tea plant (*Camellia sinensis*) has co-evolved with humans for a very long period of time. The original growth place is usually located in the Eastern Himalayan corridor that span upland areas of Northeast India, Bhutan, Nepal, Tibet, Yunnan, Myanmar, Thailand and Laos (van Driem 2019, 6–7). The plant has, as the conventional story goes, been domesticated. Recent scholarship has, however, come to question domestication as a one-way process of human domination, suggesting instead that both plants and people play active parts and hence have agency. James C. Scott turns domestication on its head in his recent book, *Against the grain: A deep history of the earliest states*, arguing that if the standard narrative claim that humans have domesticated wheat, rice, and animals like the sheep and the pig, "one could argue that it is we who have been domesticated" (by these plants and animals) (2017, 87). Anthropologist Marianne Lien puts this in slightly less bold terms, saying that even in the high-tech aqua-industry of salmon farming, humans are not in full control. The fish "talk back" in different ways, which make domestication more open-ended and unpredictable (2015, 4–7).

With tea, historical records suggest at least 3,000 years of human engagement with the plant, and as part of that, more systematic attempts of selecting breeding that can be traced back to as early as the 8th century AD (Meegahakumbura *et al.* 2018, 8). Recent research seeking to map the tea genome suggests a split some 22,000 years ago of the plant into the two main varieties, that is, the China tea plant (*Camellia sinensis* var. *sinensis*) and the Assam tea plant (*C. sinensis* var. *assamica*), and, much later, a subsequent split of the Assam plant into two distinct varieties, the China Assam type and the Indian Assam type, with their different "breeding histories" (Meegahakumbura *et al.* 2018, 1, cf. Xia *et al.* 2017). In view of this, one can also ask if something like "wild tea" – a plant that is not marked by human touch – could still exist? Frank Kingdon-Ward raised this question in a 1950 article titled 'Does wild tea exist?', in the journal *Nature*. He did not reach a definite conclusion, but pointed out that most places where people have reported to have found wild tea are located along major trade routes, or in sites in the vicinity of existing or abandoned villages.

During the early 19th century, the British had become desperate to find an alternative source of tea to escape the costly imports from China that were draining the imperial finances. Here one cannot underestimate the earlier-mentioned discovery of "wild tea" in Assam. It took some ten years to gain scientific approval of the discovery. The Assam plant was different from the known Chinese tea plant. For the newly established Tea Committee, the wild Assam plant itself was "entirely dispensable", being too "savage"; instead, the plan was to introduce the superior Chinese plant (Sharma 2011, 30–31). In the end, the Assam tea plant with its larger leaf turned out to be the most suitable for large-scale production. What followed was a transformation unprecedented in speed and scale, turning this sparsely populated frontier tract of Assam into a massive plantation zone. Generous land grants were handed out to British investors, a transport and communication infrastructure with river steamers, railways, and telegraph lines was put in place, and plantation labourers were brought in from central India (Guha 1977). By the turn of the 20th century India had become a major exporter of tea, pushing the Chinese tea industry into decline. "The tea of empire was accruing unstoppable momentum", write Ellis, Coulton and Mauger (2015, 241).

As part of the expanding empire of tea, British planters brought seeds of the Assam plant to the East Africa colony, and in 1904–1905 the Caine brothers were the first to plant tea, later followed by the first commercial tea plantation in Kenya in the 1920s, made by the Brooke Bond Company. Assam tea seeds had also been circulated to other British colonies, and back in 1839 Dr Nathaniel Wallich – who was head of the Calcutta Botanical Garden and member of the India Tea Committee – sent seeds to the Royal Botanical Garden at Peradeniya in Ceylon (present-day Sri Lanka). The tea plants thrived, and tea soon came to replace coffee as the island's key plantation

crop (Rappaport 2017, 116–117). Ceylon also became an exporter of Assam tea seeds to East Africa and other regions of the colonial empire.

REACHING OUT TO PLANTS

Anthropology has a long history of engagement with plants, not least within the subfield known as ethnobotany (Ellen 2018; Galvin 2018). But for me, as well as many of my peers, the political aspects of nature – such as resource conflicts – rather than the life of individual plants and animals have been given prominence (see Karlsson 2011, 2015). While these are still critical issues, there is more to nature. Natasha Myers calls out to anthropologists: "(w)e must get to know plants intimately and on their own terms" (2016). She suggests a new "planthropology", aiming to "document the affective ecologies taking shape between plants and people" (2016, see also Myers 2017; Hartigan 2019). I find this call highly compelling. An excellent example of what interspecies scholarship might look like is Anna Tsing's path-breaking monograph *The mushroom at the end of the world: On the possibility of life in capitalist ruins* (2015). In this rich and beautifully written monograph Tsing introduces the notion of "multispecies assemblage" to consider how different species influence each other or, as she puts it, are "coming together" (2015, 22–23). The *matsutake* mushroom is the main protagonist. It grows in the wild, preferably in pine forests that have been ravaged by logging. "Pines find mushrooms to help them use human-made open spaces", she writes (2015, 23). Different lifeways are hence coming together. This would clearly look differently in a more controlled environment like that of a plantation. Tsing also points to this, saying, "(p)lantation crops have lives different from those of their free-living siblings" (2015, 23). Indeed, but at a closer range, the plantation might also offer surprising multispecies "happenings".

Anthropologist Sarah Besky points in this direction in her work on tea in Darjeeling:

> An industrial agriculture landscape might not seem like a fruitful anthropological location to employ a multispecies perspective, but a plantation is more than just low-wage labour, disinterested management, and standardized plants. (2014, 159)

Besky elegantly shows how the life cycle of the plant "shapes the social and moral economic conditions in its landscape" and how, for example, the female labourers understand and talk about their relation to the tea plant as mother to children, commonly evoking kinship metaphors (2014, 160–161). In a similar vein, historian Arnab Dey argues that an often-forgotten aspect of the tea plantation system relates to the ecological factors that conditioned and were created by the imperial project of tea (2015). Dey draws especial attention to the insects, commonly known as "pests", that

flourished in (and pose a constant threat to) the tea plantation (Dey 2015, 563; see also Dey 2018).

When I started to explore possible sites at which to conduct field work for this project, several people in Nairobi told me I needed to tread carefully as Western journalists had exposed widespread labour abuse in the tea industry, not least systematic sexual abuse of female labourers by male supervisors in plantations owned by Unilever, the largest producer of tea in Kenya.[2] The multinational companies would hence not be particularly forthcoming, it was suggested. There had also been labour unrest in relation to demands for increased wages and the introduction of plucking machines which would suggest that many people would be laid off. As I was pondering about different options, a solution presented itself in an unexpected way. Through a friend of my wife I was introduced to Ms Jörel Day-Wilson. Jörel had come to Kenya as journalist and had fallen in love with a British planter in Kericho, married him, and settled on the farm. The tea farm was subsequently sold in the 1980s to a Kenyan family and was now run by Mr Kim Martin. Jörel introduced me to him, and Kim gladly invited our small research team to the Chesumot Farm. This turned out to be a perfect location. The plantation is situated just outside the town of Kericho in the heartlands of the Kenyan tea industry.

Kericho is all about tea. As far as one can see tea bushes are planted in straight rows, only interrupted by paths and roads and lines of white-washed trees and housing complexes for labourers. Specially designed tea trucks are busy transporting fresh leaves from the fields to tea factories. Street hawkers try to force tea packages on you when you travel on the highway. There is a tea hotel, a golf course, tennis courts, a planter's club, and the rest of the colonial infrastructure of tea that reminds of the olden days when tea was the sovereign privilege of white settlers. In Kericho there is also the Kenyan Tea Research Institute, established in 1951 by the Brooke Bond Tea company. It was then catering to the entire East African region, but was later turned into a national, state-run institution.

The Kenyan tea industry can be divided in two different sectors – the large-scale multinational corporate tea sector established in first half of the 20th century, today dominated by a handful of multinational companies like Unilever, Tetley Tea, Williamson Tea, and the Indian Tata Tea – and the small-scale tea sector established after 1963's Independence, with a total of about 500,000 tea farmers today. Tea is one of Kenya's main industries and provides employment to some three million people. Kenya is also the largest producer of black tea in the world, and more than half of

2 A film team from the French-German TV channel Arte carried the story in 2013 leading to a campaign against Unilever, which they ultimately had to respond to, see https://nanopdf.com/download/section-iii-unilever-and-rainforest-alliances-response_pdf.

Fig. 5. Mr Kim Martin at Chesumot Farm in Kericho, Kenya. Photograph by Bengt G. Karlsson.

the processed tea comes from the small-hold sector (cf. Kamunya *et al.* 2012). Many in the industry speak about the need to diversify the production and move into the more lucrative sectors of specialised teas, one being the new variety of purple tea.

PURPLE TEA

The sun had begun to set when we arrived the first time at the Chesumot Farm. The artist James Muriuki was travelling with me and our journey from Nairobi had taken over six hours by car. Kim had arranged for us to stay in the guesthouse and shortly after we arrived he turned up on a motorbike, greeting us with a big smile. Over a few beers, he gave an overview and short history of the farm. Tea was still the main focus, but as an entrepreneur Kim was constantly seeking out new business opportunities, trying for example to open up the farm for tourists and to plant giant bamboos on vacant plots. At the moment, however, he was anxiously awaiting permission to start constructing his own tea factory. With a factory, he would be able to process, pack, market, and sell the tea himself. It is these latter stages of the process from plant to

cup where the largest profits can be made. As it was now, he sold fresh leaves to a nearby factory. Kim had it all worked out. The finances were ready. Machinery would be brought from India, which besides China, was the leading manufacturer of tea-processing machines. He had his own supply of eucalyptus trees needed for fuel to dry the tea leaves in the factory.

But more than anything, Kim's hope for a prosperous future was connected to purple tea, and since the release of the new clone in 2011 he had planted only purple tea on the farm. He was raising purple tea seedlings in his own nursery, also selling to other planters and small-scale farmers in the area. Kim was active in the promotion of purple tea and was the vice-chairman of the purple tea association of Kenya. The demand for purple tea has not picked up as expected and some small-scale growers have already given up, uprooting their purple tea bushes and planting other crops with more immediate and secure returns. Kim, however, was convinced that the market demand would soon take off. It was a matter of getting everything in place, and to be ready when the health-conscious consumers in the US, Europe, and Asia woke up to the advantages of drinking purple tea.

With 216 hectares under tea, the Chesumot farm is a larger size than most family-owned farms. Besides tea the farm also contains areas for tree plantations, grazing, a watershed, and buffer zones of indigenous forests and natural vegetation. The tea part of the farm is summarised in a one-page chart listing plot name, size of the plot, clone type planted, and year and number of bushes planted. Almost 2.2 million tea bushes are presently thriving on the farm. The first batch were planted in 1944, and until 1960 it was a matter of all-Assam plants. In 1961 the first clone, 31/8, was introduced on the farm, and it was later followed by a number of other high-yielding clones developed by the tea researchers at the Institute at Kericho. After 2011, as mentioned, Kim only planted the Institute's clone TRFK 306/1 or purple tea. Important to note here is that with the introduction of hybrid clones, the mode of planting also changed. Assam tea bushes were generated through seeds, so-called seedling plantations, whereas the new clones were created through vegetative propagation or cuttings. The latter method is faster and provides the exact copy of the tea variety selected. In plantations with seedling tea there would instead be a much larger genetic variation and plants with longer roots (up to 3 metres).

The Director of the Kenyan Tea Research Institute, Dr Bore, told us during a visit to the Institute and meeting with his colleagues, that the modern breeding project from the 1950s onward had all been about creating uniformity and developing ever-more high-yielding clones (Interview, 21 February 2018). But during the last two decades, the Institute has come to realise that priorities need to change. With climate change and more extreme and unpredictable weather patterns, plant resilience has become

increasingly critical. Paradoxically, Dr Bore said, he and his colleagues have also come to understand the benefits with seedling tea and the need to introduce more diversity into the plantations. A seed always contain diversity. And seedling tea has a stronger and wider root system and can therefore endure drought better than clone tea, the Director opined to the other scientists gathered. Listening to them felt somewhat schizophrenic: on the one hand they took pride in the many clones they had developed and released to the tea industry over the years, and on the other they lamented the loss of the old, seedling-based Assam plantations, as the planters switched to the Institute's high-yielding varieties.

During the meeting we were served purple tea, made with fresh leaves from bushes outside the window. Just add some lemon and the flavour and colour comes out more, they told us. It was indeed delicious, not at all the bitter, unpleasant health beverage I had been warned about. The director told us that they served purple tea several times a day at the Institute and one of the researchers underlined that he felt that his health has improved significantly after drinking it regularly. Everyone nodded in agreement. The Indian tea industry has also awakened to the potential of purple tea. Dr Pradip Baruah, a senior researcher at the Tocklai Tea Research Institute in Assam – an Indian institute that has been a close collaborator and partner institute with the Kenyan Tea Research Institute – created global headlines by asserting that not only was the purple tea clone released in Kenya an Assam variety, but that they held it for a long time in their germplasm collections. Their variety of purple or "ox-blood" tea had been discovered growing wild in the hills.[3] During a visit to Tocklai, we had a chance to speak with retired head of research, Dr B.C. Barbora, who confirmed that they had considered working on "ox-blood" tea back in the 1970s and 1980s, but that they found no interest in it back then (Interview, November 2018). What the Tocklai researchers credited their Kenyan partners with was the foresight in realising the potential of purple tea. In October 2018, the Tea Auction in Guwahati announced that it had, for the first time, auctioned a small quantity of purple tea grown in a plantation in the north-east Indian state of Arunachal Pradesh.[4] The sale had fetched the amazing price of INR 24,500 or USD 333 per kilo.[5] It is not

3 'Will purple tea replace green tea as the new health drink', *The Times of India*, 1 February 2015; 'Purple tea – Is this the tea of the future?', NDTV Food, Press Trust of India, 29 December 2014, https://food.ndtv.com/food-drinks/assam-can-now-produce-purple-tea-719507 [accessed 3 June 2018].

4 'Purple tea debuts at Guwahati tea auction, sells for record price', NDTV, https://www.ndtv.com/guwahati-news/purple-tea-debuts-at-guwahati-tea-auction-sells-for-record-price-1937092 [accessed 28 October 2018].

5 The prices of tea vary greatly depending on quality, but ordinary black CTC tea from Assam is usually sold for around INR 150 per kilo.

clear what kind of purple tea this is: possibly the Kenyan clone TRFK 306/1 that had travelled back to India.

TRAVELLING PLANTS

Environmental historians have traced various long-distance movements of plants. Alfred Crosby's classical notion of "ecological imperialism" alerts us to how European biota historically have been dominating the world (1986). But plants also travelled in the other direction, that is, from South to North. It became fashionable among European royals and the nobility in the 16th and 17th centuries to have ornamental gardens with collections of exotic plants, and it is at this time too that the idea of botanical gardens holding, ideally, all the plants in the world, started to spread. Plants granted power, but were simultaneously also valued for their medical and economic usefulness. Historian Richard Drayton gives a detailed account of such plant movements,

Fig. 6. Purple tea produced in Kenya and distributed under the brand names Kericho Gold and Emrok Tea. Photograph by Bengt G. Karlsson.

especially focusing of the role of the Royal Gardens at Kew in London as a node in the circulation of valuable plants (2000). To get access to exotic plants Kew and other botanical gardens depended on the assistance of botanist, professional plant hunters, merchants, naval officers, soldiers, and planters in Africa, Asia, and the Americas (Drayton 2000, 46).

Tea was one of the more sought-after plants. The Swedish botanist Carl von Linné (Linnaeus) was obsessed with idea of obtaining the valuable Chinese plant for his botanical garden in Uppsala. After several attempts to germinate seeds that he had acquired from travellers, he managed to get hold of two living bushes. After two years, the bushes bloomed, and as von Linné writes he then realised that he had been tricked by the Chinese. What he obtained was not the tea he expected, what he then called, *Thea,* but *Camellia.* According to von Linné, the two were very similar, but the latter had somewhat wider leaves. It is hard to tell which plant it was that von Linné had ended up with, but what I find particularly interesting in this story is that von Linné's motivation for getting hold of the tea plant was not primarily scientific, but rather economic. He aimed for Sweden to establish its own tea plantations in the southern part of the country (von Linné [1765] 2002; Koerner 2001). A better-co-ordinated attempt to establish tea plantations in the Global North was made by the US Patent Office in mid-19th century. Scottish botanist and plant hunter Robert Fortune manage to smuggle living plants from China, and these were successfully reproduced in greenhouses. In 1860 the Patent Office started distributing tea seedlings to farmers in the southern states. But with the advent of the American Civil War, the experiment came to a halt and never got back on track. However, a few farmers in South Carolina did pursue tea-growing, and one can still today find American-grown tea in the market (Fullilove 2017, 67–85).

Robert Fortune also played a key role in bringing Chinese tea seed and plants to India. The Chinese tea plants, however, did not do well in the Assamese soil and after a period of experimentation the British planters soon turned to the native Assam variety (Dey 2018, 43–47), a move that eventually paved the way for the global success story of Indian tea that the Empire so desperately needed. Seed of the Assam tea plant was subsequently brought along with British settlers to East Africa and found to thrive in plantations equally well there. During the 20th century tea became a rapidly growing industry, first as a colonial venture reserved for settlers, later during the post-colonial period as part of an ambitious state-led agriculture programme for smallholder, local farmers and with processing and marketing organised by the Kenya Tea Development Agency.

One of the key problems with large-scale single crop plantations is that when all

vegetation is removed, one creates an environment conducive not only for the particular crop but also for those life forms that co-habit or thrive along with these crops, that is, insects, bacteria, fungi, etc. When the crops are made to travel, these "companion species" tend to move along as well. Many of the "pests" that presently infest plantations in tea-growing regions around the world are believed to have travelled along with tea plants from Asia. As put by historian Arnab Dey, "out of 1,000 and more arthropods that infest tea globally, more than 380 come from India alone" (2018, 202). One of the most troublesome ones is the red spider mite that was originally found in plantations in Assam in 1868, but has now spread to tea plantations in Bangladesh, Sri Lanka, Kenya, Taiwan, and Zimbabwe, Dey notes (2018, 202).

Many of those involved in tea in Kenya proudly point out that the industry there is relatively free from pests, and thus they use fewer pesticides in their fields compared to tea growers elsewhere in the world (cf. FAO 2015, 20). The main disease that troubles the industry is Armillaria root rot, caused by a fungus (*Armillaria mellea*) that infects tea bushes, initially discolouring the leaves then reducing growth, and eventually kill-

Fig. 7. A field with purple tea in Kericho, Kenya. Photograph by Bengt G. Karlsson.

ing the bush. The fungus is common in forest zones around the world, mainly in temperate, but also in tropical areas. It thrives in the roots and stumps left in the ground after a forest has been cleared to make place for a plantation. Research in Kenya points to three different varieties of *Armillaria mellea*, out of which only one is found to be native to Africa; of the two others one is assumed to have travelled along with tea plants from Asia (Otieno 2002, 349). The root rot causes major problems especially in the small-scale tea sector. So far, no successful method to clear plantations from the fungus has been developed. At the Chesumot farm, root rot was also rather common, but Kim and his staff were not too troubled by it. Infected tea bushes were uprooted, usually along with their closest neighbours, and the plot was then left barren for a few years before being replanted again.

PLANT AGENCY

While the story of tea appears as a straight-forward story of man's control and appropriation of nature, it is critical to understand how the plant itself came to structure the industry that was built around it. Sidney Mintz points, in his now classical study *Sweetness and power: The place of sugar in modern history* (1985), to two especially critical aspects of the sugar plantation in Puerto Rico, which also speak to tea. First, the temporal aspect, that is, "the inherent perishability of the crop" (1985, 50). When the sugar cane is ripe it needs to be cut and immediately afterwards the cane has to be processed. This simple fact, Mintz writes, structures the entire venture. Factories have to be located inside the plantation or in its vicinity, requiring both a specialised labour force and technology at the site. This also holds true for tea. The fresh tea leaves have to get to the factory shortly after picking. "Perishability" further enters later stages in the commodity chain, when, for example, the processed tea is to be transported to the auction in Mombasa, delays can spoil or reduce the quality of the produce. The other, and more elusive, aspect Mintz alerts us to is the stimulant or "active substance" extracted from the plant; sucrose in the case of sugar cane, and caffeine in the case of tea. While the craving for these stimulants stems from an acquired taste – the consumption of both sugar and tea gained popularity through their symbolic attachment to the élites in society – the users are eventually being hooked on, or addicted to, these substances. Mintz put this aptly for sucrose as, "the affective weight of sweetness" (1985, 208). In parenthesis one can note the entangled history of sugar and tea, famously enjoyed together in a cup of hot sweet tea. Perishability and addictiveness enters in different ways into the story of tea, as well as other plantation crops like tobacco and coffee.

Recent plant research reveals that pollinating insects similarly can be hooked on stimulants released by plants. Honeybees have, for example, been found to be attracted

by the caffeine-laced nectar of the coffee plant. The plant is thus described to "manipulate" the behaviour of the pollinator (Wright *et al.* 2013, 1202–1204). A large number of plants can similarly defend themselves from attacking insects by the release of chemical compounds that make the leaf less tasty or even poisonous (cf. Mancuso & Viola 2018, 102–103). As an unexpected consequence of this it has been found that tea plantations in Taiwan infested with the tea green leaf hopper (*Empoasca onukii*) produces tea with an especially pleasant taste. While the total yields of these plantations are lower, the farmers can earn more due to the higher price of "bug-bitten" tea (Nowogrodzki 2019).

FULL CIRCLE: BACK TO THE FOREST

Historian Erika Rappaport ends her rich monograph, *A thirst for empire: How tea shaped the modern world* (2017), by saying that "we do not know as much as we think we know about tea" (2017, 408). This is also something I have come to realise through my more-modest attempt to follow tea seeds from the Assam forest into the colonial plantation, and subsequently across the Indian Ocean to become one of independent Kenya's most important export crops. As part of this journey, the tea plant has undergone a series of transformations where a number of modern, high-yielding varieties have been developed, the latest being the clone TRFK 306/1 or purple tea. Purple tea is presented as the future for the industry, as it is a plant that is more resilient and can thrive also in situations of more erratic weather events. The beverage is further marketed for its health benefits, in the hope that purple tea will become the privileged choice of health-conscious consumers around the world.

What, then, can this story tell about the relation between people and plants? What stands out to me is the extraordinary power of the seed, allowing the tea plant to travel and expand into new territories. The seed contains diversity, it carries the history of all previous human entanglements and the places it has grown. In modern plantations the idea is to have uniform fields with genetically identical plants of selected, high-yielding varieties, hence the planting of clonal cuttings. While this has proven successful in terms of productivity, the modern plantation is highly susceptible to new risks relating to climate change. Today it seems that the challenge for the tea industry is to bring diversity back into the plantation. Here we are back to the Singpho people and other indigenous communities in the Eastern Himalayas that grow (or used to grow) tea in the forest. They seemed to have got it right from the very beginning.

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ROY ELLEN

Seeds versus vegetative propagules as strategies for surviving the Anthropocene: Social profiles and biocultural consequences

There is a well-established observation that humans play an important part in the dispersal of plant seed and other propagative material, either inadvertently or deliberately (e.g. Hodkinson & Thompson 1997; Mack & Lonsdale 2001). In a paper published in 2011, Simon Platten and I expanded on this to demonstrate how forms of dispersal reflect different patterns of human interaction and relationship, and how the opposite may also be true: that patterns of human exchange modify the properties of plant germplasm subject to further co-evolutionary selection. While these patterns had been reported in the ethnobotanical literature for rural tropical and subtropical regions, there had been little work on comparable patterns for industrial and post-industrial Europe. In the paper, we illustrated the issues with reference to data on the management of germplasm in British allotments in East Kent and West London. We noted that despite official regulations restricting seed trade and dispersal, allotments (in the UK, community plots of land made available for individual, non-commercial gardening or growing of food plants) were a significant site for informal exchange, experimentation, and diversity production.

In this chapter I return to the relationship between kind of propagule (or disseminule) and social agency, but question the much-purported hegemony of seed as a mechanism and consider some forms of vegetative reproduction where the agency of plant and human cultivators converge. For it is not only seed that has a social life, but other plant parts that serve to reproduce vegetatively. In adopting this line of argument I move from the allotments of East Kent to the marginal Nuaulu and Kei swiddens of eastern Indonesia where I have undertaken most of my fieldwork since 1969. It must be said that although recreational East Kent allotment keepers outnumber Nuaulu (who in 2015 comprised something over 2,000 individuals), the biocultural consequences of their actions on the wider host population, though interesting, have very little impact on food intake and social resilience. By contrast, Nuaulu and Kei Islanders still

maintain food sovereignty despite consuming increasing amounts of food purchased through the market, and despite a history of receptivity to new germplasm. It is instructive therefore to take a broader look at germplasm manipulation, to examine the trade-offs between different kinds of propagule, particularly between seeds and various forms of humanly-assisted vegetative reproduction, and undertake "counterwork" (see e.g. Fardon 2003) to re-assess some sloppy assumptions that underpin the idea that seed is supreme.

SEED AS A REPRODUCTIVE MECHANISM AND TROPE

Let us start with Henk Beetje's economical definition produced for a definitive publication produced by the Royal Botanic Gardens at Kew:

> seed, the structure produced from a fertilised ovule by which all seed plants reproduce, consisting of an embryo and usually a seed-coat, with endosperm; reproductive part of fruit; the integumented megasporangium (Beentje 2010, 105).

Seed has had a good press recently. As a form of dissemination and as natural capital it is conspicuously triumphant (Hanson 2015). There is excitement generated by the practice of seed exchange, concern expressed regarding seed "ownership", seed as cultural property and its commodification (van Dooren 2008). Entire industrial technologies and plant breeding programmes are based on seed (Kloppenburg 2004). Moreover, the concepts and practices of seed-saving (Phillips 2013) and even more seed-banking are accompanied by a great deal of scientific, political, and financial investment (Smith *et al.* 2003). Consider, for example the Kew Millennium Seed Bank at Wakehurst Place (Lewis-Jones 2019) and the Svalbard Global Seed Vault (Westengen *et al.* 2013). In the reconstruction of our evolutionary history a great deal of analytic weight has been placed on seed as the "fulcrum" of the first agricultural revolution separating nature from the social (Boyer 2014, 85). In plants that reproduce through seed, everything necessary for its success seems preserved within it: the plant in microcosm, a tiny capsule with a huge regenerative capacity. This is why seed as trope, or as concept metaphor, is so powerful in development, feminist (Shiva 1992), and environmentalist discourses, going back to the philosophical musings of Henry Thoreau (1917–1862; see e.g. Thoreau 1993) and beyond.

Not all seeds conform to the default stereotype of the small and robust entity you can keep in your top pocket, while the range of seed types (and certainly the fruits that encompass them) is much more varied than often popularly imagined in global debates about the valuation of nature (see e.g. Bell & Bryan 2008, 194–197; Hickey & King 2000, 173–186). Nevertheless, seeds as a whole are valued more than other forms

of plant regeneration, such as suckers, and there is more talk of the conservation of seed than the conservation of stolons. Moreover, seed and pollen survive much better in archaeological and palaeoecological contexts, which may lead us to over-estimate their historical role. True, in terms of tropery, we find a rebellious challenge in the favoured image of the rhizome as used by Deleuze and Guattari (1980), and their various post-modernist and post-humanist acolytes, to represent a mode of knowledge and model of society that is non-hierarchic, network-like as opposed to generating linear arborescent hierarchies, and in the fungal mycelium and mycorrhizal analogies adopted by Tim Ingold (2011, 86) and Anna Tsing (Matsutake Worlds Research Group 2009) to understand the entanglements of social creativity. Nevertheless, seed metaphors as well as seed itself retain the upper hand in how most people, including neo-liberal agencies, think about life and regeneration more broadly. Such linguistic uses and the assumptions underpinning them are possibly reinforced by the undeniable preference for grain-based foods over root-based foods in the great historic Eurasian culinary traditions (Goody 1982), and the invariably low status accorded to roots, tubers, and palm starch. Thus, 19th-century Irish peasants ate potatoes because they could not afford bread, and many contemporary Indonesian smallholders eat cassava and sago when they cannot afford rice.

FORMS OF VEGETATIVE PLANT REPRODUCTION AND THEIR NEGLECT

There is little doubt that seeds are ideal material for commodification, and more than any other form of germplasm are amenable to the processes and potentials of industrial capitalism: in the way they can be produced, stored, packaged, and distributed. Propagules afforded through other diverse forms of vegetative reproduction do not lend themselves in the same way to this work of exchange and consumption. But this is hardly due to lack of variety. The common and effective forms of vegetative plant reproduction are arguably as numerous as the ingenuity with which botanists come up with typologies. In non-human systems we have: bulbs, runners, rhizomes, tubers, suckers, corms, offsets, stolons, plantlets, bulbils, turions, layers, hibernacula, adventitious buds, callus formation in root buds, and so on. To take two very different examples: clonal trees such as Californian coastal redwoods (*Sequoia sempervirens* (D.Don) Endl) sprout plantlets from the base of the trunk, while fallen trees of many species readily continue to grow by sprouting phototropic branches that become new trunks. One such case is hornbeam, *Carpinus betulus* L., showing vertical re-establishment in English woodland as illustrated by Oliver Rackham (2003, 438, figs. 27.1 & 27.12), that great pioneer in understanding the vegetal Anthropocene.

But certain forms of vegetative reproduction have become vastly more important, and greatly enhanced as a result of human management, such as through planting hops from rhizomes (*Fig. 1a*) in East Kent or (an example I shall develop further below) propagating sago from suckers in Indonesia. Some forms of vegetative reproduction are only possible with human intervention, such as stem cuttings, budding, and grafting. The significance of anthropic vegetation propagation in semi-managed tree landscapes can be seen in English woodland where ash, chestnut, and beech normally spread by sprouting new plants in ever-widening rings as a result of systematic coppicing. Similar examples (such as that of the coppice stool of *Acer rubrum* L., a native eastern North American species transplanted to southern English woodland) have been meticulously documented and interpreted by Rackham (2003, 434, fig. 26.15).

Beyond trees, we might note that grassland reproduces and expands extensively through stoloniferous or rhizomatic growth. Where humans have intervened to select and manage grasses to produce grain as food the propensity to reproduce vegetatively has been selected out, though there are now attempts to re-introduce it, as in the case

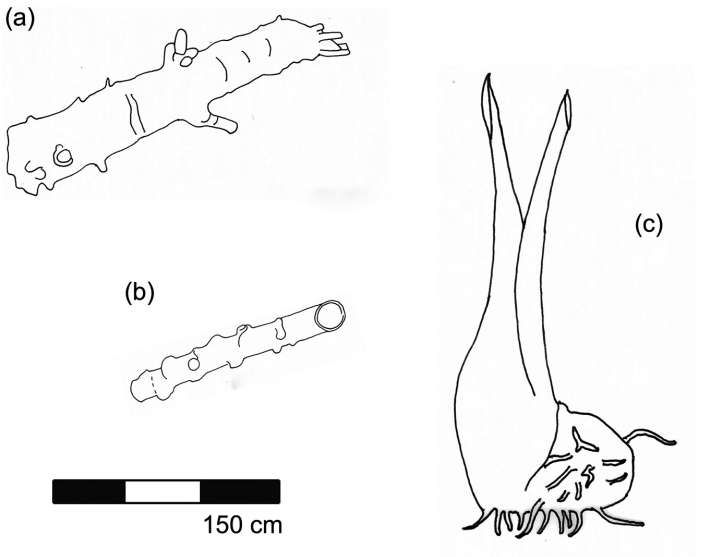

Fig. 1. (a) Hop (Humulus lupulus L.) rhizome: East Kent, (b) cassava (Manihot esculenta Crantz) stem cutting: Debut, Kei Kecil, Indonesia; and (c) sago (Metroxylon sagu Rottb.) sucker prepared for planting: Nuaulu, central Seram, Indonesia. Note the physical similarity between (a) and (b) despite the genetic distance between the two taxa, and the propagules being different plant organs. Line drawings from carpological specimens in the UKC Ethnobiology Laboratory collection: 2015-22-4. Approximate scale.

of rice (Kush 1997; Yoshida *et al.* 2016).[1] But our interest in the seed of grain crops is less as seed than as food, and some food grains we have produced are quite unsuitable as reproductive mechanisms. In other cases, social mechanisms prevent its use as seed, either by engineering out the physical possibility of effective sexual reproduction (as in so-called "terminator" seeds), or by employing commercial legal instruments such as gene patents (Stone 2018, 2602–2605). However, if we look at the ten most important food crops globally (Bates 1985; *Table 1* below), though the top three are seed reproducers, half of the species are mainly vegetative reproducers, the fourth and fifth most important being potato and cassava. The reason for this lies partly in some of the advantages of vegetative reproduction (such as the simplicity of immediately replanting stem-cuttings once cassava roots have been lifted); but also productivity factors, root and tuber crops, for example, producing twice as much useful dry matter as cereals (Flach & Rumawas 1996, 25).

Table 1. The ten most important staple food crops in global terms. Source: https://www.businessinsider.com/10-crops-that-feed-the-world-2011-9?IR=T [accessed 24 June 2019].

	Crop	Annual production/tons 2008
1	Maize	822,712,527
2	Wheat	689,945,712
3	Rice	685,013,374
4	Potatoes	314,140,107
5	Cassava	232,950,180
6	Soyabean	230,952,636
7	Sweet potato	110,128,298
8	Sorghum	65,534,273
9	Yams	51,728,233
10	Plantain	34,343,343

1 Other wild species in the genus *Oryza* are also perennial. While perennial *Oryza rufipogon* spreads vegetatively by above-ground stems (stolons), *O. longistaminata, O. officinalis, O. australiensis*, and *O. rhizomatis* spread by underground stems (rhizomes).

The triumph of seed is no doubt in large part due to its susceptibility to easy commodification, but its triumph as a trope while hardly unrelated, also requires that we consider other features. While it is easy to conceive of plant seed strategies, it is not so easy to envision, say, rhizome strategies. The fact that they are not so good to think with sometimes leads us to ignore or downplay the importance of other forms of vegetative reproduction, which are no less important than seed in feeding the world, certainly in its more peripheral areas. And this too is perhaps another reason for their neglect.

SOCIAL MECHANISMS OF VEGETATIVE DISPERSAL AND EXCHANGE

In assessing the extent and ways in which different forms of vegetative reproduction adopt a social profile we need to specify some relevant physical and behavioural qualities. Here are just a few, not necessarily mutually exclusive: size (obviously), woodiness, durability, ease of handling, ease of division, tolerance to temperature fluctuation, resistance to freezing, drying, moisture and to rough treatment, and storability. Bearing these qualities in mind, I shall focus here on just three types: bulbs, stem cuttings, and suckers.

BULBS

It is hardly surprising that the vegetative propagules most successfully circulated through the market are those morphologically and functionally similar to seed, and the obvious examples here are bulbs and corms. Consider the widely cited example of the so-called Dutch "tulip mania" of the 17th century (*Fig. 2*), in which bulbs took on virtually the same liquidity as currency. Although in 1637 the trade spiralled out of control in a classic early capitalist bubble, the market was in fact rationally organised and for the most part highly successful (Goldgar 2007). That it was so was in part due to the commodity being so readily transported over long distances, storable, diversified, circulated, commoditised, and subject to theft through "breaking" – that is through the simple separation of the bulb cloves. Of course, market mechanisms have been harnessed to disseminate other kinds of non-seed propagule, especially nowadays given the ingenuity of science-driven capitalism to utilise modern technologies of preservation and communication. But in developing countries non-seed propagules still rarely pass through the market. And even bulbs and corms are exceptional among the main food crops, restricted mainly to species used as relishes, such as onions and garlic.

Fig. 2. Double portrait by Michiel Janszoon van Mierevelt, of a husband and wife with tulip, tulib bulb, and shells, 1609. Public domain, Wikimedia Commons: source ArtDaily.org. Copyright 2000–2018, The Athenaeum.

STEM CUTTINGS

Far less amenable to market mechanisms, but nevertheless of considerable significance in large parts of the world is propagation through stem cuttings (*Fig. 1b*). The anthropological significance of this, especially for cassava, was first demonstrated by James Boster in work amongst the Aguaruna in the north-west Amazon. As with seeds, it is not the stem cuttings alone that are disseminated (the germplasm itself) but the associated knowledge, and in ways consistent with wider social norms and practices. This importantly includes division of labour by gender, depending on whether it is males or females who have the predominant role in farming. Boster (1986) was able to describe how cassava cultivar stem cuttings and knowledge moved between female cultivators along kinship lines.

But what is additionally interesting about cassava is that from the 16th century onwards it spread throughout the rest of the tropical world, and by the late 19th century was established in eastern Indonesia. In a comparative study of the Nuaulu and Kei islanders in 2009, Hermien Soselisa and I found similar patterns of transfer to those described by Boster for the Aguaruna, though with perhaps a less skewed gender distribution. What was additionally significant were the differences between Nuaulu and Kei. Nuaulu, living in humid tropical forest and traditionally reliant on sago palm for most carbohydrate, had relatively few cultivars, while in Kei, over 100 years of deforestation and consequent aridification had transformed the economy from one dependent on sago and other pre-Columbian cultigens to one in which cassava was king, and had been extensively diversified, especially in terms of the numbers of bitter landraces that performed better under arid conditions. Moreover, the shift from sago suckers to cassava stem cuttings was also a gender shift from entirely male control to predominantly female control of germplasm (Ellen & Soselisa 2012; Ellen *et al.* 2012; Soselisa & Ellen 2013).

SUCKERS

Compared to cuttings, bulbs and seeds, suckers – here exemplified by the sago palm *Metroxylon sagu* (Ellen 2006) – might seem unpromising material for social dissemination. Sago suckers (*Fig. 1c*) – shoots that are continuously branching off a stem at or below ground level – like the leaf sheaths that constitute the main stem, are mostly covered in thorns. There is just one variety that does not have thorns. Nevertheless, sago suckers are certainly tricky to handle, have to be carefully separated from the parent tree and usually wrapped in leaf sheath epidermis with the thorns pointing inside rather than outside, and secured tightly with a piece of rattan or liana. In this way they

can be moved from place to place and planted in a convenient new location. Sago suckers move around Nuaulu villages between relatives, but are less likely to move further afield, to change hands for cash or barter, and therefore we might expect that their wider dissemination within a region is much slower. As long as the palms producing the suckers do not flower, fruit, and produce seedlings, the genetic composition of the clone will remain stable and there is some evidence that clonal stability has been achieved over many hundreds of years. As a trope, the sago palm, with its numerous suckers and phenotypic continuity over generations, is widely compared to patrilineal descent lines, the removal of suckers from a parent tree to clan segmentation, and the relationship between suckers from the same palm to siblinghood, a figurative language widely found amongst the sago-peoples of lowland Melanesia (e.g. Gell 1975, 144).

The resistance of the physicality of suckers and cuttings to the market can also be seen in advanced economies. Indeed, kinship and friendship are no less important for the dissemination of vegetative propagules amongst houseplant-keepers in East Kent than amongst Nuaulu sago extractors and Kei cassava farmers. In a study with Réka Komáromi (2013), we were able to show how householders reconstruct networks of kinship and friendship through their houseplants, in terms of what they had both given away and what they had acquired, and how certain forms of propagation were more amenable to social dissemination than others. Amongst allotment-keepers, raspberry canes (in some respects like sago suckers) move through friendship networks and those renting contiguous plots (Platten 2013). These provide a robust means of social storage, re-distribute both germplasm and knowledge diversity, and are a reservoir of variation as conditions change. As in traditional societies, most management knowledge rests in individuals, who transmit this through distributed kinship and friendship links.

In both the studies with Komáromi (Ellen and Komáromi 2013) and with Platten (Ellen and Platten 2011) we were able to show the importance of "tolerated taking", that is, movement of plant germplasm through the removal of cuttings (especially in private and public gardens) where no permission had been explicitly granted, but where there was widespread tolerance by owners of the practice, either because policing such low-level theft was considered not worth the effort, to avoid accusations of stinginess, or because a positive social value was placed on the spirit of generosity that acceptance reflected. The concept, which appears to have its origins in behavioural ecology (Blurton Jones 1987), might be seen as a more benign and socially acceptable instantiation of what Marshall Sahlins (1965) called "negative reciprocity". Empirically, it is clear that an enormous amount of germplasm circulates in this way, in all agricultural societies, in some cases with attempts to reduce it through social control. Under capitalism, and for seed, like many forms of informal circulation, tolerated tak-

ing or theft provides an additional hazard, in threatening standardisation of quality and undermining brand position in the market.

DISSEMINATION, TRANSMISSION, AND STORAGE

We can see that the redistribution of domesticate germplasm of any cultigen, and hence cultivar variations, is inevitably related to human movement, whether inadvertent or deliberate, but it also depends on evolved forms of plant reproduction and their different properties. To summarise, seed is the most resilient form of germplasm, and different forms of vegetative propagule vary greatly in their ability to move effectively through human systems (Ellen & Platten 2011). Moreover, although vegetative propagules can be selected for and managed to improve their efficiency, and technology applied to do so further, on balance it is usually more labour intensive than seed propagation and therefore more expensive for the farmer. For example, Carl Zimmerer (1991, 39) found that among Andean Aymara-speakers, maize seed was distributed much more frequently, easily, and widely than potato tubers. However, although seeds are highly convenient when it comes to transport, long-term survival, and dispersal, it is likely that some of the major vegetal successes – such as cassava, taro, and banana (triploid and sterile), spread through dissemination of vegetative propagules. Cassava, as we have noted, first made its way gradually to Southeast Asia as stem cuttings, both from West to East and from East and West, as slave food. Only in the 19th century was it taken seriously by Dutch colonial agricultural extension officers, who produced new varieties that they encouraged farmers in the East to plant. But once cassava was in, say, the Kei islands, it reproduced entirely through stem cuttings, and moved around the islands in that way.

In addition to ease of dissemination, storage potential is also a key difference between seed and most vegetative propagules. Seeds are easier to store than vegetative propagules, and most literature on plant storage concerns grains and pulses, directly destined for food rather than put aside for crop propagation, for which the environmental requirements are often different (Howard 2017). Under normal conditions, Baduy rice barns in upland west Java (Iskandar & Ellen 1999, 121) contain many more types of rice than are necessarily used in any one year, some bunches of which have been stored for up to 90 years and yet still maintain their viability. Under *ex situ* conditions we have, of course, the Millennium Seed Bank, the Svalbard Global Seed Vault, and exceptional examples of dormant prehistoric seed being resurrected (e.g. Yashina *et al.* 2012; and for cultigen seed, the example of a 2,000 BP date palm, mentioned by Hanson 2015, 85–89). By contrast, while the germplasm of many clonally reproducing crops cannot easily be stored *ex situ*, and the technical problems are much greater

(partly due to higher moisture content: see e.g. Flach & Rumawas 1996, 25), it is transmitted instead through live-storage in fields, by periodically supplementing planted cultivars from wild stock (as with sago), or through social storage, either relying on others to plant cultivars or by keeping germplasm in constant circulation.

CLONAL AND SEED DIVERSITY

Finally, we need to take a look at cultivar diversity (Ellen 2020). It might be thought that seeds are better at producing useful diversity, though in a lot of national collections of domesticates this diversity is effectively located in the growing plants rather than the seed. For example, at the British national collection of fruit trees at Brogdale in Kent (Brogdale Horticultural Trust 1998), the varieties are maintained by grafts on rootstocks, and it is the grafts that are circulated, thus "by-passing" the seed stage (Boyer 2014, 98). This "by-passing" is critical to maintaining phenotypic clonal diversity, for where clones of – say – cassava or sago are left to flower, fruit, and disperse as new plants, the very virtues that farmers seek and actively manage (whether consumption virtues such as taste, or production virtues such as pest-resistance) will likely be lost. Looking at seeds *sensu stricto* in his Andean study Zimmerer (1991) found 21 cultivars per field for potato, but only 2.9 cultivars per field for maize. If we compare Nuaulu basic starch crops (*Table 2*), non-seed producing cultigens contain much more diversity than those reproducing by seed (compare taro, cassava, yam, banana, and sago with rice and maize). This pattern is reflected in nomenclatural data from other studies (*Table 3*), though Baduy rice diversity is exceptional at 89 landraces, as is rice in general.

Table 2. Numbers of locally named landraces for selected Nuaulu cultivated plants (modified from Ellen 2006).

Species	English name	No.
Musa x paradisiaca	banana and plantain	37
Dioscorea alata	greater or purple yam	11
Metroxylon sagu	sago palm	11
Manihot esculenta	cassava or manioc	11
Cocos nucifera	coconut palm	10
Capsicum annuum	chilli pepper	9
Colocasia esculenta	taro	9
Dioscorea esculenta	lesser yam	8
Areca catechu	betel palm	5

Table 3. Numbers of named landraces for selected domesticates in various study populations (modified from Ellen 2006).

Species	English name	Number of landraces	Location	Sources
Oryza sativa	rice	89	Baduy, West Java	Iskandar & Ellen 1999
Ensete ventricosum	Ethiopian banana	71	Ari, Ethiopia	Shigeta 1996, 236–239
Ipomoea batatas	sweet potato	64	Wola, New Guinea	Sillitoe 1983, 29
Manihot esculenta	cassava	50	Aguaruna, Peru	Boster 1984, 38–39
Pandanus brosimos, P. julianetti	screwpine	45	Wola, New Guinea	Sillitoe 1983, 45
Colocasia esculenta	taro	43	Wola, New Guinea	Sillitoe 1983, 37
Solanum tuberosum	Irish potato	30–40	Quechua, Peru	Brush 1991, 156
Cocos nucifera	coconut	14–17	Kerala, India	Thampan 2000
Zea mays	maize	12–17	Tzeltal, Mexico	Brush 1991, 158
Cocos nucifera	coconut	9–13	Solomons	Eyzaguirre & Batugal 1999
Saccharum officinarum	cane sugar	12	Wola, New Guinea	Sillitoe 1983, 84

Whether as seeds or vegetative propagules, high levels of diversity have the effect of buffering adverse short-term ecological conditions. As conditions change so traditional farmers such as the Baduy and Kei Islanders vary the proportion of different cultivars in their fields, and how groups of cultivars are arranged within a field. High levels of diversity are achieved through planting a wide range of cultivars in a given year, in the same field or over a number of fields. But as we have seen, in the case of seed crops diversity can be enhanced by long-term storage of germplasm, while diversity in clonally reproducing crops has in many cases to be in the form of live storage in the fields. While much selection and incorporation of individual cultivars in a local inventory is calculated and deliberate, it has been widely reported that many populations encourage variation for its own sake. There, is in other words, an "aesthetic of diversity", reflected and supported through distinctive moral regimes (Ellen 2017). Thus, the maintenance of diversity itself can be a key factor in long-

term adaptation. We can see this in the example of Baduy rice, but also in Nuaulu sago and in Kei cassava.

A major environmental hazard influencing diversification of crop cultivars has been aridification, accentuated through global warming and other biocultural features of the Anthropocene. One of the reasons why cassava spread so widely out of its area of endemism in north-west Amazonia was its flexibility as a crop, and particularly its tolerance of dry conditions. A key feature that makes this possible is high levels of HCN (hydrogen cyanide). This serves to combat competing pathogens and thus confers an advantage in dry zones. The range of HCN toxicity is wide in cassava, but in dry areas toxicity tends to be higher and the ecology selects for cultivars with high HCN concentration. Farmers in Africa, Indonesia, and elsewhere have learned to take advantage of this and deliberately favour high toxicity cultivars. Thus, in the Kei islands there are as many high toxicity cultivars (*enbal*) as low toxicity cultivars (*kasbi*) (Ellen & Soselisa 2012; Soselisa & Ellen 2013). In a comparative study of Kei and Nuaulu cassava diversity, Ellen, Soselisa and Wulandari (2012) used DNA evidence to show that the close genetic relatedness between most of the larger number of Kei cultivars and a distant genetic relatedness between all of the smaller number of Nuaulu cultivars, strongly indicated that Kei farmers were much more active in selecting propagative material than Nuaulu, who – living in a less arid area – were far less dependent on the crop.

THE BIOLOGICAL AND SOCIAL IMPLICATIONS OF NON-SEED PLANT REPRODUCTION

A seed is actually a risky form of reproduction compared with vegetative propagules – an r strategy rather than a K strategy (Pianka 1970) – in which survival of the genetic line is reliant on the production of huge quantities of replicators rather than heavy investment in just a few. With vegetative reproduction, all the hard embryological and maturational work has been done, and there is a much greater chance that a clone will grow to produce its own seeds or clones. For as long as variation within cloned cultigens is not sexually transmitted, the original genome is maintained, and so is available for future manipulation, unless the ability to flower has been completely lost, as sometimes happens. A stem clone contains all the same genetic information as a seed, but a crop when planted through clones will usually only reveal the characteristics of a particular phenotype of the individual parent plant. If the plant goes to seed there is no guarantee that it will reproduce in exactly the same form as the parent clone. This issue of predictability is one that Nuaulu sago cultivators face all the time, both a problem and an advantage, as the unpredictable reproductive outcomes of wild sago that has gone to seed are also opportunities for new and interesting clones. This same

phenomenon is why, under capitalist market conditions, vegetative reproduction is problematic: the seed is not guaranteed to breed true. When particular clones become extinct there is no certainty that they will re-appear; if mature sexually reproduced cultivars become extinct we at least have their seed.

In botanical terms, a comparison of *Metroxylon sagu* (a slow-growing perennial), with say rice or maize (annuals) may seem invalid without a discussion of such matters as generation length and breeding systems. However, my starting point has been ethnobotanical: people's recognition and codification of diversity, and what they make of it, and what we might learn from it. Therefore, despite evident genetic variability within the species, cultigens such as sago, managed for their starch, diversify and form stable cultivars somewhat less than other cultigens. In vegetatively reproducing starch crops, such as taro (Matthews 2014), selection is for the most part of somatic mutations through continuous propagation, and with very high numbers of local named clonal cultivars. By comparison, the sago palm, which in anthropogenic contexts reproduces mainly by vegetative means, is disproportionately sustained as a reproductive strategy by human harvesting before fruiting and the deliberate transplanting of suckers, but has relatively fewer distinct cultivars. Grains such as rice and maize are selected mainly on the basis of sexual recombination. In the Andean study by Zimmerer (1991) potatoes appeared to be selected for diversity, while maize was selected for specific characters. Amongst Andean farmers, Zimmerer (1991) notes, potato selection tends to be for perceptual difference, while maize selection is for direct consumption and production traits.

THE SIGNIFICANCE OF CLONAL CROPS

In this chapter I have tried to make the case for the importance of vegetative plant propagation, both in colonising the world and in shaping the Anthropocene, and would suggest that these two processes are closely connected. The development and history of agriculture and food cultures in whole regions of the world is heavily influenced by the significance of clonal crops: Amazonia, Oceania, and Melanesia for a start. In vegetative reproduction there is no temporal break in the life cycle of the plant of the kind precipitated by seed dormancy. Instead, vegetative reproduction compresses the time taken to produce food by removing the seed stage, the plant becoming, as it were, a "'never-ending perennial" (Boyer 2014, 98–99). Vegetative propagation underpins much human production capacity, but also reveals how different social mechanisms assist this process. Tubers, roots, rhizomes, and bulbs, no less than seed, are implicated in intimate relations of biocultural mutualism with human social and technical practices.

I am of course being deliberately provocative here, and perhaps even "over-egging the pudding", since I broadly accept the hegemony of the seed narrative. But quite apart from redressing the balance in our interpretation of the science of plant reproduction and its impact on human lifeways and economy, it reminds us of the trap entailed in confusing the genetic with the biological (Ingold 1990; 2007; 2011, 9; also Palsson 2013), of assuming that the world around us is simply the unfolding of genetic determination, when in fact what we see and experience is the outcome of complex ontogenetic processes in which genes play an important but not an overwhelming part. Genes, like seeds, and like cells, are powerful tropes, each of which have successively and successfully captured our imagination. All are tiny entities that seem to contain within themselves everything we need, and are conveniently manipulable. We fall for the illusory supremacy of both gene and seed at our peril, as these disguise the very complexity of life processes necessary to adapt to rapidly changing conditions. We need to recognise that the agency in plants will simply seek to reproduce itself in the most efficient way, that it is unwise to always privilege Henk Beentje's "integumented megasporangium", and that we must not forget the vegetative propagules and their many virtues. We will need all the biocultural resources we have to survive the Anthropocene.

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KAJ ÅRHEM

Seed as signs: Seed symbolism and the "flow of life" in Southeast Asia

> "For this young man and woman, let one embrace the other, and one cling to the other, so that the shoot of the coconut may grow, and the germ of the areca nut may sprout, so that she may give birth to nine times nine children..."
>
> (Part of a ritual formula used at the Rotinese wedding ceremony quoted in Fox 1971, 236)

Seed is, probably universally, a potent symbol of bio-social reproduction – of life, growth, and renewal. As such, it figures as signs in cultural-semiotic systems around the world. It is, therefore, relevant to introduce a cultural perspective on seed and some ethnographic examples of seed symbolism. I will focus on seed symbolism in societies in Southeast Asia that practise what anthropologists usually call asymmetric marriage or asymmetric alliance.[1] It is particularly widespread and socially important in Southeast Asia. As a shorthand, I will refer to societies practising this type of marriage as *asymmetric societies*. Specifically, the chapter examines the ritual significance of plant seed in the context of asymmetric marriage. A fundamental premise of asymmetric alliance systems is the division of affines – that is, actual or potential relatives by marriage – into two strictly separate categories: *spouse-givers* and *spouse-takers*. The result is a one-way transfer of spouses between social groups that, in Southeast Asia, is widely conceptualised as the "flow of life".

I will draw on ethnographic material from eastern Indonesia, exemplified by the patrilineal – meaning that descent is traced through the paternal line – Rotinese people living on the island of Roti south-west of Timor. As a contrastive case, I will also introduce comparative data on the matrilineal – implying that descent is traced through the maternal line – Khasi people living in north-east India. Both among the Rotinese and the Khasi, the ritual treatment of seed plays a significant role in marriage exchange. For the ethnography on eastern Indonesia I rely mainly on the contributions in the volume with the telling title *The flow of life* (1980a), edited by James Fox, and an earlier

1 Lévi-Strauss (1969) refers to this type of marriage as "generalized exchange".

paper by Fox (1971). For the Khasi, I use original sources spanning a century from the early 1900s to the present: mainly Gurdon (1907), Roy (1938; 1963), Nakane (1967) and Nongbri (2013); see also Århem (2000).

In addition to this body of published material, my analysis is informed by my own research over the past two decades among the upland Katu in central Vietnam (Århem 2006; 2010; 2016; and forthcoming). The patrilineal Katu practise asymmetric marriage and, as in the case of the Rotinese and the Khasi, Katu matrimonial exchanges involve the ritual exchange of cultivated plant seed, notably rice. On the whole, the material from eastern Indonesia and north-east India resonates strongly with my own data on asymmetric alliance and its cultural expressions among the Katu.

ASYMMETRIC MARRIAGE EXCHANGE

In patrilineal societies practising asymmetric alliance, the marriage system is conveniently characterised in terms of an exchange of women between wife-giving and wife-taking groups: men marry ("take") women from wife-giving groups and, concomitantly, "give" kinswomen to wife-taking groups. The system implies that women "move", as it were, unidirectionally from wife-giving to wife-taking groups. Reversal of the direction is generally strongly condemned; there should be no direct reciprocity, no reciprocal exchange of women. Hence asymmetric marriage.

The ideal form of marriage for a man is to marry a real or classificatory *mother's brother's daughter* or matrilateral cross-cousin. Marriage with a *father's sister's daughter* or patrilateral cross-cousin is prohibited or strongly discouraged. When marriage with a mother's brother's daughter occurs, the affinal bond between allied houses tends to be close and systematically repeated. It is, as it were, inherited. However, a man must not necessarily marry a true matrilateral cross-cousin. It is sufficient that he marries a woman from a wife-giving lineage since his preferred father-in-law, a real or classificatory maternal uncle, always falls in the category of wife-givers. Consequently, an unmarried female cross-cousin on his mother's side is always a potential wife.

Among the Austronesian groups, the wife-giving and wife-taking groups generally correspond to local patrilineages, each inhabiting a particular house or residential compound – and are therefore usually referred to by the vernacular term for "house" (*uma* in Rotinese). In Southeast Asia, the relationship between wife-giving and wife-taking houses is invariably hierarchical. Wife-givers are regarded and treated as superior to their wife-takers. However, this asymmetrical power relation is intransitive: it does not automatically carry over to other spheres of society and does not form the basis of society-wide political hierarchies. The ritual superiority of the wife-giving house is internal, as it were, to every particular marriage alliance. In practice, every house

has a number of different wife-givers and wife-takers, each marital alliance implying a separate power asymmetry.

Asymmetric marriages are – at least in patrilineal systems – accompanied by an obligatory exchange of standardised gifts between the affinal parties. The groom's house pays a bride price to the bride's house and, reciprocally, the bride's house pays a dowry accompanying the bride in the reverse direction. This gift-exchange is also asymmetric. The gifts that move in opposite direction are necessarily different and "gendered". The bride price has strong male connotations – large livestock, precious metals, weapons, brass gongs, and so on – while the dowry consists of "feminine" objects, notably woven cloth, rice, and sometimes pigs. This obligatory exchange constitutes a standardised exchange code which, in its essentials, is remarkably enduring and shared among the patrilineal asymmetric societies across Southeast Asia. Among the Katu in Vietnam, for example, people strictly adhere to this exchange code today (Århem 2010; 2016). Nevertheless, the quantities of objects exchanged and the specific objects subsumed under the gendered categories are likely to change over time and vary between groups.

EASTERN INDONESIA: ASYMMETRIC MARRIAGE AS THE "FLOW OF LIFE"

In the now classic volume *The flow of life*, James Fox (1980a) has collected a series of studies on asymmetric societies in eastern Indonesia. In it, he shows that that there are important similarities between these societies in terms of how they conceptualise asymmetric marriage- and alliance relations. I think we can extend Fox's findings to asymmetric societies beyond eastern Indonesia to also include asymmetric upland societies in mainland Southeast Asia, suggesting that we can effectively talk about a generic cultural model which, in its essentials, is shared across the whole asymmetric domain of Southeast Asia. The key idea of this model in both patrilineal and matrilineal societies is the notion of the "flow of life".

The Austronesian-speaking Rotinese provide a particularly clear example of this model in its patrilineal version. As such they largely typify the patrilineal Austronesian societies in the region. The Rotinese cultivate a mixed range of crops, including rice as a staple, but also depend heavily on lontar-tapping for subsistence and cash.[2] They also keep livestock, horses, and pigs. The population is subdivided into hierarchical polities, each centred on a chief or lord. Clans and lineages are patrilineal, meaning

2 *Lontar* is a sugar juice from a Borassus palm (*Borassus flabellifer L.*), cooked to a syrup, stored and consumed daily as food; fermented to beer, and distilled to a gin drunk at social gatherings (Fox 1971, 223).

that names, offices, land, and property are inherited in the paternal line. Apart from the chiefly clan, there are various high-ranking aristocratic clans and low-ranking commoner clans (Fox 1971; 1980b).

A fundamental feature of the generic model of asymmetric alliance is that marriage is understood as the transmission of life, where "life" stands for fertility and reproductive power. In the patrilineal version of the model, life is conceptualised as uterine or maternal blood transmitted, through marriage, from wife-givers to wife-takers, and – through uterine affiliation – from mother to child. It is this maternal blood that, mixed with paternal semen, constitutes a new person. In this way, the life-giving blood flowing from wife-givers to wife-takers converts the marital bond into a relationship by blood, literally turning affines into blood relatives (consanguines). Transmitted from mother to daughter and from daughters to grand-daughters along the female line, this fertile fluid creates a maternal "blood line" – a subdued and ephemeral matriline – that is recognised by the patrilineal Rotinese as the "path of life". The flow of life between intermarrying houses and the resulting uterine path of life ensure the fertility and continuous reproduction of the patrilineages that constitute the basic building blocks of (patrilineal) Austronesian societies in the region.

Among the Rotinese, there is another set of images that describes the asymmetric marriage, not in terms of transmission of blood but as an exchange or transfer of plant seed between intermarrying houses. Thus, as a preliminary to marriage, the man requests "seed" from the house of his prospective father-in-law, who ideally is his maternal uncle. Although the term for seed here refers to a specific class of cultivars, the context makes it clear that seed is used as a metaphor for the reproductive potency embodied by the future bride (Fox 1971, 222).

The seed imagery is thus roughly consonant with, and complementary to, the image of uterine blood flowing from wife-giver to wife-taker. But while the blood imagery primarily evokes the link between mother and daughter, the seed imagery establishes a consanguineal – and at the same time affinal – bond between maternal uncle and his sister's child, particularly his maternal nephew who is, ideally, also his future son-in-law. Consistent with this botanic idiom, the maternal uncle refers to his sister's child as his "plant". As different from the blood imagery, the seed/plant imagery is performative and future-projected. The maternal uncle is understood to ritually "plant" and make his sister's child "grow" into a mature plant. The full significance of this botanic – or planting – idiom becomes comprehensible as we examine the nature of the relationship between mother's brother and sister's son.

The maternal uncle among the Rotinese effectively acts as a ritual guardian of his sister's child. At, or even before, the birth of a child, a specific maternal uncle is chosen for this role – a function he is expected to exercise from the child's birth to his/her

death. As ritual guardian, the chosen maternal uncle will be responsible for the health and wellbeing of his protégé(e). To this end, his duties include the sponsorship of important rituals at the birth, marriage, and death of his sister's child – his plant. His role at these life-cycle rituals is central. If he fails to perform them properly, his status as spirit guardian is forfeited, and he will be replaced by another, carefully selected, maternal uncle (Fox 1971). [3]

An analogous ritual relationship between mother's brother and sister's son is common throughout the asymmetric domain of Southeast Asia, including a number of the patrilineal upland groups, the so-called "hill tribes", in mainland Southeast Asia (particularly in Upper Burma/Myanmar, Laos, and Vietnam). Thus, among the Lamet (or Rmeet) in Laos, when a child falls seriously ill, the maternal uncle of the child is called to perform curing rituals for the same reason – that is, because he is regarded as ritual guardian of his sister's children. And, if a married woman remains childless for an unusually long time after marriage, the husband turns to his wife's brother or father to perform a sacrifice for the childless couple, requesting aid from the ancestors (Izikowitz [1951] 2001, 93, 103). This is also the case among the Katu and related Katuic groups in Vietnam and Laos. In all these patrilineal cases, the wife-giving house – which includes the real or classificatory maternal uncle – plays an exceedingly important ritual role for the children of their wife-taking houses.

The reason for this close relationship between the maternal uncle and his sister's child is that the maternal uncle is regarded by his nieces and nephews as their "source of life". Among the Rotinese, he is referred to as "the maternal uncle of origin" or "maternal uncle of the root". The maternal uncle and *his* living and dead maternal uncles are contextually referred to as "spirits" – representing the ultimate source of all life. Life, fertility, and vitality flow from the maternal "grandfather of origin" to the maternal "uncle of origin" along the path of life to his living (and future) uterine descendants, who are, at the same time, relatives by blood and by marriage (Fox 1980b, 118–119).

It is therefore easy to see the mother's brother-sister's son relationship among the Rotinese and other patrilineal asymmetric societies in Southeast Asia as a male version of the protective, caring, and nurturing relation between mother and child. Although the avuncular relationship in this case is an affinal relationship in that it is mediated by a marital alliance, it is also a consanguineal kinship relation with an evident maternal quality. Among the Rotinese, this maternal quality is conveyed by the botanic idiom in which the avuncular relationship is cast, namely as one between planter and plant, in a cultural context where women are prototypical cultivators.

3 Given the generational difference between uncle and nephew, the role of ritual guardian is regularly inherited, ideally by the uncle's eldest son. This is particularly likely to be the case in the context of the funerary ritual of a deceased protégé(e) (Fox 1971, 228).

It is therefore significant that, in rice-growing societies across Southeast Asia, women commonly speak of their rice plants as "their children". Concomitantly, women are themselves widely referred to as "mothers of rice". According to the same symbolic logic, the spirit of rice is often identified as the "grandmother of rice" (such is the case, for instance, among the upland Katu in central Vietnam; cf., Århem 2006). These symbolic associations suggest an analogy between, on the one hand, a woman's caring and nurturing relationship to her cultivated plants, particularly rice, and, on the other hand, the maternal uncle's ritual relationship to his sister's children – his metaphorical plants. The maternal uncle, then, is a kind of male mother to his sister's children whom he has planted and ritually cultivated.

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Summing up our observations so far, three points stand out regarding the patrilineal version of the asymmetric model: first, life in the organic sense of fertility and vitality is symbolically associated with the transient and corporal aspects of the physical person – the body – and, as such, with the biosocial cycle of birth, growth, death, and renewal. Life-giving vitality in this sense is metaphorically represented in terms of two separate, gendered, and complementary images – uterine blood and plant seed. Both imageries imply a transfer of substance from wife-givers to wife-takers. As life-giving blood embodied by fertile women, it flows from wife-giver to wife-taker through the marriage relationship, and from mother to child along the uterine path of life. As seed, given as part of the dowry from wife-givers to wife-takers, it evokes the future birth and growth of a human child, ritually planted and cultivated by a maternal uncle who acts as a male mother and ritual guardian for his sister's children.

Secondly, if, as is widely the case in Southeast Asian patrilineal societies, the vital but perishable element of the human person – the body – is derived from the life-giving blood transmitted from mother to child, the intangible, spiritual component of the person – the soul – is conveyed from father to child. Metaphorically represented by the imperishable bones that remain after death and the decomposition of the body, the soul constitutes the enduring agnatic identity of the person. As opposed to the transient and socially subdued uterine path of life, the patrilineage is the basic and lasting building block of society. Conceptualised as a timeless agnatic community of souls, the patrilineage defines the social self.

Thirdly, the affinal alliance relationship between wife-giving and wife-taking lineages is a relation between the social self and social others. As such it is hierarchically structured. In Southeast Asia, the wife-giving group is invariably regarded as superior to the wife-taking group. This ritual superiority of the wife-givers is directly related to

their association with the vitality conveyed by fertile uterine blood and the generative potency of seed: as wife-givers, they are life-givers.

A MATRILINEAL CASE: THE KHASI OF NORTH-EAST INDIA

The matrilineal Khasi inhabiting the uplands of north-eastern India provide a contrastive case. The Khasi are a Mon-Khmer speaking group practising asymmetric alliance.[4] Like most traditional Austronesian polities, Khasi society is a moderately stratified agricultural society, hill rice being the traditional staple. The population is divided into a number of petty chiefdoms, each ruled by a sovereign (*siem*) of chiefly clan. Succession to siemship – and to political offices generally – follow the matriline. Aside from the chiefly clan, there are high-ranking aristocratic clans, a priestly clan, and commoner clans of different ranks. Thus, except for the fact that the Khasi are a matrilineal people, their autochthonous sociopolitical organisation is – or was in the past – comparable to the patrilineal asymmetric societies of eastern Indonesia reviewed above.

The Khasi people are conventionally divided into five subgroups (Upland Khasi, Jaintia or Synteng, War, Bhoi, and Lynngam), all speaking fundamentally the same language although with considerable dialectical differences (Nakane 1967). Cultural traditions also vary between subgroups, including details of marriage practices and the inheritance- and succession rules. The following account mainly refers to the Upland Khasi living in what is considered the traditional heartland of Khasi culture (Gurdon 1907; Roy 1963; Nongbri 2013). With the exception of Nongbri (2013) and Nakane (1967), my sources refer to the situation in the Khasi Hills during the first half of the 20th century, and obviously much has changed since then. Already by the mid-1950s, when Nakane carried out her fieldwork in War country, most of the Khasi were nominally Christians. The traditional economy of the Upland Khasi, based on swidden cultivation of rice, millet, and other native crops, had been more or less completely replaced by the cultivation of potato, introduced by the British in the 1830s as a new staple and cash crop (Nakane 1967, 98). Nevertheless, the workings of the matrilineal

4 This assertion may be seen as controversial. Nakane (1967), for instance, affirms that the Khasi, as opposed to their matrilineal neighbours, the Garo, do not practise asymmetrical alliance. However, her analysis of the Khasi marriage system is narrowly focused on the non-prescriptive kinship terminology; she does not give proper consideration to the broader classificatory system of the Khasi social universe and, particularly to the division of the affinal category (*kha*; literally social "others") into spouse-givers and spouse-takers (*kpa kha* and *khun kha* respectively) which must be regarded as the diagnostic feature of any asymmetric marriage system (Århem 2000, 101; Roy 1963; Nongbri 2013).

descent system and asymmetric marriage system remain remarkably stable and consistent.

Matrilineality among the Khasi implies that property, including land and house, is transmitted matrilineally from the female head of the house to her youngest daughter – the heiress – at the exclusion of all her other children. The disinherited elder sisters of the heiress have to establish their own households, usually in the village of their mother. The Khasi make an important distinction between the property owned collectively by "the house" (*iing*), inherited exclusively by the heiress, and property acquired by individual household members which can be more freely bequeathed to their children, including from father to sons. However, all lineage members generally have use-rights in clan-land and/or communal village land, allowing them a modest subsistence. Ritual authority is vested in the youngest daughter; it is she who takes care of all rituals of the local lineage segment occupying the house. Political authority, by contrast, is vested in the men of the matrilineage and transmitted from maternal uncle to sister's son.

The intermarrying units are the local lineage segments – also referred to as houses (*iing*). As in all asymmetric societies, the social universe is divided into spouse-givers and spouse-takers. But, as distinct from the patrilineal case where it is convenient to refer to these mutually exclusive categories as wife-givers and wife-takers, in matrilineal societies like the Khasi it is more appropriate to call them husband-givers and husband-takers. Among the Khasi, the vernacular term used for husband-givers is "fathers" (*kpa kha*) while husband-takers are referred to as "children" (*kun kha*). As among the Rotinese and other patrilineal asymmetric societies in Southeast Asia, and as implied by the vernacular Khasi terms, the spouse-givers ("fathers") are regarded as socially senior and superior to the spouse-takers ("children") (Gurdon 1907, 211; Roy 1963, 522; Århem 2000, 101; Nongbri 2013, 418–419).

Marriage is generally uxorilocal – the couple live with the wife's family – and invariably so in the case of marriage with an heiress. The groom moves to his bride's house soon after the formal but relatively simple wedding ceremony which takes place in the bride's house. The couple exchange bags of betel nuts and, formerly when they could afford it, silver or gold rings. Rice wine, supplied by both families, is poured on the ground by the officiating priest and a fowl or pig sacrificed to the ancestors of both families, pleading for the future wellbeing of the couple and the fertility of the union (Gurdon 1907, 130–131).[5]

5 Khasi marriage practices are currently undergoing momentous changes. There is also a great controversy about marriages between Khasi women and non-Khasi men – a politically charged and hotly debated issue in Khasi society today, linked to questions about alienation of indigenous lands.

Although Gurdon describes the wedding ceremony as a reciprocal exchange of seed (betel nuts) and wedding rings, the symbolic discourse that legitimises Khasi marriage practices is formulated in terms of an asymmetric exchange of seed. Thus, while the preferential norm of matrilateral cross-cousin marriage encourages marriage with a woman of the children category (husband-takers), it strongly disapproves marriage with a woman of the father category (husband-takers). This disapproval is justified on the grounds that it is wrong for "children" to give seed to the house of the "fathers" (Roy 1938, 130). Roy, a native Khasi scholar, explains this injunction by stating, in a rather abstruse manner, that "no seed, e.g., seed of trees, rice, cucumber, pumpkins, shrew or Job's tears, or millet, [can be] taken from the children of the son by the family of the mother of that son without payment" (Roy 1938, 130). In other words, no seed should pass from "children" (husband-takers) to "fathers" (husband-givers).

This cryptic passage suggests that the Khasi metaphorically equate semen with seed, thus implying that for a man to marry into the father category would be like returning the seed/semen received from the "fathers" (i.e., the husband-giving house); it would "make everything foul, defiled and corrupt" (Roy 1938, 130). To marry a woman from the father's house would be to reverse the flow of life – in this case conceived as a flow of paternal semen. The Khasi sociologist Tiplut Nongbri (2013) sheds additional light on this issue. She observes that the Khasi regard father's-sister's-daughter marriages with strong aversion since it reverses "the gift of sustenance and life" that a son has received from his father. The gift of life here refers to the procreative power provided by the husband in the conjugal union and is symbolically represented in Khasi culture as a transfer – a gift – of rice from "fathers" to "children". Nongbri notes that, among the Khasi, rice is used as a common metaphor for "husband" (Nongbri 2013, 417, n. 1) – which would seem to be a circumlocution for "semen". Thus, marriage with a father's sister's daughter is disparagingly spoken of as "an exchange of rice" and thus a direct, reciprocal exchange of husbands between the two houses. This "unflattering phrase", she continues, "carries the connotation of an improper act that takes away the merit of the relation", cancelling, as it were, the social value of the marital alliance (Nongbri 2013, 417). It negates the asymmetric marriage rule and reverses the flow of life.

In other words, just as seed/blood in the Rotinese case is symbolically associated with the life-giving potency transmitted from wife-givers to wife-takers, the seed/semen association in the Khasi case refers metaphorically to the procreative potency transferred – by men – from husband-givers to husband-takers (Århem 2000, 101). Significantly, in the metaphoric language of bodily substances, procreative power is thus identified with maternal blood in the case of the patrilineal Rotinese, while it is identified with paternal semen in the case of the matrilineal Khasi.

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The Khasi say that the human person is constituted by a spiritual element, the soul, derived from the mother's milk during infancy and associated with the bones that remain after death and cremation, and a physical element, the body, which is derived from the father's semen and perishes at death. While the spiritual element (immortal soul) is transmitted matrilineally from mother to child, the physical element (corporal vitality) is transmitted agnatically from father to child. Uterine relatives – relatives by soul – are said to be born "from the same womb" and "suckled of the same breast" while agnatic relatives, sprung from the same paternal seed/semen, are regarded as "relatives of one umbilical cord" (Roy 1938, 124). This seemingly paradoxical metaphor for the agnatic relationship is, at the same time, strangely appropriate since it expresses the ephemeral nature of the agnatic link. Just as the umbilical cord is cut at birth, so the agnatic bond is severed at death (Århem 2000, 108). It is perhaps significant in this context that marriage with an actual matrilateral cross-cousin is only allowed after the death of the maternal uncle – that is, when the agnatic link between the prospective spouses is severed (Gurdon 1907, 78; Århem 2000, 102, 104).

The notion of the "umbilical cord" – the agnatic line of seed/semen – among the matrilineal Khasi would seem to be the precise counterpart to the uterine path of life/blood among the patrilineal Rotinese. Just as the Rotinese person receives life and vitality (blood) from the mother, the Khasi person receives life and vitality (semen) from the father. And just as the affinal relatives by blood among the patrilineal Rotinese constitute a uterine and ephemeral shadow line (the path of life), the affinal relatives by seed/semen among the matrilineal Khasi form a subdued and transient patriline (the umbilical cord).

While marriage among the Khasi is a relatively simple and unceremonious event, death is the occasion of an exceptionally elaborate ritual process involving cremation and secondary burial. In the past, the funerary process extended over several years and included the erection of a whole series of imposing memorial stone formations (Roy 1963; Århem 2000). The ultimate resting place of the bones of deceased matrilineal relatives is a tomb house of stone (*mawbah*; literally "great stone"), which is symbolically equated with the celestial abode of the maternal ancestors, the house of god (*Iing U Blei*). In it, the spirits of all the dead lineage relatives, who have been uxorilocally dispersed in life, are eventually reunited in death (Århem 2000, 128–129).[6]

6 It seems to me that there is, among the Khasi, a significant connection between the birth rituals, particularly the elaborate treatment of the placenta (Gurdon 1907, 124–126) and the protracted funerary process ending with the placing of the bones of the deceased in the lineage tomb. Thus, the ritual preservation of the placenta, which amounts to a kind of burial,

At the end of the protracted mortuary process, the relationship between the two affinal exchange units – "fathers" and "children" – is made explicit. A brief but, I believe, significant ritual dialogue then takes place, ostensibly to make account of the expenses related to the funeral:

> A senior representative of the "fathers" ask the "children" (the assembled members of the deceased's lineage): From where did you obtain the funds to arrange the funeral? The "children" answer: We have received it from you, "as it was left by you the father" (Roy 1963, 545).

The ethnographer here adds that the children must reply in this manner "even though they have borrowed [money] or taken on loan" – that is, even if they have received nothing from their "fathers" (Roy 1963, 545).

What this ritualised dialogue actually suggests, I believe, is that although the "children" (husband-takers) receive nothing – no material wealth or property – from their "fathers" (husband-givers), they nevertheless receive everything from them, namely life itself.

THE FLOW OF LIFE AND THE FERTILITY OF DEATH

By way of conclusion, we may reformulate and generalise our earlier observations on the patrilineal societies of eastern Indonesia. Thus, drawing on both patrilineal and matrilineal societies of the asymmetric domain in Southeast Asia, I have tried to show that the ritual transfer of seed and seed symbolism in connection with marriage is a recurrent feature in these societies and that, where an exchange of seed occurs, it passes from spouse-givers to spouse-takers. This transfer of seed is symbolically equated with the transmission of life, conceptualised as the flow of life.

The notion of life, understood as fertility and vitality, is associated with the transient, corporal aspects of the person – the body – and, as such, with the biosocial cycle of birth, growth, death, and renewal. By contrast, the intangible and enduring spiritual component of the human person – the soul – defines a person's lasting social identity. This enduring relationship by soul thus forms the basis for socially dominant institutional groupings – lineages, clans – while relations by body through the transmission of bodily substances – blood, semen – underlie the formation of the ephemeral and socially subdued links of affiliation that I call "shadow lines": the uterine "path of life"

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symbolically affirms the physical link to the father, the "umbilical cord", while the placing of the bones in the lineage tomb asserts the spiritual bond with the deceased's uterine relatives and, ultimately, with the maternal ancestor beings, U/Ka Blei – the male creator and the female preserver respectively. Thus, in death the Khasi attain the perfect lineage community they are denied in life (Århem 2000, 106).

among the patrilineal Rotinese and the agnatic "umbilical cord" among the matrilineal Khasi. Identification by soul is the hallmark of kinship in the sense of a relational "mutuality of being" (Sahlins 2013) – that which constitutes the social self. Identification by body, on the other hand, is characteristic of affinity, the relationship with social others through marriage.

In asymmetric societies, the affinal relationship is necessarily divided into two separate categories – spouse-givers and spouse-takers. The relationship between spouse-givers and spouse-takers is hierarchical. In Southeast Asia, the spouse-giving group is invariably regarded as superior to the spouse-taking group. This ritual superiority of the spouse-givers is directly related to the vitality and fertility they convey to their spouse-takers.

It is significant that the symbolic representation of the vitality conveyed through marriage differs between the patrilineal and matrilineal versions of the asymmetric marriage structure. In the patrilineal version, life and fertility is symbolically represented as uterine blood and plant seed transferred (via women) from wife-givers to wife-takers (from mother to daughter, and from maternal uncle to sister's child). In the matrilineal case, life and procreative power is metaphorically associated with paternal semen/seed, passing analogously (via men) from husband-givers to husband-takers (from husband to wife, and from father to child).

In both cases, life and vitality is metaphorically represented in a corporal idiom (blood, semen) as well as in a botanic idiom (seed). In either case, the spouse-givers are the source of life. The ritual and discursive transfer of seed makes this fundamental fact explicit: spouse-givers are life-givers. By supplying the seed of life, they ensure the continuing flow of life and, thus, the continuity of society.

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Widening the purview of our exploration beyond what I have called the asymmetric domain of Southeast Asia and its focus on the transfer of seed in connection with marriage, there are other fertile fields of seed symbolism in the region. The symbolic importance of seed in connection with marriage rituals may even seem a little trivial. After all, seeds are eminent symbols of life and fertility. More unexpected and even seemingly paradoxical is the widespread symbolic association between seed and violence – as in the practice of headhunting (or head-taking) which was common among indigenous societies in Southeast Asia until recent times. In most, if not all, the societies which practised the custom – many of them featuring asymmetric marriage systems – , headhunting was considered a life-promoting activity, believed to enhance life and fertility in the headhunters' community.

The connection between headhunting, female fecundity, and crop fertility is uni-

versally attested in the region. Head-taking generally involved raids on enemy groups – usually distant and unrelated people who nevertheless were regarded as a potential source of marriageable women – to capture heads which were then brought back to the raiders' home community for ritual treatment. Downs (1955) quotes mythical narratives from the Solor archipelago in eastern Indonesia suggesting that head-taking was conceived of as a male form of agriculture. In one myth, the hero is exhorted by the gods to "take these weapons [...] in order to till my field and fill my barn [...] with human skulls". This and similar myths were recounted to justify the practice; if there were no wars (headhunting), the myths implied, granaries and barns would be empty; there would be no rain, no vegetation or crops. "For these reasons the [...] hostile parties never *dare* to make peace" (P.P. Arndt, quoted in Downs 1955, 54–55; my italics). Headhunting, then, was sustained to evade a greater calamity – infertility, crop failure, and hunger.

Among the Iban in Borneo, reputed headhunters well into the 20th century, head-taking was conceptualised in an agricultural idiom closely associated with female fecundity.[7] In myth and ritual, captured heads were metaphorically represented as fruits, and head-taking as the harvesting of tree fruits and cultivated crops in the otherworld, where the reaped fruits/crops would turn into babies nurtured by female spirits (Davison & Sutlive 1991). Derek Freeman (1979) gives an even more suggestive and illuminating account of the generative connotations of headhunting. To the head-taking Iban raiders, he writes, the severed heads of their victims were regarded as containers of fertile seed (including hill rice, betel nuts, and seeds of a variety of other plants) that, after being ritually planted by the killers, would germinate and grow into a human crop of enemy people, thus securing a continuous supply of life-giving heads to be harvested by the head-taking community (Freeman 1979, 244).

The symbolic association between rice cultivation and head-taking is quite explicit among the Iban. It is elaborated in a series of rituals preceding and following the head-taking raids in which heads-as-enemy-seed are symbolically planted, tended, reaped, and eventually stored in the longhouse community. The beheading of enemies is thus metaphorically equated with reaping the mature rice crop; the placing of the trophy head in the longhouse gallery after a successful raid is equated with the storing of the harvested rice, and the preparatory rituals preceding a raid enact the planting of the sacred rice that is believed to ensure an ample crop of enemy heads and life-giving seed. Interestingly, there is a similar imagery among the Katu in Vietnam expressed in their harvest rituals. As the ripe rice is harvested, the sheaves of the last standing rice plants

7 Iban have a bilateral kinship system, meaning that kinship is traced through relations on both the mother's and father's sides.

are cut and taken whole to the granary to protect the stored grains. The rice sheaves are compared to the head of the plant, and the act of cutting them is metaphorically equated with the taking of enemy heads.[8]

The message of these symbolic equations between plant cultivation and head-taking seems to be that just as women engender life by cultivating crops and giving birth to children, men generate life by killing and beheading enemies – that is, planting, tending, and reaping their human crop (Århem 2020). Severed enemy heads are human seed, and head-taking a male mode of cultivation and procreation.

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PART IV
SEEDS AND THEIR CARETAKERS

L. JAMILA HAIDER

Rituals and biocultural diversity in the Pamir Mountains

Alone on the hillside, swaying in the wind, the wheat stalk pulls nutrients from the thin arid soil with its deep roots, and exposes its long wispy awns to the summer sun. At 2,800 m there is not much else around. Dry soil, a few other grasses. This wheat has fat grains, a short ear, and is red in colour. It catches a shepherd's eye as he walks by, and he picks it, cracks open a seed and tastes it. Such a heavenly sweetness! More of this red wheat is collected from the mountainside. There is not much of it, growing between such rocky soil. The collected seeds are dried and stored in a holy place. They call it *rashtak* (or *rush-kakht*).

Fig. 1. Rashtak. Photograph by Judith Quax, Bartang Valley, 2011.

At the first signs of thaw, felt in the landscape and in the human body, the red grains are taken out of storage, milled, and the *rashtak* flour is put into a cauldron. It is the end of winter, so no other ingredients are left, and the cooks just add ice to melt for water – hoping that the sweet, nutty, and fatty nature of the grain will be enough. They stir the flour and water all night long in a slow rhythm with a wooden paddle until it has a smooth consistency.

In the morning, in the light of day, at the first sign of spring, the porridge is poured into a *tabak*, a communal wooden plate. Men, women, and children taste the porridge. After a long hard winter, the sweet, nutty porridge is the most delicious thing they have ever tasted. They call it *baht.* From then on, they save the sweetest, hardiest seeds from year to year, and start to grow it closer to their homes, with the crop more closely spaced, often intercropped with other grains or legumes. Over the years, they move rocks from the fields, irrigate that land, and collect more and more seeds, and each year they are able to save more seeds. Soon, *baht* made from *rashtak* is known through the entire valley and is always made during *nawruz,* the Persian New Year. They call this ritual *baht-ayom*.

This is an imagined story of how *rashtak* might first have been cultivated thousands of years ago in the Pamir Mountains of Tajikistan. It is based on the observation of the continued celebration of the yearly ritual *baht-ayom* (which I observed together with colleagues between 2009–2016, and which is more extensively documented in van Oudenhoven and Haider (2015):

> We make this recipe only once a year and it must be made by men. We use a red variety of wheat that is cultivated specifically for this occasion. It is called *rush-kakht* and grows only at high altitudes in the upper reaches of Bartang Valley. The red wheat is precious because of the sweetness it gives to the *baht*. Those who make *baht* on this day keep a small quantity of the wheat from the autumn harvest in their home throughout the winter, to use in this festival. On the morning of the day when we begin to prepare the *baht*, the wheat is taken to the mill to be made into flour. When we return home, we greet the woman of the house with the words: "*Shogun bahor muborak*," which means "May you have a happy blossoming day." She takes some of the fresh flour and makes a *būn* /blessing/ on our shoulders, and responds: "*Bar rui shumo muborak*." With those same words, we also make a small *būn* on all the pillars in the room where the *baht* will be prepared. (As told by Aydarsho Ghulomnabev from Sipönj, Bartang Valley, in van Oudenhoven & Haider 2015, 174).

Today, it is impossible to disentangle *rashtak* from *baht.* Which came first? Does *baht* and all the language and traditions around it exist because of *rashtak,* or does *rashtak* exist because of the human ingenuity that first domesticated this wheat, and gave it life? They have co-evolved. But *baht-ayom* today has also changed. Only one isolated village still grows *rashtak.* This is a village I choose to name Seedkarthé (which means "with seed", a combination of the English "seed", and *karthé,* "with" in Shugni, the

main Pamiri language). Some people in Bartang Valley receive flour from Seedkarthé to make *baht* for *baht-ayom,* but most people now use imported refined white flour and add sugar and vegetable oil (or margarine) in order to make it sweet. During the time of the Soviet Union, people were forcibly removed from the land and required to work in factories or *kolkhoz,* the collective farms. However, spiritual crops were often allowed to be cultivated, and their corresponding rituals were permitted to be practised. The knowledge therefore was maintained. Perhaps an even bigger threat to biocultural diversity in the region were the development interventions of the early 1990s and which continue today. These brought in improved seed varieties in order to increase production, but often had deleterious effects on local seed varieties and food culture.

This chapter focuses on the question: What is the role of ritual in conserving a biocultural landscape, and how does it matter for the resilience of the global food system and for spiritual and cultural well-being?

CASE STUDY AND METHODS: THE PAMIR MOUNTAINS, HOTSPOT OF AGRICULTURAL DIVERSITY

The Pamir Mountains, which extend across eastern Tajikistan, northern Afghanistan, and into western China, are an area of high agricultural biodiversity and a centre of origin of various staple food crops we see around the world today. The famous Russian and Soviet botanist and geneticist, Nikolaj Vavilov, spent much time in the Pamirs collecting specimens, and the Pamir region is consequently now known as a Vavilovian Centre of Diversity. Rye, for instance, is just one notable crop that was first domesticated here (Vavilov 1917). The diversity of grains found in these mountain lands is staggering – in part because of the large altitudinal gradient farmers have on which to experiment, between 2,000–4,000 metres above sea level. A total of 151 varieties of wheat are grown in the Pamirs, including the humble *rashtak.* Growing alongside, and indeed often intercropped with the grains, are dozens of varieties of apricot trees, cherry trees, and mulberry trees (Nabhan 2009).

The importance of the seeds that make up this diversity has long been recognised (at least since Vavilov's day). Most of the seeds have been collected and stored in global seed vaults. However, the knowledge and culture that created and maintained these seeds is often neglected. The Pamirs are also home to high linguistic and cultural diversity. Each valley speaks a different language – there are seven distinct languages in the Tajik Pamirs alone – and each valley has distinct cultural and spiritual practices. Different types of agriculture and livestock herding characterise this landscape, and today people most commonly practise "combined mountain agriculture" (Kreutzmann

& Watanabe 2016), in which families most often have a handful of animals, fruit trees, kitchen gardens, a few fields, and some alternative livelihood stream.

The case study selected here is in the Bartang Valley of the Tajik Pamirs, in Gorno-Badakhshan Autonomous Oblast. Bartang is one of the poorest valleys in the Pamirs, in part because it is a steep valley with little arable land, and difficult to access year-round due to avalanches, flooding, as well as land- and rock-slides. Bartang is also known for its rich diversity of folklore and lively folk traditions. The case I focus on here is on the changes experienced by two communities anonymously called Seedkarthé ("with seed") and Beseed (*be* meaning "without" in Shugni) following a specific development intervention: the introduction of an improved wheat variety (*Triticum aestivum*). It is known across the Pamirs as Mahmoudi due of the name of the extension agent who distributed the seeds in the early 1990s. This intervention is typical of modern high-input seed interventions, which often have negative long-term effects on ecosystems, culture, and long-term sustainability (McAllister 1992; Wiggins & Cromwell 1995; Jacobson 2013; Scott 1998). The fieldwork was undertaken in 2016 and related results are presented in Haider *et al.* 2019.

Seedkarthé still cultivates *rashtak*, while Beseed does not. Seedkarthé is situated at 3,000 metres above sea level, and about 18 kilometres from the main road. There are 64 households, spread across 45 hectares of land, most of which is under wheat cultivation. There is no mobile phone access or electricity in this village. Less than 10% of the village's young people are abroad. This is a very low rate for Tajikistan, where on average more than half of families have members working abroad (Danzer *et al.* 2013). This village was selected for study because it still cultivates *rashtak.* The second village, Beseed, is located on the valley floor and was selected because it holds yearly traditional food festivals and receives *rashtak* flour for the yearly *baht-ayom* festival. In 2011, there was still one person who cultivated a small amount of *rashtak* in Beseed for *baht-ayom*, but by 2016 he no longer did. No fields in Beseed are under grain cultivation: all are fodder crops, and most food is imported. Most young people from Beseed work abroad in Russia and the Caucasus, and the main source of income for the village is remittances sent home by these expatriate workers. This represents a broader trend in Tajikistan, where the majority of the GDP is comprised of remittances (World Bank, Migration and Remittances Team, 2014).

Ritual can be interpreted as a formal, ceremonial situation, or also more broadly as a social situation producing a "momentarily shared reality"(Collins 2004). The data collection and analysis presented in this chapter focuses both on the ceremonial ritual of *baht-ayom*, and on food preparation as a ritual in daily practice. This creates a momentarily shared reality between people within a community, between communities, and between people and landscape. Food preparation and celebration provided an op-

portunity for participatory observation of post-harvest practices, meal preparations, and celebrations (Haider *et al.* 2019*).* Food can be used as a method to help break down conventional power structures. In particular, women often feel they do not have a voice in development processes. Food is also emotive and evocative, and embodies health, nature, and culture in the past and future (Haider & van Oudenhoven 2018).

For data collection and analysis, the ritual of *baht-ayom* was observed as a set of three distinct practices; sowing (the seed); harvesting (the grain); celebrating (using flour). The data was analysed using a lens of co-evolution. We regarded the environment, values, knowledge, organisation, and technology as co-constituted in a process of co-evolution (Norgaard 1994). Then we analysed how these co-evolutionary relationships, as manifested through the ritual of *baht-ayom,* changed over time due to the introduction of Mahmoudi wheat seeds. In the following section, I summarise the results from this analysis (as published in Haider *et al.* 2019), and focus the rest of the analysis on how and why the practice of ritual can lead to the conservation of biocultural practices and landscapes.

EFFECTS OF THE INTERVENTION

Seedkarthé still grows *rashtak* and practises *baht-ayom* in the traditional way. There is very little outmigration in the village, and collective agricultural work is still practised. Knowledge is still actively passed through the generations, where skills such as blacksmithing and milling have been carried out by the same families for generations. Beseed on the other hand no longer grows *rashtak*, or any other grains for that matter. The ritual of *baht-ayom* is practised with substituted products: refined flour, sugar, and margarine. A few key community members are committed to ensuring intergenerational knowledge exchange: through an annual traditional foods day-festival (*taomhoi meli)*, and a harvest dance choreographed by a teacher which all the children learn (van Oudenhoven & Haider 2015, 662–663). These new celebrations play a role in modifying rituals so that they retain relevance.

The differences between the two communities can be visualised using the co-evolutionary framework (*Fig. 2*). Focusing on the celebration of *baht-ayom*, we see in *Fig. 2a* "the environment" is represented by the traditional seed *rashtak,* which requires "knowledge" to be prepared as *baht,* and the skills and "technology" to work the mill. The preparation of *baht* is "organised" by *tabaks*–the word means a village neighbourhood as well as a shared wooden plate. This celebration represents core "values" of the community: hospitality, sharing, and spiritual fulfilment. In Beseed (*Fig. 2b*), the *rashtak* has been replaced first by the improved seed "technology" and later by a fodder production "environment". But the values (hospitality and sharing), knowledge

(through dance), and organisation (in *tabaks*) of Beseed are upheld by the celebration of *baht-ayom*, and through additional new celebrations, such as *taomhoi meli* and the harvest dance. The harvest dance was choreographed by the music and culture teacher in Beseed. He felt that most children he taught were not aware of their culture, and did not have any agricultural knowledge. Movements of the dance are choreographed to represent every step of wheat cultivation, from sowing the seeds, to irrigating, harvesting, winnowing the grains, storing them, and milling the grains into flour. One could almost say that the cultural side of the biocultural diversity has been maintained through ritual. The question arises how biocultural diversity changes over time (*Fig. 2b*), and which new relationships form in a landscape dominated by fodder production and improved seeds, with values, knowledge, and social organisation that are seemingly disconnected from the ecological reality of the landscape.

In Seedkarthé, it seems that the ritual of *baht-ayom* has maintained a specific biocultural landscape and practices, but in Beseed, it has maintained the cultural diversity, but lost the biological.

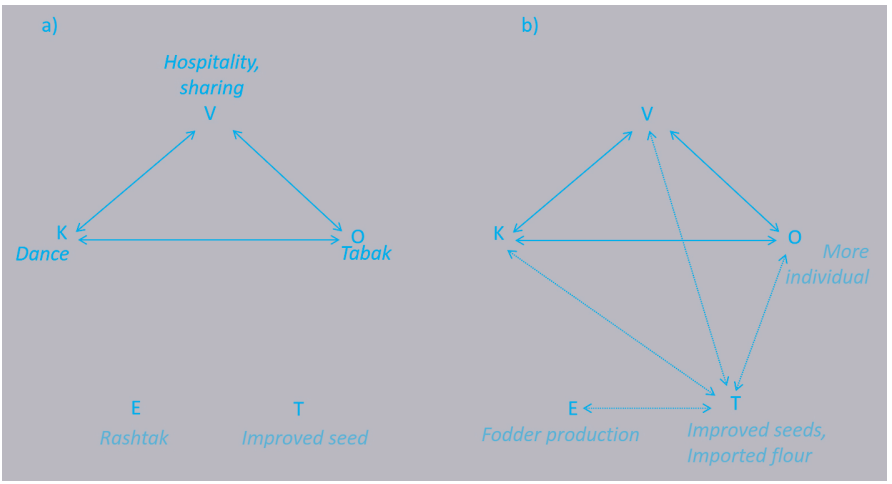

Fig. 2. Co-evolutionary representations of the celebration of baht-ayom in a) in Seedkarthé as the traditional ritual, in b) in Beseed as the current situation of cultural diversity disconnected from biodiversity or the landscape (based on Haider et al. 2019).

THE ROLE OF RITUAL IN MAINTAINING BIOCULTURAL LANDSCAPES

The ritual of *baht-ayom* plays a role in maintaining the biocultural landscape of the Pamirs, whether in the direct way apparent in Seedkarthé, or indirectly in Beseed. The day before *baht-ayom,* as the fire is lit in the *khitsor* (hearth), seeds are placed within the hearth. The seeds that do not burn to ash are sown the next day. At the end of *baht-ayom,* some *baht* is saved in order to decorate *nasrak,* little animals made of dough, which children often bring to holy places as offerings for fertility and good fortune (see van Oudenhoven & Haider 2015). However, rituals are not static relics of traditional knowledge, but rather evolving practices. Here I present three ways in which rituals can maintain biocultural landscapes.

RITUAL FOR THE RESILIENCE OF GLOBAL FOOD SYSTEMS

Agricultural biodiversity matters for global sustainable healthy food consumption. In the context of deep uncertainty due to climate change, it is unclear which seeds will be needed and be able to grow in rapidly changing growing conditions around the world. Globally, it is highly likely that drought- and pest-resistant strains (such as *rashtak)* will become increasingly important over time as land becomes increasingly arid. Moreover, high-quality grains and legumes are recognised as a major contribution to healthier diets (Willett *et al.* 2019), which is important locally in nutrient-poor contexts such as the Pamirs. These will also become increasingly important globally in a shift towards more plant-based diets. Many seeds from the Pamirs have been collected and saved by the Crop Trust in the Svalbard Global Seed Vault in Norway, but it not just the seeds that need to be saved, but also the more tacit aspects of knowledge and practice that co-developed with these seeds over millennia. As *baht-ayom* has shown, rituals are living repositories of this knowledge and practices which form the foundation for place-based adaptation, and contribute to resilience of global agricultural biodiversity.

SPIRITUAL IMPORTANCE AND CULTURAL SIGNIFICANCE OF RITUAL

There are clear functional arguments for the importance of agricultural biodiversity and the role of ritual in maintaining it, but *baht-ayom* also demonstrates the spiritual and cultural importance of ritual which contributes to well-being. A migrant from Beseed says: "I leave in order to come back." This sentiment is evidenced more gener-

ally in the landscape by the many half-built houses one encounters all over the Pamirs, but particularly in Bartang Valley. Young people today would like to build their own homes, in a modern style, and spend the majority of their wages earned abroad on building materials which they then transport back to the Pamirs. A schoolteacher from Beseed does not earn enough from her teaching salary, so alternates years in Moscow where she sells chocolate bars from a make-shift street-stand. She says: "When I dream I'm in the Pamir. Whenever I dreamed, I was never in Moscow, my dreams were there [in the Pamirs]. I'm climbing the mountains, or I'm crossing the bridge to the next village. I'm always there, always there, nowhere else." The ritual to celebrate *baht-ayom* remains, but one of the dancers explains that in Beseed its meaning has changed: "Now we keep the tradition and prepare *baht* from flour from the shop. The taste is not the same, there are different properties. Physically we keep it, but spiritually it is not that *baht*."

THE ROLE OF RITUAL IN MAINTAINING VALUE SYSTEMS AND SOCIAL ORGANISATION IN A DECOUPLING WORLD

The Pamirs have always been remote yet connected, isolated but not forgotten. At the time of writing it still takes a minimum of twelve hours – and usually much more – to reach the Pamirs from the Tajikistan capital Dushanbe, by one of the world's most precarious overland roads, meandering along the Amu Darya River. To the south is the border to northern Afghanistan, to the east a closed border to China, and to the north a border to the most remote areas of Kyrgyzstan. Despite this remoteness, a main artery of the Silk Road passed through the Pamirs. It was also the last battleground of the Great Game between the Russian and British Empires in the late 1800s, and it marked the celebrated eastern frontier of the Soviet Union for much of the 20th century. The global trends of urbanisation and migration in the context of climate change, and interconnectedness of trade, which characterise the Anthropocene, are all acutely felt here. Despite these numerous large-scale influences, many rituals continue to be practised in the Pamirs today. As argued above, ritual clearly plays a role in biocultural diversity conservation, and agricultural biodiversity is important for the well-being of both ecosystems and humans. Correspondingly, cultural diversity plays an important cultural and spiritual role for human well-being. These two aspects cannot be disentangled.

Recently, Nyström and colleagues (2019) characterised the global production system as global biomass managed by different sectors – such as crop production – and affected by a broad set of distant drivers. This global production system is further characterised by increasing connectivity, decreasing diversity, and "decoupling in a

hyperconnected world." The effect of the improved wheat seed variety on *rashtak* offers an opportunity to probe into the latter. The introduction of the new wheat seed, Mahmoudi, is representative of increasing connectivity to global markets and pressures, and the effects of the new seed is a loss in the local seed, and of broader biological and cultural diversity. The introduction of the new seed and loss of seeds and cultural practices represent the concept of "decoupling in a hyperconnected world". An interesting question arises of how biological and cultural, or ecological and social realms can therefore be "recoupled". In this chapter I have argued that ritual as daily practice and celebration contributes to recoupling, by either maintaining key social-ecological relationships or creating new ones. In cases where values or institutions have been decoupled from the ecological reality, such as the case with a loss of seed, ritual plays a role in maintaining the social structures and values that gave rise to and can maintain these landscapes. *Fig. 2* shows how in Beseed, values of hospitality, sharing, and reciprocity are maintained, and collective work in *tabaks* continues. However, other value systems, such as more individualised profit-driven values, have also started to gain prominence. Improved seed varieties, intended to increase production and marketability, promote growth, competition, and individual gain, are often at odds with the traditional values in the Pamirs. The role of ritual can arguably be one of maintaining certain value systems and social organisation. When the materiality of social-ecological relationships that have existed over millennia begins to change, the role of ritual can be to uphold the non-material aspects (such as knowledge, values, organisation). Ritual has played an important role in biocultural diversity creation and maintenance, and could be used as an anchor-point for development processes.

Ritual is a shared social situation, encapsulating both daily practice and celebration. It includes a combination of old and new elements and is therefore far more than a relic of the past, and instead creates the foundation for adaptation and transformation of future pathways. Ritual often encapsulates and maintains biocultural diversity, which matters for the resilience of the global food system. Ritual is of spiritual and cultural significance, and it plays a role in maintaining social and value systems that are important for sustaining and recoupling biocultural relationships in contexts where they have become disconnected.

This chapter did not intend to paint a romantic vision of biocultural diversity and specific place-based rituals. The Pamirs present an interesting case to represent a microcosm of sustainable development more broadly. Characterised by poverty, malnutrition, soil erosion, and natural disasters, the need for interventions is dire. The chapter has shown how interventions to tackle narrowly framed problems lead to solutions that may actually reinforce the problems, rather than alleviate them. Ritual provides an

entry point for more context-appropriate interventions that consider how to maintain and strengthen social-ecological relationships rather than break them apart.

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REBECCA ÖHNFELDT

"Marching to the beat of a different drummer". Heritage plants and their farmers

> Our father used to eat dried peas like it was candy. On Sundays, when he went to church, he always had some peas in his pocket. He would put them in his mouth and suck on them until they softened and he could chew them. Almost as though it was a chewing gum![1]

Anecdotal stories, such as this one told to me by farmer and painter Lars Eliasson, contributed to my discovery of the meaning of inherited seeds. However, the event that triggered my quest into the plant and seed world took place in February 2018 at a fancy restaurant in Stockholm – around a year before I sat in Lars Eliasson's living room. At this restaurant I had my first memorable encounter with a heritage[2] vegetable when I was served a Swedish legume called *gotlandslins* (lentils from the island of Gotland). I was intrigued to find out that these lentils, after surviving decades of near-oblivion, were now being grown again in their place of origin. After some time had passed, these lentils got me pondering why I, a person interested in food in general and plant cultivation in particular, knew so little about heritage plants and seeds. Fortunately, I did not have to wonder much longer as I was able to channel my curiosity by undertaking a master's thesis in global environmental history.[3]

The initial research quickly pointed me towards the importance of heritage plants for both agricultural diversity and food security (see for instance FAO 2019), and I

1 This quotation and the following of the same kind are my own translations from interviews that I have conducted in Swedish.

2 In this text the term "heritage plants" incorporates vegetables and cereals and mainly refers to the oldest domesticated cereal varieties, such as emmer wheat and einkorn wheat, and the so-called "landraces" ("lantsorter" in Swedish), which are plants that have evolved and adapted to certain places over time – through the consistent sowing, harvesting, and seed-saving undertaken by farmers. Further, modern varieties coming from the formal plant breeding system can be characterised by homogeneity whereas the older (in this case heritage) varieties are characterised by heterogeneity (Leino 2017).

3 Öhnfeldt 2019.

understood that I both needed and wanted to look further. When I realised that it is not common to farm with heritage cereals and vegetables in Sweden, I began wondering more about what motivated those farmers who – going against the stream – had decided to do so. Through this pursuit, from October 2018 to February 2019 I met with farmers scattered across Sweden, and one in Norway, and the conversations that we had opened up a new world in terms of different views on seeds, plants, soil, farming, and seed ownership.

One of the issues raised by some of the respondents was a longing for an expanded dialogue with a different set of discussion topics. As farmers they often get questions regarding their financial situation or how large their latest harvest was, but they were suggesting that those questions are not sufficient if we want to create and maintain a more sustainable and diversified food production system. One of the farmers whom I visited, Per-Olof Larsson, has founded Lögens mill and farm, located outside Lysekil on the Swedish west coast north of Gothenburg. Here he grows different heritage varieties of wheat, rye, and barley, and he talked about how society as a whole should find ways to get a wider range of questions onto the farming agenda:

> In society in general and within the agricultural sector in particular revenue is often in focus. I would like us to talk about 'cultivation' instead of growth in order to shift focus away from simply producing more and more towards creating and valuing other aspects of farming and food production – such as taste, nutrients, and biodiversity.

A variation of this statement was repeated by several of the other interviewees; however, none of them believes that this suggested shift towards crop and practice diversity will be easy. One of the other respondents underlined that we often form our practices based on what we are familiar with. He further suggested that a farmer who has invested in heavy machinery, and who has been cultivating modern crop varieties – the word "modern" here refers to seeds coming from the formal plant breeding system – within a conventional system for many years, might not be able to change his or her approach due to the insecurity created by being under economic pressure.

SOIL: THE BASIS OF EVERYTHING

Many of the conversations began with me asking the farmers what they were growing and why, but no matter which plants and seeds we were discussing we almost always ended up on the same topic: soil. Some of the farmers had been invested in soil-care before they began farming with heritage plants and some had an interest in soil that had become deeper once they began being more involved with older plant varieties. One reason for this is that older cereals are different than the modern ones, requiring

that farmers start paying attention to other aspects of farming. Adam Arnesson lives at Jannelunds farm, located in Mullhyttan outside the city Örebro, 124 kilometres west of Stockholm. Here he grows both older cereal varieties and heritage legumes, such as a Latvian pea variety *Retrija gråärt*, and he explained his experience:

> I learned that older cereals are better equipped for organic farming since they are not adapted to grow with the pesticides and fertilisers often used within conventional farming. Heritage cereals stand taller, have longer awns, more leaves, and much deeper roots, which make them naturally stronger and more resilient towards drought and weeds.

Roots naturally draw us towards the soil in which they grow – the deeper the roots the more sturdy a plant. The farmers that I talked to were occupied with questions regarding soil. What does it look like? How does it smell? What texture does it have? Johan Swärd, who together with his wife Kristin Swärd runs a farm in Brandbu, 48 kilometres north of Oslo, Norway, was one of the farmers to whom I talked who had spent a large amount of time working on his soil. He was worried about the state of the world's soil:

> We know that the world's soils are degenerating each year, the humus content is steadily decreasing, and soils are eroded or too tightly packed due to heavy machinery. I find this development alarming. One problem is that many farmers are working under too much pressure, something that might prevent them from making time for the necessary soil-improving work, which in turn leads to short-sighted decisions. To improve poor soil certainly takes time: I should know since I spent almost two decades working on the soil here on our farm when we took over. But if we are to provide people with food in the future, we as a society have no other option but to direct all our energy towards the soil.

This reasoning is connected to the so-called "efficiency trap", which refers to how the intensive industrial model has led to us reaching the limit for how much yield we can receive from an increased input. The use of synthetic fertilisers and pesticides lead to higher returns initially, but the yields diminish over time. At the same time as yields are decreasing, problems such as soil depletion and biodiversity loss accumulate, making this sort of production a dead-end for food security and biodiversity conservation (see discussions on the "efficiency trap" in Barthel *et al.* 2013a; 2013b; and Montgomery 2017). Per-Olof Larsson also indirectly referred to the "efficiency trap" when he talked about how society as a whole must work towards creating fertile and regenerative soils. Per-Olof Larsson thinks that we must be careful not to dismiss, for instance, older cereals as something odd and marginal:

> There are ancient varieties that have been around for more than 10,000 years, just think of emmer wheat or spelt for instance. The farming system of today is only a small parenthesis in the history

> of the earth. In Sweden we have practised so-called modern and commercial agriculture for less than a hundred years. But what have we really achieved during these past decades? I say we have a big responsibility resting on our shoulders and I am not sure we are taking it seriously enough.

EMBODIED KNOWLEDGE

As these last two quotations exemplify, there was a rather high degree of concern among the interviewed farmers. A fear of loss was more or less present in all of the conversations. Fear of depleting soils, fear that seeds will be lost forever if they are not kept in cultivation, fear that their work will have been in vain if no-one can step in and take over once they are gone. One aspect, difficult to circumvent, is that the tacit knowledge possessed by these farmers requires both practise and physical involvement for it to be passed on. We can ask questions in order to try to map and safeguard different practices for the future, but that is not enough. And sometimes the answers are not what one might hope for. I experienced this myself when I talked to farmer Börje Ström, who owns a small farm together with his wife Lena Ström, in Vik, Järvsö in the middle of Sweden. Since Börje Ström practises a very traditional form of farming I asked him to explain some of his practices to me. As this quotation shows, he found it rather difficult to answer since he always knew instinctively what to do:

> I have never followed any schedules or used any templates; I just always know what to do. I grew up surrounded by people who practised small-scale agriculture, so my knowledge is just there, it is not something that I reflect upon.

If the knowledge possessed by farmers, such as those that I interviewed, is to somehow be transferred, the need for these places and the people who operate there are vital. Not only are their farms important knowledge reservoirs, Adam Arnesson told me that, for him, his farm is something similar to an outpost of hope:

> When I think of the future and all its challenges, I sometimes feel less than hopeful. But I always have to come back to my farm and focus on what I can do here. The farm is a place that I can use in order to maximise my service to society. The farm is my tool.

By talking about his farm as his tool Adam Arnesson is seeking to focus on what he can do, even though he is sometimes afraid of what the future might bring. Spoken out loud or not, for Adam Arnesson, as well as for the other farmers, the farms are often an important element in the fight against monocultures, both in terms of crops and practices, and thoughts and ideas. During my research I realised that no matter what end one is working for, the need for context and support is crucial if heritage seeds are to be kept in cultivation.

In Sweden some of this support comes through the *Allkorn* association, of which many of the people who cultivate heritage varieties in Sweden are members. Growers trade knowledge and seeds with each other through the *Allkorn* network. As told to me by some of the association's members, seed trade in small quantities is possible within the network since all the members can be considered to be plant breeders. Discussions regarding how seeds can be traded are connected to the rules and regulation of seed trade. In Sweden this is based on the EU seed certification scheme, which constitutes the basis for the marketing of plant reproductive material in EU countries. Each country has its own official list of approved plant varieties meant to be used as support for persons or companies who market and trade with seeds, partly motivated by a need to oversee the condition of the seeds. In Sweden this list is maintained by the Swedish Board of Agriculture (*Jordbruksverke*t). In 2009 in relation to the Convention on Biological Diversity it was decided that heritage plant varieties should also be somehow regulated, in order to facilitate their survival. In the Swedish context these plants are referred to as *bevarandesorter* – varieties that are worth preserving – and they have their own official list that is also maintained by the Swedish Board of Agriculture. One of the basic demands for the plant varieties on the "worth preserving" list is that they have been grown in Sweden prior to 1945. If a heritage plant is listed, it means that its trade is regulated in the same way as the "modern" seeds. The ones that are not on the list cannot be formally traded. However, they can be bartered or given away, and here the *Allkorn* association is also useful since the network is a means of facilitating seed exchange. At the moment the "worth preserving" list contains, for example, 14 kinds of potatoes, 26 different cereals, and 17 kinds of peas (Jordbruksverket 2011; 2019). These plants are far from all of the heritage varieties that exist in Sweden. It is possible to get more heritage varieties added to the "worth preserving" list by sending in an application that will be assessed, for a fee.

Some of the respondents said that they think it would be easier and better for farmers to have more heritage varieties on the official list. This could however be difficult since plants have to be somewhat uniform and stable to make it onto the list, which is something that clashes with the often-heterogeneous traits of the heritage varieties. This is a paradox. As soon as a coherent list is to be compiled there is a need for homogenisation of certain traits, despite the intention to provide means for diversification. When it comes to plants this is even more difficult, since they are a living material which, in order to stay alive, always adapt and change according to its local environment and conditions. Thus the plants' initial characteristics might change. However, the new Organic Regulation (EU) 2018/848 will likely provide opportunities for more diversification when it comes to trading with seeds and other plant reproductive material. Article 13 in the new Organic Regulation describes that so called "organic heterogeneous material"

– material with a high level of genetic diversity – can be marketed and used by farmers and suppliers without it being listed as a particular variety. The official governing body in each country must however receive a declaration containing certain descriptions before the plant material can be traded. The new regulation will be ready for practical implementation by 2021 and the guidelines for how to describe organic heterogeneous material and the exact implementations of the new provisions are yet to be worked out when this is written (see for instance IFOAM 2019 for more details).

THE ROLE OF CONSUMERS

To get more varieties listed and in circulation could be one way going forward; another is to involve more people through spreading knowledge. Through my research I have come to realise that almost anyone can take part in the project to maintain both food security and agricultural diversity. Some of the farmers pointed out how important the consumers are. As Curre Niklasson, who operates his farm in Näs county on the island Gotland together with his wife Lotta Carsbo Niklasson, expressed it:

> I want to produce food that is good for people and their environment and I am doing my part of the job. But people have to support my work through buying my food. Consumers who can afford to buy better food must do so. It is about priorities as well. Perhaps we could all spend more money on food and less money consuming things that we do not need?

Farmer and miller Per-Olof Larsson told me how difficult it was for his family when they started their organic farm in the beginning of the 1980s, and his journey since then is one example of how things have changed partly thanks to some consumers:

> In the beginning we could not even sell our products as organic as the demand was too low. But suddenly, during the early 2000s things began to happen. I believe it was this TV show where a Danish woman baked bread with a heritage wheat variety. People started calling us and wanted to buy flour from old cereals. She was an early trendsetter, and since then the interest has continued to grow through chefs, bakers, and the media. Those who cook professionally want access to good produce and that has spread on to the consumers as well. Today the demand for our products is greater than we can cater for.

Even though some small-scale farmers might have experienced a higher demand for their products there is still a need, according to Johan Swärd and others, to spread knowledge regarding heritage seeds and plants to both growers and consumers. Since the early 2000s Johan Swärd has been involved with cultivating a large variety of heritage cereals, and today he actively grows around 15 varieties. He suggests that information should be provided through, for instance, different agricultural educational

programmes. He also believes that the issues regarding seed ownership might limit how information is spread. Since heritage seeds are not owned by seed companies, no one will actively promote them to farmers. Johan Swärd has also had experience with misinformation from seed consultants who have said to some of his farmer colleagues that heritage seeds should not be farmed for a number of reasons – such as that they would bring certain pests with them or provide a very low yield. He also told me that each year in April his phone is constantly ringing as people who want to try to farm with heritage cereals want his advice on how to proceed.

Another outcome from the interviews was the realisation that heritage seeds and plants, with their inherent heterogeneity, will not fit into the large-scale industrialised systems of today which demand homogeneity. Johan Swärd talked about this:

> In regular flour production one wants a stable product that is fit for industrial baking where deviations are not welcome. Large mills will pair different lots of flour in order to get the exact same product over time. The flour that comes from my heritage cereals differs greatly from year to year depending on the conditions and this will in turn require skilled and adaptable bakers. Which is why I have a hard time imagining industrial baking with flour made from heritage cereals.

To imagine his flour being part of an industrial baking system was not something that Johan Swärd wished for; instead he was happy to see his flour being used by skilled artisan bakers. To this end he had built a small mill, in order to be able to grind his own flour to sell. In general, the farmers to whom I talked are not striving towards making their plants and practices part of the dominant conventional farming systems, but instead wish to expand the horizons for what is desirable when it comes to farming in terms of what and how we farm.

SEED STORIES

During my research I came across an expression that I found very descriptive of how I perceived the farmers that I met, which is that they are both ordinary and extraordinary at the same time. This description is borrowed from anthropologist and ethnoecologist Virginia D. Nazarea who, over the course of the last couple of decades, has interacted with many small-scale farmers and seed-savers from different parts of the world (see e.g. Nazarea 2005). To explain further, the farmers that I interviewed are ordinary in the sense that they carry on with their daily practices simply because it is their occupation or their hobby. However, they are at the same time extraordinary since they through their everyday work contribute to creating a web of diversified practices that are vital not only to themselves, but also to other humans and non-humans.

One of the things I bring with me from my research is how significant stories about plants and seeds are to those who are interested in understanding *in situ* conservation. It is through naming and storytelling that we turn objects and places into something familiar and relatable, through something that Tuan (1991, 686) called "the casting of a linguistic net". In other words, naming and storytelling gives us a sense of place, and places for cultivation are fundamental to the relationship between humans and plants. The farmers' practices and the spread of seeds, names, and stories are part of the casting of linguistic nets that have the potential to really captivate the listener. These nets give the farmers meaning and context, but also expand at the moment someone passes on a seed or a story. Once you know the name and story behind a certain pea, that pea will never be just a pea again. A seed-saver and a grower are things that anyone can become at any given time. The net might appear in different ways on a local scale, but its mechanisms are global. This was something I learned through comparing the stories I encountered to the ones that Nazarea and her colleagues have collected over the years. Some of these stories tell the tale of a stubborn relative who – often without any outspoken purpose or recognition – persistently grew a certain vegetable year in and year out, simply to make sure that it did not disappear. Sometimes the recognition comes when these people are long gone, in some cases leading to that particular vegetable being named after them. For the sake of our common memory we can be thankful that there have always been these persistent types of people who are "marching to the beat of a different drummer" (Nazarea 2005, 135).

The plants – or more precisely the seeds from which they grow – not only carry particular names, stories, and memories. They also possess other claimed properties. Different, positively experienced, traits were described by most of the farmers to whom I talked. The interviewees explained how heritage cereals have deeper roots, taste better, and are more nutritious. Through the expression "heritage plants and their farmers" I want to point towards how many of the descriptions provided by the farmers reflected a reciprocal, almost affectionate, relationship with their heritage plants. It was as if their plants were dear old friends. The farmers need their plants and the plants need their farmers: in that sense they belong to each other in a constant circle of care. One example of this comes from Johan Swärd, who talked about his variety of the heritage rye *svedjeråg* (Finnish rye/swidden rye) at length, finding it difficult to stop:

> *Svedjeråg* is really something special. Since I have been cultivating it for many years I have got to know its remarkable properties first-hand. I could talk about it forever!

Not only do the heritage plants evoke these strong feelings amongst their farmers, they also seem to work as a gateway towards more crop diversity. The lentils from Gotland

that I ate at the restaurant in Stockholm are being cultivated by the couple Mari Håkansson and Jörgen Thomsson. When I met with Mari Håkansson in their kitchen she talked about how they are now are growing a wider variety of crops on the farm, inspired by their recently initiated cultivation of *gotlandslinser.* This larger variety will give them a more resilient "cultivation portfolio". Before they became acquainted with *gotlandslinser* they had been cultivating different non-heritage vegetables on a larger scale, but after having tried heritage lentils they also wanted to grow some heritage cereal varieties. It seems as if the introduction of heritage plants with their often-experienced special properties awakens a particular interest. For Johan Swärd the *svedjeråg* was the starting point that led to him actively cultivating several heritage cereal varieties. For Börje Ström it was a local barley variety, and for Adam Arnesson it was a rye called *petkus* that opened the door to other heritage plants. And the list goes on.

Perhaps heritage seeds can be viewed as a means of preserving the past, but that is a simplistic view. To take a closer look at heritage seeds and the people who farm with them is to investigate how different seeds, together with a great variety of practices, have been tested under many different conditions. In that sense even the tiniest farm plot can, together with larger units, be used as a joint laboratory for finding innovative and versatile practices required to keep up with the constant changes and challenges within the food production system. Suddenly, practices that have been considered "historical" or "traditional" are viewed with new eyes in the search for sustainable food production. The practices used by some of the farmers I have interviewed are not new, but they become something else in a contemporary context. One example of this is Mari Håkansson and Jörgen Thomson who have learned that *gotlandslinser* can be difficult to harvest and handle. In the past lentils were harvested and sorted by hand. This is of course very time-consuming and probably the reason the lentils might have disappeared from Gotland once agriculture became more mechanised. The lentils have short and rather fragile stems so they have to be cultivated together with another crop in order to be supported as they grow. Historically the lentils were often planted together with oats, which is what Mari Håkansson and Jörgen Thomson are doing today. However, they both harvest and sort them mechanically, which has not been done before. Mari Håkansson explained to me how they handle this:

> We have realised that the most difficult part is to separate the lentils from the oat grains once they are harvested. But we have just purchased an old Swedish sorting machine of the Thermaenius brand from 1935, which works fantastically well for fine sorting!

The manner in which Mari Håkansson and Jörgen Thomson are cultivating, harvesting, and sorting their lentils is a good illustration of how practices come about. So-

called "historical" practices, such as mixing crops for support, when properly understood and applied, can be perfectly in line with contemporary needs. Tacit knowledge is important here since practical habits are often built up through experience and over time. In that sense so-called "old" solutions can be helpful in order to approach current farming challenges in a diversified manner (see more of these discussions in for instance Montgomery 2017, Barthel *et al.* 2013a and 2013b, and Granstedt 2012). In this context one practice is not necessarily considered to be better than the other. It is how they are transmitted and used that matters.

Soil care and crop diversity are now on the agenda. This gives acknowledgement to farmers who have already been working with these aspects for quite some time, such as most of the farmers that I interviewed. Some of them told me how they have almost been considered as outcasts because they are thinking differently. Yet, they also experience how the rest of society is catching up and beginning to understand the benefits of what they are doing. In that sense they constitute examples of how farmers can provide important insights regarding different aspects of food production. Heritage plants and their farmers play an important role when it comes to several layers of diversity, ranging from crop diversity, to practice diversity, and biodiversity in general. Together they teach us that "new" is not always better, and that "old" can provide us with important insights for the future.

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TRACEY HEATHERINGTON

Fertility's fate. Agrarian anxieties and the social life of seed

"Divine Demeter, giver of seasons and glorious gifts,
who of the immortals or mortal men
seized Persephone and grieved your heart?"
(*Homeric Hymn to Demeter*, translation by Helene P. Foley, lines 54–56)

Let us begin with a motherly goddess of grains, and her anguish. A story recorded among the *Homeric Hymns* tells us about a deity called Demeter by the ancient Greeks.[1] She was the giver of food and fertility, blessing the toil of mortal farmers with abundant harvests. Demeter's essential importance to agriculture is illustrated when her daughter Persephone, "a sweet offshoot", was suddenly stolen away. She went to gather flowers in a lush meadow, when Hades, god of the underworld, "rose up on her" and abducted her in marriage against her will. Bereft Demeter suffered brutal loneliness, and abandoned her own place among the gods to wander the earth in search of her lost girl.

Her divine beauty cloaked with grief, Demeter disguised herself as an old woman. She offered blessings of fertility to young women she met, and inquired about suitable work for a matron. She was brought to the court of a noble house, where she at first refused hospitality, but was coaxed to better humor by a woman who regaled her with bawdy jokes. Still in disguise, Demeter accepted the position of nursemaid to a male infant of the house, protecting and nurturing him by mystical means so that he grew

1 My retelling follows Helene P. Foley's translation and discussion of the *Homeric Hymn to Demeter* (in Foley 1994, *The Homeric Hymn to Demeter*, 1–178) and is also informed by Gregory Nagy's (2000) translation, and a critical reading of *Bulfinch's mythology* (Bulfinch 2013). At the outset of the Homeric Hymn, the virgin daughter of Demeter is called Kore, who becomes Persephone after her marriage. For simplicity, I refer to her throughout as Persephone. Demeter was called Ceres in Roman mythology, while Persephone was called Proserpine or Proserpina.

miraculously, resembling a god. Yet the mother of this boy became suspicious, and discovered that he was laid in the hearth fire at night. She confronted Demeter, who became angry and cast the child away from her. Rebuking human ignorance and lack of foresight, the goddess revealed her true identity and power. People were instructed to build her a temple, where she retreated to grieve and pine for her lost daughter. Mortal humans felt the impact of Demeter's sorrow and anger in the barrenness of their fields, and the failure of their crops.

There was acute famine. Even the gods were affected when the dying mortals were unable to worship them properly. Demeter refused to give her gifts of earthly abundance until her daughter was returned to her. So it was that Zeus, although he had earlier condoned the forced marriage, asked Hades to give Persephone back to her mother. Hades agreed, but compelled the girl – perhaps by force, perhaps by guile or seduction – to eat a few luscious pomegranate seeds before she left. Because of this, Zeus determined that Persephone would spend part of the year together with her mother above ground, but must return to the underground dwelling of Hades for the other part. When the beautiful Persephone returned to Demeter's side, they took joy in each other's company, and soon the fields were filled again with leaves and blossoms. People were taught to revere both mother and daughter, who bestowed prosperity on those they favored.

Lest we diminish this epic adventure to womanish myth, let us consider its significance. Before it was written down, Demeter's ancient tale began with oral traditions, art, and ritual practices rooted in agrarian life in the Mediterranean. Such lore might distill social memory and knowledge communicated across generations, guiding both action and learning in the living world (see C. Scott 2011). These narratives should not be taken literally, for they resist linear logics (Lévi-Strauss 1955). Instead, they present metaphors and analogies that still offer insights today. Bernard Perley (2002) points out that the re/telling of stories embedded in "deep time" is always in dialogue with present concerns. With this in mind, I bring a mischievous perspective to both classical studies and cultural anthropology, in an effort to breed fruitful interdisciplinary conversations about agriculture and environment.

In this essay, I explore the story of Demeter and Persephone as an allegory of fertility that obliges attention to climate and biodiversity as fundamental non-human agencies in agricultural production. These "natural" or "environmental" inputs and preconditions necessary to successful reproduction of crops were largely taken for granted during the shift to intensive farming strategies in the 20th century. Yet even as the high modern plotlines of scientific agriculture were taking root (see J. Scott 1999), the ancient story of Demeter and her daughter continued to command fascination. By rethinking the tale of this grain goddess and her daughter with regard to the multispe-

cies bonds at the heart of agriculture, we may learn to retell it in new and relevant ways, and in so doing, bespeak the power of caring for "all our relations" (LaDuke 1999).

Contemporary crop production often relies on technological interventions, but rare is the farmer who does not still find reason to long for – perhaps to pray for – favorable conditions. Heroic accounts of the Green Revolution celebrate human mastery over seed and soil, but our food production and distribution systems remain vulnerable to seasonal variations. As climate change proceeds, our harvests are beset with new risks and uncertainties. Agricultural fertility and capacity for resilience are undermined by quickly evolving or erratic crop stresses, and even further by genetic erosion driven by modernization projects themselves. The logic of productivism fundamentally transfigured the structural conditions of ecological regeneration. The problem we face now, as Anna Tsing has put it, is how to collaborate with other people and species in order to live amidst the damage brought about by "ideas of progress and … techniques of alienation that turn both humans and other beings into resources" (2015, 19). Demeter helps us shift perspective beyond economic instrumentality to nourish affective commitments against dispossession, loss, and suffering.

What must be done to secure the future of food and agriculture? Many of the answers proposed have been highly polarized. Should the Green Revolution be continued and extended, or fundamentally challenged? Debates focus on the ambivalent legacies of hybrid seeds, chemical fertilizers, and pesticides introduced after World War II, for example, or the desirability of plant genetic modification in the 21st century. These debates too often till ideological ground with tropes that estrange science from society, knowledge from religion, rationalism from emotion, and the present from the past. These ruptures are counterproductive. On the one hand, while humanistic and cultural perspectives on our crops remain institutionally marginalized, small farmers are poorly assisted in their role as guardians of biodiversity, and agricultural scientists are poorly supported in their mandate to work with them. On the other hand, critics who dismiss the agricultural sciences as universally flawed – by modernist pretensions, ethnocentrisms, élitism, or corporate interests – are throwing the proverbial baby out with the bathwater. In the thick of urgent challenges, we need an exuberant reciprocity of so-called "traditional" and "modern" ways of knowing.

Critical interventions in the debate on food and agriculture must learn creative idioms, cross-cultural competencies, and perspectives that bridge chasms between disciplinary strongholds and ontological worlds. Accordingly, this essay propitiates Demeter, whose mysteries were ever inclined to bawdy play, with a lusty ritual involving a three-way intercourse of science, social science, and humanities. I draw from research conducted at the Global Crop Diversity Trust ("Crop Trust") in 2015, as well as academic/scientific reports and public documents associated with the conservation of

plant genetic resources for food and agriculture. These sources span segments of the natural and social sciences. This essay considers the story of Demeter and Persephone, in its different versions. Some feminist lenses have been applied to its analysis, suggesting fresh perspectives on "seedy" debates. Amitav Ghosh (2016) has urged that we need the power of storytelling to address "the broader imaginative and cultural failure that lies at the heart of the climate crisis", and I take storytelling seriously as an analytic practice in which we are all interdependently engaged, and implicated.

By invoking the possibilities of transdisciplinary storytelling, I suggest, we may seek the good grace of non-human protagonists whom we should not have neglected, for only at our peril do we ignore who feeds us.

THE SEASON OF SORROW

In the iconic *Homeric Hymn to Demeter* summarized above, the goddess Demeter is noted as "the bringer of seasons", and she is the central protagonist of the story. Helene P. Foley comments that the story was fundamentally concerned with the agricultural cycle, since "Persephone is associated with the planted seed and absent while it is in the ground" (Foley 1994, 97). The text – which is only one version of a narrative that likely had multiple local variants in ancient Greece – resists a definitive interpretation, but the rituals associated with the cult of Demeter were practised with reference to the agricultural calendar (Brumfield 1981). There is more to the tale, however, than a "just-so" story about the origin of the seasons. The representation of the women's world and the mother-daughter relationship has drawn scholarly and popular interest.[2] It should be kept in mind that the principle characters in the story are *not human*, although they are personified and seen to interact as people. The mother-daughter theme is therefore essentially tied into broader concerns with the nature of reproduction, including the reproduction of domesticated and wild plants, whose collective flourishing is essential to sustain us.

In her analysis, Foley identifies kinship and social organization as a salient theme in the story, and suggests that the myth may have normalized a particular social structure. Anthropologists would emphasize, however, that the family relations in question cross the line between culture and nature. Implicitly, the kinship at stake is a more-than-human, multispecies kind of kinship (Kirksey 2014). Indigenous scholars remind us

2 The story of Demeter and Persephone has been analyzed for its insights into women's worlds and gender politics (Hirsch 1989), psycho-social themes of motherhood and mother-daughter relations (Irigaray 1994; Chowdorow 1994; Carlson 1997), and feminine symbolism (Agha-Jaffar 2002). Many literary adaptations have focused on feminine themes; for analysis of representations and cultural shifts see Radford (2007).

that our human kinships to seed, sprout, and tuber can go very deep indeed (LaDuke 1999; 2005). Consequently, the story of Demeter and Persephone cannot be reduced to a mere reflection of society or psychology in classical Greece. It is also necessarily a parable about the ongoing relations between people, soil, weather, and plants.

A famous Roman version of the tale in Ovid's *Metamorphoses* is called 'The Rape of Proserpine'. Although the beloved stolen daughter is always a key reference point, the central character remains the agricultural goddess, called Ceres by the Romans. Ovid's account is slightly different from the earlier *Homeric Hymn*, but it nevertheless emphasizes the anguish and wrath of Ceres (Demeter) when she finds proof that her daughter, Proserpine (Persephone), has been stolen away:

> Where the girl was, she knew not, but reproached
> The whole wide world – ungrateful, not deserving
> Her gift of grain – Sicily in chief
> Where she had found the traces of her loss
> So there with angry hands she broke the ploughs
> That turned the soil and sent to death alike
> The farmer and his labouring ox, and bade
> The fields betray their trust, and spoilt the seeds.
> False lay the island's famed fertility.
> Famous through all the world. The young crops died
> In the first blade, destroyed now by the rain
> Too violent, now by the sun too strong.
> The stars and winds assailed them; hungry birds
> Gobbled the scattered seeds; thistles and twitch,
> Unconquerable twitch[3], wore down the wheat.
> (Ovid, 'The Rape of Proserpine' lines 472–486, translation by A.D. Melville)

In the cosmology of ancient Europe, the seed, the environment, and the weather are all divine gifts. Each bears influence upon mortal fate. The harvest requires more than human agency. The abundance of agriculture is seen as the result of deliberate tending by Demeter/Ceres. Her inclination to nurture both children and crops is part of the

3 "Twitch" is a vigorous, invasive grass weed.

appropriate order of things, but when she becomes too distraught and angry to do so, there are severe consequences. Her suffering is potent. The goddess of agriculture is one powerful dame, whose moods are made manifest in the climate and the seasons. The violence of her grief thus wreaks havoc upon crops, leaving both men and gods hungry. All share this season of sorrow.

Periods of intense storm surges may have caused significant losses to coastal agriculture in the central Mediterranean during the mid-to-late Holocene (Kaniewski *et al.* 2016). This sounds very much like the grief of a divinity who brings the seasons. Whether or not these verses preserve some condensation of distant cultural memory, a literal interpretation is beside the point. The significance of the narrative lies partly in its evocation of the environmental vicissitudes inherent to basic food production in the Mediterranean basin, a key agricultural zone and a center of agricultural biodiversity. It anticipates some of the concerns of today's "climate fiction". Ovid's depiction could resonate all too well with 21st-century farmers as they begin to experience impacts associated with global climate change.

Consider some of the challenges confronted by cultivators and pastoralists on the Mediterranean island of Sardinia. Like Sicily (referenced in Ovid's text), Sardinia is a large Italian island, once among the granaries of Rome. Its main exports are primary products such as wine, cheese, and vegetables, while the majority of local and tourist food consumption is also provisioned from local agriculture. There is intensive agriculture in the lowlands, where enterprises are modernized with machinery, irrigation, and animal shelters. Extensive agriculture remains important in the mountains, a less prosperous area where open pastures and rain-fed cultivation predominate. Particularly in those highlands, some agricultural activities are orientated to the local subsistence economy rather than commercial production. The island's legacy of biodiversity is celebrated by its nature parks, but also embedded in traditional agro-pastoral systems. Sardinian heritage varieties of barley, lentil, grasspea, and other landraces are currently studied for their resilience characteristics, and the island is among the priority hotspots for the collection and conservation of crop wild relatives. The unfolding impacts of anthropogenic climate change are expected to bear heavy impacts across the island, from rising sea levels and decreasing precipitation, to "increased frequency of extreme events linked to the weather, sea storms, increased wave energy and the effects of prevailing winds" (Satta 2020). Recent examples illustrate the multispecies suffering that ensues from extreme weather events.

In November 2013, Sardinia experienced its most severe storm in decades, when Cyclone Cleopatra brought record downpours and heavy winds. Floods and landslides killed 18 people, affected thousands more, and did massive damage to infrastructures, causing a state of emergency to be declared. Although it was the death toll that held

media attention, the storm inflicted significant impacts on agriculture and ecological systems. Winter crops and livestock were directly affected. The storm left greenhouses, warehouses, farmsteads, cellars, and stables underwater, while vehicles, machinery, and vending outlets were damaged, supplies were blocked, fields were flooded, and many animals went missing. Insurance coverage was not widespread for smallholders and despite some government relief, the unfolding economic impacts landed on the shoulders of victims and communities who could scarcely afford it. Some losses to subsistence gardens and semi-formal herding enterprises that are a common mainstay of families in the economic margins of highland Sardinia were likely "off the books", but they nevertheless disrupted distinctive cultural ecologies of people, animals, plants, and pollinators.

Other kinds of weather extremes take their toll as well. In 2017, the island saw an exceptional winter blizzard in mid-January, hitting central Sardinia particularly hard. Hundreds of animals were lost in the rural highlands, a famous pastoral area; some herders were trapped by the snow and had to be rescued. Cheese production was hindered by transportation issues, and many small agricultural enterprises bore serious losses. A highly unusual late spring frost followed in April, damaging early crops and grape vines even in some of the lowlands. Then, Italy suffered one of its driest springs and early summers in 60 years. Heatwaves came in June and July/August, the latter sufficiently severe that it was named "Lucifer", with highs of over 40° C recorded in Sardinia. The water shortage grew so bad over all of Italy that Rome and Vatican City turned off their famous fountains, while ten regions, including Sardinia, requested state of emergency measures. The national agricultural association *Coldiretti* assessed damages to crops of vegetables, fruit, tomatoes, olives, grapes, and hayfeed across Italy at about 2 billion euros (Unione Sarda 2017). This does not, of course, take into account the impacts on the informal economy, which are harder to measure. In Sardinia, the drought, heat, and other weather anomalies of that year took a further toll on historic forests and wildland ecologies of the island.

Climbing global temperatures drive many effects on agriculture. A review of scientific evidence collected in the *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* confirmed that by 2014, the impacts of global climate change were already evident in several regions of the world, with existing trends indicating predominantly negative impacts on crop yields (Porter *et al.* 2014). Physical stresses such as extreme daytime temperatures are expected to affect yields of major grains, particularly when models with increases of more than 2° C are projected. Food production may also be affected by changing biotic stresses associated with weeds, pests, and diseases. The Intergovernmental Panel on Climate Change (IPCC) (2014, 488) has warned, "All aspects of food security are potentially affected by climate change, including food

access, utilization, and price stability". According to the Food and Agriculture Organization of the United Nations, FAO, a disproportionate burden of famine and food insecurity linked to climate change will fall upon people in poverty (FAO 2016a; 2016b). The most vulnerable include women and small farmers throughout the developing world, particularly in Asia and Africa. As a confirmed warming and drying trend continues in the Mediterranean, some of that same vulnerability will be felt in the cradle of classical Europe, where old stories of Demeter/Ceres are rooted (Seneviratne *et al.* 2015). Paradoxically, these historic agricultural regions of Southern Europe have now become the economic periphery of the European Union.

Thinking about the fragility of food systems in more-than-human terms must consider the political ecology of agriculture, because small farmers, herders, and subsistence gardeners play roles to safeguard multispecies biodiversity *in situ* (Brush 2005; Nazarea 2005). While instrumental conceptions of food security might focus on the continuing yield capacities of Sardinia's most modern commercial farms and livestock operations, the future of marginal and informal producers is important for agricultural and ecological resilience writ large. Study suggests that in the long term, water stress associated with climate change in Sardinia is likely to exacerbate the economic divide between rain-fed and irrigated agriculture (Dono *et al.* 2016). This divide roughly corresponds to the highland and lowland areas of the island, reinforcing old patterns of vulnerability versus relative prosperity. Sardinian mountain towns knew hunger and insecurity well into the mid-20th century, and the memory of it is not far away, as families struggle to get by in tough economic times. Changing climates portend new seasons of sorrow. How rural communities will fare through them is part of the larger picture of food security.

THE SOCIAL LIFE OF SEEDS

In the ancient story, Demeter's maiden daughter is the personification of potential fertility (cf. Foley 1994; Spencer 2003). As she is certainly more than human, we might think of Persephone as the embodiment of biodiversity that disappeared from the fragrant meadows and gardens of bygone days. In this aspect, she is a compelling metaphor for what is now thought to be the key to climate resilience in agriculture. Genetic erosion and agricultural yield losses are fundamentally about vanishing fertility; in contrast, it is the potential fertility of biodiversity that may enable acclimation and ongoing improvement of crops. Rereading the account of Persephone's absence as a nuanced reflection on relationships with plant life allows us to explore the so-

cial life of seeds.[4] Persephone's sojourn in the underworld is also charged with social transformation, a process that is largely outside of view, but profoundly important. This affords an opportunity to consider both *in situ* and *ex situ* conservation of plant diversity. Today, agricultural scientists are trying to ensure conservation of a multitude of marginal landraces and crop wild relatives for use in agricultural research supporting future adaptation to changing climates. Facing trials and endless exertions, they are seeking to rescue Persephone, *this seed which is not one*.[5] For as the embodiment of fertility, Persephone is an abstraction of biodiversity, symbolized by *polysporia* (multi-seededness). Take, for example, the complex, many-seeded stew of legumes, grains, pomegranates and raisins that is made as an offering at the annual special mass at the Church of Panagia Mesosporitissa, built near the site of the ancient temple to Demeter and Persephone in Elefsina, Greece. The revival of this recipe for *polysporia* reenacts the harvest rites of the Eleusinian tradition.

Persephone has been much on my mind since I sat in on the meetings of the Global Crop Diversity Trust partners in October 2015. There were rows upon rows of different kinds of pomegranate trees at the field gene bank of the Aegean Agricultural Research Institute (AARI) near Izmir, Turkey, where the meetings were held. The variety is astonishing, with over 120 different kinds kept in cultivation. Some produced fruit that is light and sweet, some that is dark and sour; our hosts shared samples during a tour of the facility before the day's presentations. AARI is the oldest gene bank in Turkey, and its carefully tended living field collections bear testament to the importance of the region as a center of origin and biological diversity for many crops. These resources are considered to be of national significance, and Turkey has just built a modern facility in Ankara. Along with the field collections, there are also *ex situ* collections of seed samples, which are catalogued and stored in deep freeze. Each sample conserved in the biorepository must be regenerated over time, to ensure that germination rates remain viable to perpetuate intra-species variability for use in research and breeding. The work of such living gene banks consequently involves cycles of seed collection

4 The term "social life of seeds" offers homage to Appadurai's (1986) theorization of how objects circulate in and through human social interactions, but my discussion also considers multispecies ethnography in recognizing that seeds are living things imbued with distinctive forms of agency. This is a slightly different approach than that taken by scholars who discuss "vibrant matter" (Bennett 2010), since it is not merely the inherent material agency of seeds that is at issue, but also the dynamic relational context of that agency (Abrahamsson *et al.* 2015).

5 Luce Irigaray's (1985) famous phrase "this sex which is not one" recognized the complexity of female genitalia with its multiple erogenous zones. Similarly, the multiplicity and complexity of biodiversity (that is, many different species in relationship, as well as many different individuals and potential recombinations of diversity within each species) is inherent to fertility.

and classification, along with "grow-outs" of seed for replacement, duplication, and distribution of samples.[6]

Such stores of biodiversity are increasingly in contrast with the monocultures of large industrial farms. Strategies to produce escalating yields, gains, and dividends have had unintended effects upon crop diversity. Many varieties cultivated before the Green Revolution have been lost, leading to genetic erosion (see Fowler & Mooney 1990; FAO 2004; Khoury *et al.* 2014). Unloved foods and the crops associated with them are forgotten, like old friends cast away for more advantageous society. Extinctions thus proceed apace, in the domain of human domestication as well as in the wild. As Deborah Bird Rose grieves, these losses represent "the unmaking of country, unravelling the work of generation upon generation of living beings; cascades of death that curtail the future and unmake the living presence of the past" (Bird Rose 2012).

To assuage these impacts, the Crop Trust worked in collaboration with the Kew Gardens Millennium Seed Bank on the initiative, 'Adapting Agriculture to Climate Change: Collecting, Protecting and Preparing Crop Wild Relatives'. In 2015, representatives from many of the collecting and research projects funded under this initiative were brought together in Izmir, along with the gene bank managers who gathered for the annual meeting. At the Izmir meetings, I met Penelope Bebeli, a plant scientist from the Agricultural University of Athens. She has carried out plant collections of landraces and related species in the Greek islands for many years, and is now part of a project sponsored by the Global Crop Diversity Trust to fill in gaps in existing gene bank collections of crop wild relatives. During her talk, Bebeli told her colleagues that long-term collaboration with communities could help create genuine, dynamic reciprocities between on-farm and *ex situ* conservation. In a presentation to a room full of gene bank managers, a few of whom might have been doubtful about collaboration beyond their own ranks, she explained that she has worked closely with anthropologists, sociologists, and local farmers on her collection expeditions. She noted that landraces (including vegetables, fruit, legumes, and certain grains) are still cultivated for local consumption in many parts of Greece. Because farmers working on small fields and terraces may not be able to irrigate, they do not switch over to the new seeds that have displaced local varieties in more productive regions; many local varieties can therefore be found in remote and isolated areas, particularly in the mountains and on small islands. These plants are adapted to the soils and harsh climatic conditions, and are suitable for low-input agriculture. They tend to be non-uniform, and are sometimes

16 Description based on interviews with Crop Trust personnel. See van Dooren 2009; Dalyan 2018 for discussion.

cultivated for that very reason (Terzopoulos & Bebeli, 2010, 143; Douma *et al.* 2016, 66). They are often culturally important. Since they have never gone out of cultivation, they have continued to evolve adaptive traits that may be useful in the context of climate change.

Bebeli's research methodology emphasizes reciprocal communication with farmers. Her teams undertake interviews with them in connection with seed collection. One of her presentation slides showed a glimpse inside one farmer's own special store of seeds kept in glass jars, in a simple cellar room. Bebeli noted that the farmer knew about field isolation, and appropriate places to plant. However, seeds stored and saved like this could not always be guaranteed free of disease, so her team encouraged only local seed exchanges, while collaborating with the national gene bank to characterize, evaluate, and register landraces for long-term conservation. They discussed the results of their research with the local community in order to strengthen their awareness of landrace value; for communities in the less-favored areas of Europe, the use of landraces has multiple benefits including the preservation of cultural heritage, and the ability to market unique local products.

While other presentations at the meetings focused on managerial standards, scientific methods, high-level politics, treaty compliance, and funding mechanisms, this effort to keep present a view from the periphery was important. Bebeli's research is focused upon a plant-science perspective of species diversity, but she gives us vital insights into the social life of seeds, revealing the importance of local food systems and economic strategies that conserve agrobiodiversity in the farmers' fields. During an intermission in the conference, Marie-Noëlle Ndjiondjiop, a senior molecular scientist from the Africa Rice research station in Benin, came to meet Penelope Bebeli. She explained that the work of anthropologists in her own region is also very important to acquire the relevant data for collections. Like Bebeli and her colleagues, they expect to work collaboratively with the community. Although national regimes for plant collecting differ, scientists in the network of international agricultural research centers (CGIAR)[7] reviewed and promoted ethical guidelines to govern the work of collection and use of genetic resources (Engels *et al.* 2011, 107).

Bebeli's work proceeds at the juncture of two worlds. On the one hand, seeds, plants, and their fruits are part of the social life of communities, passed from hand to hand as gifts, commodities, and legacies. They are objects of social, economic, and symbolic exchange. Fundamental to the material cultures of humanity, seeds inspire what Nadia Seremetakis calls the "memory of the senses", which entails a consciousness

7 CGIAR, formerly the "Consultative Group for International Agricultural Research", is now a global research partnership focused on food security.

of place and history (Seremetakis 1994). As popular awareness of genetic erosion escalates, particular varieties of seed have become affective symbols to people who have historically depended upon them. *Manoomin* (wild rice) for Anishinaabe peoples, maize in different areas of rural Mexico, and the potatoes important to Indigenous Andean communities are examples of cultural ethics of care for plant kin.

Seeds now also circulate through other social worlds connected to plant research, conservation, and breeding. Just as Persephone acquired a double life above and below ground once she became a matron and Queen of the Underworld, seeds play roles not only in the familiar domains of farmers, communities, markets, and consumers, but also in the less-visible sphere of scientists at laboratories, conferences, and field-sites. This sphere includes a network of actors in public and private institutions, governmental agencies, and non-governmental or intergovernmental organizations. These individuals tend to understand seeds in yet another culturally distinctive way. To them, the seed is not simply an integral plant embryo with a simple role in the living world. Their vision of the seed as a material resource operates at the micro and macro levels. Seeds contain a reservoir of genetic data, and are therefore interesting at the sub-chromosomal level. For this reason, seed bank managers and plant scientists extend an ethic of care to entire gene pools of each species. Historic collections are viewed in total, as a library of genetic traits, and a living toolkit of past and future evolution (c.f. Hartigan 2017). Specialized instrumentation and information technologies enable new forms of knowledge about the material nature of seeds to be produced. Care for both the living collection of seed and indexed biological information is fundamental to practices of scientific conservation and research.

Key advocates for seed banking emphasize that the worlds of *in situ* and *ex situ* plant genetic resource conservation are inherently complementary (see Fowler 2013; 2016). Yet the distinct ontological spheres in which these two forms of conservation are practised can be challenging to bridge. Seeds often mean quite different things to the laboratory scientist and the Indigenous farmer; the data infrastructures that make seed accessions and associated details kept by agricultural gene banks increasingly "transparent" to other researchers and a global public are not typically set up to store information about the cultural histories and intangible significance of crop landraces. At the same time, farmers who draw their seed from a local co-operative may have little idea that the varieties they use have been conserved, maintained disease-free, or improved for yield, quality, or resilience thanks to national or regional institutions that depend on public seed banks. The ancient story of Demeter and Persephone helps us to connect these worlds. Persephone becomes a subterranean or earth-dwelling, "chthonic" divinity who shares the power of her mate in the underworld (cf. Haraway 2016). With her mother's intervention, she is able to move back and forth across the

boundaries of the underworld, the world of the living, and the celestial realm of the gods. Her example may prove important to agrarian survival.

FERTILITY'S FATE

The forced marriage of Persephone has been a point of fascination in classical and folklore studies. In multispecies perspective, it raises compelling questions. Is Persephone's abduction a tale of biopiracy? Some social movements betray anxiety that seed banks and agricultural researchers might be complicit in pervasive agro-industrial profiteering (c.f. Shiva 2000; 2016). After all, Hades conspired with Zeus in his plan to procure a bride, then used stealth and force to carry off the maiden. He was possessive, and employed guile to keep her. The *Homeric Hymn to Demeter* calls out against a collusion of wealth and power that serves selfish private, political, or patriarchal interests. For the Romans of Ovid's time, the god of the Underworld was also associated with the wealth represented by the resources of the earth. Yet that is not the end of the story. Instead, our allegory seeks the positive renewal that follows from the re-establishment of respectful, productive relations across gendered, institutional, and cultural domains.

In classical Greek cosmology, the underworld is perilous, austere, and hidden, but not corrupt. Hades ruled sternly over the dead, but he was not malign (Felton 2007). In fact, Persephone's accepted mate remained unusually faithful and their marriage endured; it is this marriage that enabled her own passage into adulthood and established family ties between heaven, earth, and the underworld (Foley 1994; Suter 2002). Ultimately, Hades and Persephone governed their realm together, sharing agency. Hades had a limited role in the plot, and never fully controlled his wife. Our mythic analogy problematizes the polemics on biopiracy and inspires a more nuanced interpretation of fertility's fate. Although issues around the ownership, saving, and sharing of seed are certainly among pressing debates on the future of food and agriculture, it is necessary to complicate the role of the sciences (c.f. Gusterson 2005; Stone 2002).

Let us ask, then, how the projects of agricultural science are animated, and who accordingly benefits? The answers are open-ended. Agricultural modernization was associated with early to mid-20th century development paradigms emphasizing productivism and economic growth. These tended to bear the imprint of top-down, colonial, and male biases. Both social movement critiques and austerity schemes eventually changed the game. The growth of neoliberal partnerships in the late 20th century allowed for NGO advocacy, but also for the sway of notorious private interests. Institutional shifts were apparent when Fowler and Mooney (1990, 137) wrote: "Until the 1970s, much of the innovative force in plant breeding came from universities and state-run institutes … Now these public institutions – the last barrier preventing com-

plete domination of plant breeding by multinational petrochemical corporations – are dying." These corporations and their seed patents have had a growing role in global agriculture, and such structural transformations are a matter for deep concern (Kloppenburg 2004). Corporate control is not totalizing, however. A heterogeneous assemblage of organizations, partnerships, national frameworks, subject positions, and practices still engender multiple outcomes of scientific research and technological innovation in agriculture.

Like the "blasted landscapes" where cherished *matsutake* mushrooms eventually sprout despite massive environmental damage (Tsing 2014, 87), humane affective commitments frequently spring up in the public sphere, even as it, too, seems wrecked by capitalist predation. Efforts to protect seed resources and science as a social good have been launched through regional, grassroots, and international initiatives. Individuals at the meetings on 'Adapting Agriculture to Climate' in Izmir represented many universities and national institutes from different parts of the world, still dedicated to public mandates. Conversations at the conference included dynamic exchanges among scientists about social engagements and obligations entailed in the research they do. This reflects strong commitments on the part of scientists themselves. Their vision of the public sector could be a garden of renewal for multispecies futures, to the extent they are also willing to learn and prioritize what matters "from the bottom up".

Today, the CGIAR network mandates ethical considerations including the inalienability of rights of local and indigenous communities to plant genetic resources (see Engels *et al.* 2011). Direct engagement with cultivators in developing areas has become a priority. As seed repatriation and joint conservation projects set new standards of best practice for agricultural gene banking, some communities can see benefits to participation. The Potato Park partnership established in 2004 near Cusco, Peru is one example of a new model of seed banking as citizen science. The impacts of climate change in this area include rising temperatures, pests, and diseases that have pushed cultivation of staple potato varieties into higher and higher elevations over the past 30 years, with little arable land left. The International Potato Center (a CGIAR centre) works with five Quechua communities to help them restore diversity and reduce risk of crop failures, stewarding native knowledge and over 1,400 varieties of native potatoes. Farmers are directly involved in crop research to enhance climate resilience. Alejandro Argumedo, a plant scientist who directs programs for the local organization ANDES, emphasized:

> Rather than only collecting crops from farmers, scientists have also given farmers crops from their gene bank in return. The disease-free seeds and scientific knowledge gained have boosted food security, and the new varieties have enhanced income, enabling the communities to develop novel food products (IIED 2014).

New conversations bring different visions of seed into mutual focus, tempering scientific idioms with those of multispecies kinship. When Quechua Potato Guardians helped prepare samples for back-up storage at the Svalbard Global Seed Vault in northern Norway, Argumedo said, "Sending this collection to Svalbard is like sending our family members to a distant place for safekeeping, in case the rest of us need to be rescued by them in the future." (Crop Trust 2011). When the Svalbard Global Seed Vault was opened in 2008, media attention brought seed banking efforts into the limelight. Although conspiracy theories and critical debates have burgeoned alongside general interest, the vault has raised awareness of how climate change is already affecting world agriculture. It has contributed to the international co-ordination of *ex situ* conservation efforts, and celebrated the *in situ* stewardship of plant diversity by local and indigenous communities. If this 21st century icon of agricultural reproduction seems at first glance to resemble one more phallic architecture rising up to assert mastery over nature, let me playfully suggest that what is beckoning to us from this mountainside might instead be a clitoral affair. An installation of mirrors, prisms, and fibre-optic lights designed by Norwegian artist Dyveke Sanne is embedded in the visible anatomy of the building, so that its nub glitters with one woman's public commentary on the complexity of what lies within (cf. Mellis 2008). The secured entry into a tunnel running deep into the earth might be thought to resemble a vaginal cleft, leading inside thick layers of protection around distant hidden rooms where seeds are kept. The tunnel itself enjoys considerable romantic fixation in popular journalism and film documentaries. Diagrams of the vault show three interior storage rooms designed remarkably like the ovaries of the female reproductive system. It is a space of fertile possibility.

The inner sanctum of this seed repository might well have been pleasing to Persephone, who accepted her role below ground as well as above. Her part-time subterranean abode could have resembled such a vault, which is, after all, a space quite fit for a queen of botanical hibernation. Remember that modern hybrids and genetically modified organisms have no place in the Global Seed Vault; the plant collections there represent significant cultural heritage and possible futures of fertility. Seeds received at Svalbard are inalienable from their depositors but return to them at need to ensure that collections are not lost. As we have seen, they lead complex social lives, like Persephone herself.

Persephone, the embodiment of plant biodiversity, *this seed which is not one* (see Irigaray 1985), links both *ex situ* and *in situ* conservation in the reproduction of agriculture. She is an inveterate boundary-crosser (c.f. Haraway 1991). She is not too inflexible to acknowledge changing circumstances or accept pragmatic alliances. Taking her place in the chthonic realm secures her prospects, regenerating seed and society.

Persephone reminds us that a feminist conception of hopeful futures need not dismiss global science out of hand, nor relinquish faith in ancient knowledges. Her ability to adapt, to recombine, is a model of resilience.

Agriculture has involved the co-evolution of plants, pollinators, soil and gut microorganisms, pests, rusts, and hungry gatherers, scatterers, cultivators, and keepers. It has always been a multi-species collaboration. The classical peoples of the Mediterranean knew something about this. Like other peasant cultures, they were deeply aware that farming required both human tending and benign nonhuman agency. All this is apparent in accounts of Demeter/Ceres and Persephone. We know that even after her marriage, Demeter's daughter remained closely tied to her mother, just as plant fertility requires favorable climates for earthly abundance to flourish and reproduce. Mark how the old *Homeric Hymn* might be recalled anew, as a swelling of conversation about climate change asserts the urgency to address genetic erosion of agricultural crops as a risk to food security. Biodiversity is key. Seed banks are not enough, on their own, to help farmers and food systems cope with changing climates, but they give us better odds. Both old and new forms of care for our living food systems will be needed to weather the seasons of sorrow yet to come: reproducing agriculture will require better mutual understanding. We, too, must become boundary crossers, challenging "just-so" interpretations of the future of agriculture by nurturing grounded perspectives and collaborations. With their lively connections to soil and deep earth, Demeter and Persephone inspire us to balance the view from Mount Olympus with situated subjectivities. We can engage the tumultuous imaginary of the Anthropocene more critically, as the goddess of grain shows us (pro)creative ways to recalibrate our commitments to a more-than-human world, and to one another.

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Afterword
Towards an ontology of seeds for the Anthropocene

As I write this in the spring of 2020, a new invisible virus is traveling the globe and causing unprecedented changes in our social practices, eating habits, shopping possibilities, work lives, and governance regimes. While some people struggle to access food because they cannot stockpile it, the slowing and blocking of trade routes threatens global supply chains, and closed borders prevent underpaid – and often illegal – migrant workers from harvesting our food. All of this should remind us how we have often undervalued not only food, but also the seeds, plants, and their cultivators that bring food into being and into our kitchens. In this realization, the primacy of seeds as the first link in (many) food chains becomes ever more salient.

The *Seedways* volume shows us the myriad ways in which seeds also have traveled the globe, and the routes and relationships they have forged along the way. As seeds move, we can investigate what properties, knowledge, and social relations come to define them, and which get excluded. What discourses travel with them, shaping, and in turn being shaped by their journey, and what new networks do they bring into being? Where seeds have gone, other changes are sure to follow, enabling different types of relationships along the way. Seeds are indeed actants with their own kind of agency (Latour 2005).

And yet, as seeds move, assembling discourses and transforming social networks, how can we make sense of what seeds even are? Seeds as true shape-shifters: both natural and cultural, social and biological, material and symbolic, place-based and global; signifying and embodying different things at different times in different places to various communities along the roads they travel (Aistara 2011; Balázs & Aistara 2018). As Kikon (this volume) states, "Seeds and plants travel across continents and transform relations and landscapes."

These multiple and overlapping identities of seeds bring us to engage in an ontological exploration of seeds (Demeulenaere 2014). This does not mean merely sorting seeds, as it were, into Aristotelian ontological categories of substances, quantities,

relatives, or qualities (see Studtmann 2018). Indeed, that would prove a frustrating or impossible task – as we see even in this volume that while seeds are surely substances, they are also simultaneously the embodiment of relations and places and the signifier of time; seeds may be measured in quantities but are disputed for their qualities; seeds both act and are acted upon.

Rather, I suggest we investigate seeds through the relational politics of the recent ontological turn in anthropology (Kohn 2015). As the editors of this volume point out in the introduction, "Human history is fundamentally a multispecies story, and seeds thus function as a lens to trace relations and inter-dependencies between humans and plants." Indeed, as we see in the chapters of this book, humans "become with" (Haraway 2008) seeds. The various examples in this volume of what seeds are and what they become thus allow us to ask, in the words of Eduardo Kohn (2015, 313), "what we learn about the world and the human through the ways in which humans engage with the world. Attention to such engagements often undoes any bounded notion of what the human is." I would argue that humans' engagements with seeds throughout time have made and unmade us as humans and human societies, and thus have a great deal to reveal. In what follows, I share some reflections about what the cases in this volume show us about the agency of seeds and the mutual constitution of humans and seeds as a form of worlding.

As the title of this volume suggests, seeds can bring us down very different roads and paths, where sometimes seeds are the bridge that connects disparate places, things, or indeed worlds; sometimes seeds are the signposts along the way; and often seeds create their own paths and networks as they travel. Much like the spiders in Ingold's (2008) meshworks, they create new webs of material, symbolic, and political interconnections, weaving the world as they go.

SEEDBRIDGES

First, several of the chapters show us the important work that seeds do as roads, pathways, or bridges that actively connect disparate elements or groups of people.

In Müller's chapter in Canada, genetically modified canola seeds brought together an unlikely coalition of conventional farmers and political activists. These seeds, which had appeared on the side of the road and made it into Schmeiser's field, inspired debates about different conceptions of property as divisible or indivisible, and various forms of resistance, first as a form of stubbornness (*Eigensinn*), but gradually taking on also more political meanings. The dispute over the right to sow seeds on one's land thus also displays the *Eigensinn* of seeds to germinate and grow where they want, beyond human design.

Westengen investigates the long-term connections of co-evolution of maize seeds and New World societies. This happens both biophysically, as maize becomes a materially constitutive part of human bodies, and socially and symbolically, in creating cultures that consider themselves "people of the maize". Seeds of maize leave such a strong imprint on people's bones and societies that they can be traced thousands of years later. This can be seen both in the early Anthropocene as well as as a result of the post-WWII industrialization of agriculture and the widespread use of corn in animal feed. There is also a cultural change that can be traced, from how early maize-reliant societies developed the nixtamalization process that helps avoid nutritional deficiencies resulting from corn use in the diet, to how maize has become a political-economic agent of corporate agribusiness governance in the Capitalocene. These recent developments also mean that not only has maize seed served to connect people and plants, bodies and symbols, but also that it reveals the disconnects between democratic and economic systems in human societies.

Leino's chapter helps us gain a longer term understanding of how seeds create relationships "between crop diversity, climate, and humans". The heterogeneity of Swedish landraces used in the early 1900s helped them resist pest epidemics and contributed their flavour properties to flour. Farmers exchanged seeds to maintain this diversity, but always within the confines whereby it would not dilute the most important qualities of the population. While landraces are often considered primitive from the point of view of modern mechanized agriculture that relies heavily on inputs, these landraces were very well-adapted to the systems in which they evolved. The seeds of landraces of the past thus demonstrate how the cultivation of heterogeneity *in situ* can be valuable also for future climate adaptations to make for more resilient agricultural systems. They also help us see the shortcomings of seed laws, which have done as much to endanger landraces as has the introduction of modern agriculture.

Finally, Heatherington shows us how heritage seeds kept in gene banks can facilitate knowledge exchange between farmers and scientists and help to begin to connect the ontologically diverse worlds in which they live. Seeds thus help delineate our silos, but at the same time, seeds are "boundary crossers", linking science with multispecies kinship. Likening seeds to the fertility goddess, Persephone, who can transverse the above- and below-ground worlds much as seeds can live their lives *in situ* in farmers' fields as well as *ex situ* in gene banks, Heatherington shows that this ability to move between these sectors can be seen as a model of adaptation that is necessary for resilience.

Second, seeds are powerful symbols that act as signposts along the lifeways humans inhabit, from fertility (Heatherington) to marriage and reproduction (Århem), to knowledge, livelihoods, and biosocial landscapes (Kikon, Haider), through to death (Århem), or in the words of Zuryak, symbols for "everything that is dear to the human heart."

Århem discusses seeds as signs and symbols of biosocial reproduction. In eastern Indonesia, the ritual exchange of cultivated seeds is a requisite part of marriage ceremonies in both matrilineal and patrilineal societies. While in patrilineal societies, seeds become "a metaphor for the reproductive potency embodied by the future bride," in matrilineal rituals the semen is seen as the seed. Despite these opposing symbolic attributions, seeds are potent symbols in both, representing body and soul, respectively. And among the Iban people in Borneo, even headhunting rituals use seeds as a metaphor for the heads to be "harvested." These various examples from Southeast Asia attest to the deep cultural interlinkages between human and plant life cycles that govern both life and death.

In the Pamir Mountains of Tajikistan, *rashtak* wheat seeds become the object of rituals, bringing spring into being through the porridge made from them, and continuing age-old traditions even as all things around them change. Haider suggests that this raises a chicken-and-egg question of whether the culture exists because the seed still gets planted or whether the seed gets planted because the culture necessitates it? Seeds here become a powerful symbol and preserver of the biocultural landscape, and of the co-evolutionary relationships made up of environment, values, knowledge, organization, and technology. Within the ritual, seeds must resist fire to be planted and demonstrate that they have the strength to connect the values of "hospitality, sharing, and spiritual fulfilment." In other regions where introduced seeds have become more popular, those new seeds have brought with them other values such as production, growth, competition, and individual gain.

The seeds thus become "living repositories of this knowledge and practices" that will allow them to continue to be cultivated *in situ,* as well as adapt to climate change and grow in increasingly hotter climates.

Zuryak's piece reveals the many ways that seeds in the Fertile Crescent have been used as weapons, as tools of colonial conquest, as objects of capital, or as a form of resistance. This is why they often play such a key role during war and conflict. These multitudes of meaning accumulate into the control over seeds that can cause a metabolic rift, separating seeds from the land and humans from nature. Rabo, on the other hand, reminds us that despite the fact that seeds "contain the history and

the experiences of working the land", they can be easily taken for granted. Seeds were the very object that allowed her to trace links between corruption and steppe agriculture in Syria over decades, but remained themselves nearly invisible, hidden inside sacks and untold stories. Left unquestioned, unseen seeds are also easily lost as cultural heritage.

Kikon takes us to the Nagaland highlands of India and suggests that "seed stories highlight histories of community ties and relations." While heirloom seeds embody knowledge, collective memories, histories, and practices of indigenous groups, which are considered backwards by the state, hybrid seeds promoted by the state come to symbolize what residents perceive as the corruption and bad governance of the state. Hybrid seeds became the primary tool of a civilizing mission by the state, in a both material and metaphorical battle of seeds: "The purpose of the hybrid seeds was the 'defeat' of the local seeds." Kikon shows us how in this battle "culture" becomes a double-edged sword: invoked by the state as the explanation of the indigenous communities' refusal of the hybrid seeds, which thus eludes the political and militarized histories of the divide within which the different meanings attributed to the seeds must be understood. Seeds here reveal the degree of disconnect between the state, the Naga highland cultivators, and the young students who are soon-to-be state agents. Seeds were intended as a bond between new young agricultural field assistants and communities; instead they turned out to represent the breach that separated them. Seeds proved unable to heal larger rifts in agrarian political economies whereby young people with little interest in agricultural issues could find no other secure state jobs so had to endure the training and fieldwork at the insistence of their parents. For the young state agricultural trainees, seeds were "scary". As the trainees failed to learn much about seeds and the larger histories and conflicts which they symbolized, seeds memorized as a chore became "bearers of nothing but their own individual names" (Foucault [1966] 1994, 131).

SEEDWEBS

Finally, seeds also create new paths, roads, and networks as they travel, transforming and creating worlds as they go.

Karlsson's chapter shows us how tea seeds forged new pathways "from the forest to the plantation" and from "Assam across the Indian Ocean to East Africa and the Kenyan highlands." Along these journeys the plant has changed, becoming more productive and adapted to different conditions, but has also facilitated other changes, such as creating colonial livelihoods, and new claimed health products. The colonial transportation of the plant ended up changing the plant itself, creating new varieties

and hybrids – thus the seed's transfer brought an entirely new industry into being, including tea breeding for plantations in Kenya, with all of their attendant labor issues and simplification and destruction of forest landscapes, as encompassed in the critique of the "Plantationocene". These traveling plants show the relational interdependence of plants and people that co-evolve in a cumulative fashion, as each move of the plant "carries the history of all previous human entanglements and the places it has grown." Furthermore, human societies are shaped not only by the interaction with the plants, but also by their various traveling companion species, for example fungi, red spider mites, and root rot. Humans in their efforts to control plants sometimes try to undo such connections, for example producing hybrid clones that have displaced Assam plants grown from seed, but these often also sever desirable connections. We thus see that co-evolution can also sometimes be a form of violence – lessening genetic diversity or shortening plant roots, for example, and thus making both plants and people more vulnerable. We can only hope that humans can recognize the maladaptive nature of their own human ingenuity and inspire a return to more wild plants grown in more diverse forest ecosystems in the future.

In Sweden, Öhnfeldt demonstrates how heirloom seeds embody knowledge, practices, and exchange networks, and bring them all together again in inseparable ways. Here, as in Tajikistan and Nagaland, India, while improved seeds inspire narratives of growth, heritage varieties allow us to think more in terms of cultivation than growth and move "towards creating and valuing other aspects of farming and food production – such as taste, nutrients, and biodiversity." Heirloom seeds inspire farmers to transform the world, first by caring more about the soil, then by creating exchange networks among themselves, learning embodied practices from one another, and finally imparting this enthusiasm to consumers. Heirloom seeds can thus show us a new path out of the "efficiency trap" of modernized and industrialized agricultural practices that rely on synthetic fertilizers and pesticides. They remind us of the longer geological timeline along which agriculture and seeds have developed and that the current trend of industrialization is comparatively short. In fact, this ability of heirloom seeds to inspire actions in humans, to enlist their own advocates in the seed-savers who develop diversified practices in order to save them and create stories about them, may be one of their most important features. These seeds inspire stubbornness in gardeners who insist on continuing to grow them year after year, and attract affection, whereby plants and people enjoy a reciprocal relationship as old friends. Seeds, then, can facilitate a more than human sociality in the effort to "care for (other) species" (Hartigan 2017).

Yet Ellen also tells a cautionary tale about imbuing seeds with too much agency. He notes that discourses of seed symbolism have developed a hegemony of their own – outcompeting root crops with the "illusory supremacy of both gene and seed". He con-

tends that seeds have not been the only ones to transform the world. Other propagules may in fact be just as important as plant reproductive pathways, and have their own social lives. Seeds and pollen are more recognized historically because they can outlast propagules in the archaeological record, and are easier to take advantage of through commodification and storage. Vegetative propagules, like seeds, are also interdependent with humans, and are in some cases only made possible with human intervention. They have also been passed down for generations along kinship lines, have their own symbolic meanings, and abilities to fight off pathogens. In short, both seeds and other types of propagules have been important "in colonising the world and in shaping the Anthropocene", and are thus "implicated in intimate relations of biocultural mutualism with human social and technical practices".

WHITHER THE ANTHROPOCENE

Returning to Kohn (2015), what do these seed stories say about what it means to be human, in particular about recent claims about humans' supreme agency in transforming the planet?

As seeds reveal their own agency and social lives in the seed stories we have read, they cast the limits of human agency into stark relief. They remind us that we have co-evolved with seeds, learned from seeds, and are dependent on seeds and plants and their reproduction. Seeds are not mere objects, but active agents in these chapters, changing discourses, relationships, people's bodies, and even the course of history. Seeds, in fact, may ultimately have more power than humans, allowing us to question the notion of the Anthropocene. Without seeds and other types of plant reproductive materials, humans would never have been able to persist, let alone wreak havoc on the world. Without seeds and other plant propagules, would humans be able to survive the current pandemic and beyond? Even the "Plantationocene" is in the end dependent on seeds from which hybrid plants could be made. These lessons should humble us as humans, and encourage us to take the arrogance of the "anthro" out of the Anthropocene (Crist 2013). Perhaps what these seed stories can teach us is that to be human is to admit that we do not have control over seeds (or the planet), but rather are entangled in myriad relationships at their behest.

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