Plants as Records of Human and Biological History : Exploring the Ethnological Collection

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Plants as Records of Human and Biological History: Exploring the Ethnological Collection

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Archives are important in all research disciplines and are often established for very specific purposes. Over time, collections of materials and data may acquire new significance. Botanical and economic botany collections have largely been established for and valued by biologists, while ethnological collections have largely been established for and valued by anthropologists. Recently, the significance of economic botany collections as 'biocultural archives' has been highlighted in several publications. Initial exploration of the ethnographic artefact collection of the National Museum of Ethnology reveals that although the range of materials is very broad, plants are the predominant source material across all periods of time represented in the collection. It is argued here that ethnographic collections are not only significant for human history and human source communities, but also for biological history and biological source communities, and for the deeply entangled history of human and plant relationships. The discussion is illustrated with a limited number of examples and concludes with suggestions for an imaginary future exhibition at the Museum.

1. Introduction

In recent decades, the palaeosciences of archaeology, archaeobotany, and palaeobotany have provided increasingly detailed information about past uses of plants and human interactions with plant communities. Studies on plant systematics, ecology, and evolution have also advanced greatly, powered by new methods of genetic analysis and the use of large amounts of DNA sequence data from present-day to ancient source materials. Together, the palaeosciences and genetics have played leading roles in our current understanding of plant evolution, the natural and cultural history of environmental change, and the domestication of many crops. All these disciplines are important because plants are the primary physical foundation for all human life, harnessing sunshine and nutrients to provide food, medicine, materials for production, and energy (Beerling 2019; Smil 2014). They are also deeply embedded in our aesthetic, spiritual, and religious views of the world (Dahill and Erickson 2019; Raguso 2020). No long-term general history of human life can be written without reference to plants, nor can any recent local history. Plants have been and still are important to humans, and *vice versa* (Rupprecht et

al. 2020), on all chronological and spatial scales.

The palaeosciences have led to research on our long-term relationships with plants, providing chronological frameworks for other approaches (e.g. by providing fossil reference points for calibration of 'molecular clocks' in phylogenetic studies). Historical ecology embraces the palaeosciences (Szabó 2015) and sees human history as being embedded in landscapes and ecosystems that have been shaped by human activities over thousands of years: landscape itself is a historical archive. Meanwhile, anthropology, ethnology, ethnobiology, and ethnobotany in particular, have provided many contemporary and historical starting points for deeper explorations into human relationships with plants.

One way to broaden our view of human history, human relationships with plants, and plant potential is to consider the diversity of plants represented in historical collections of ethnological artefacts. Ethnological museums have preserved artefacts from diverse societies across all regions of the world, beginning with historical times when most of us still lived in environments dominated by plants, and still depended on them to produce most material culture, including houses, boats, carts, furniture, textiles, ornaments, domestic utensils, farm tools, and public infrastructure.

According to Yoshida (2020), the National Museum of Ethnology (hereafter 'Museum') holds 'the world's largest ethnographic collection built mainly in the late 20th century.' Nevertheless, many of the artefacts come from earlier historical periods, so the collection spans the global transition from pre-industrial to industrial production. Shelton (2018) reviewed the philosophical and logistical origins of the Museum's collection and the manner of its exhibition, noting:

> Unlike most ethnographic museums, Minpaku is a museum of the immediate past — cultural innovation, hybridity, the reuse of materials and objects for different purposes, and the globalised circulation of objects and images are highly visible (Shelton 2018).

In the following sections, I review the development of collections that contain plant materials, and then offer a glimpse into the historical transition from pre-industrial to industrial production, using a pilot survey of collection dates and object materials found in a random selection of ethnological artefacts held at the Museum. The aim here is to expand thinking on the ways of looking at ethnological collections and learning from them.

2. Collections, Plants, and Ways of Knowing Plants

Social scientists and biologists alike have given special attention to plants that have contributed significantly to modern or present-day human economic and cultural development, that is, to plants and the diverse production systems that underpin agriculture (Vasey 1992). Major economic plants that are easily preserved and highly visible in archaeological records (corn, rice, or wheat, for example) have been the most studied of all plants. An understandable human bias favours the attention given to major economic plants, their associated production systems, and their cultural significance. This

creates a reinforcing feedback loop in which research targets dominant crops and dominant production systems, amplifying their apparent importance in the past, providing practical support for their dominance in the present, and increasing our dependence on a narrow range of plants for food, fibre, wood, and other purposes. This process has been discussed in more detail with regard to taro, a globally distributed food plant and 'orphan crop' that now competes with the dominant food crops for attention (Matthews and Ghanem 2021).

In the plant sciences, plant materials are usually collected for research in taxonomy, palaeobotany, evolution, ecology, and crop development. The research is often very specialised, with little connection to the social and cultural roles of plants in human life. When a connection is made, it is usually in relation to contemporary economic interests. This is reflected in the name of one of the best-known academic journals for studies of useful plants, *Economic Botany*, which is published by the New York Botanical Garden for the Society for Economic Botany. Articles in this journal often embrace the broader field of 'ethnobotany,' which extends to non-economic plants, and interactions between humans and plants generally, but the economic emphasis remains. Botanical gardens have a long history of introducing economic plants to their living collections, not just for educational purposes, but also as active participants in economic development. This was most famously the role of the Kew Botanical Gardens, which was established during the emergence of Britain as a global economic and colonial power (O'Brian 1987; Fara 2003; Nesbitt and Cornish 2016). Kew today has a very large collection of economic plant products, assembled primarily to illustrate the utility of diverse plant taxa:

> The collection holds around 100,000 objects. These include raw plant materials and artefacts representing all aspects of craft and daily life worldwide, including medicines, textiles, basketry, dyes, gums and resins, foods, and woods. All plant uses and most parts of the world are represented, with an emphasis on the former British Empire. Most specimens date to the period 1847 to 1930, but about 2,000 specimens are still added each year (Kew 2020).

As educational organisations, botanical gardens are sites for education about the diversity of plant life in specific regions of a country, all countries, and the entire world, each according to its mandate and capacity. According to Friedman (2020), 'botanical gardens and arboreta are not typically viewed as museums of natural history,' but can be 'reconceptualised as museums of living, evolving objects' that more explicitly educate the public about the process of evolution. Living plant collections are already used to illustrate human relationships with plants (with a focus on economic relationships), and plants as members of evolving plant communities (including anthropogenic plant communities). However, the non-living plant materials represented in artefacts held in ethnological collections are not used in these ways; the artefacts are primarily seen as artefacts, and the wider significance of their exact material composition is rarely obvious.

Most ethnological collections are composed of non-living objects or artefacts produced using natural materials derived from nature, such as plants, animals, and

minerals. Of all the kinds of knowledge and relationships associated with artefacts and plant materials in their original contexts, symbolic or philosophical knowledge and relationships may be the least likely to be preserved when the materials are stored in museums, out of context. Labels and lists attached to artefact collections generally offer very brief information on the source location and date of the collection, name(s) of the collector(s), ethnic group or community name(s), object name(s), main functions, material or material type (broadly categorised), and method of production — and further information is often lacking or difficult to find.

With such data, historical research related to plants is mainly focused on narratives related to plant exploitation, economic development, and the social significance of artefacts, that is, of humans using plants as inanimate, material objects, or resources. In reality, however, plants are often also regarded as living organisms with their own agency or personhood, or as the embodiment of various kinds of living spirits (Stone 1974; Rival 1998; Gammage 2012; Hall 2019). As collected materials, artefacts inevitably lose their original significance, or become separated from — though still significant for — their source communities. The objects found in ethnological collections are often so far removed in space and time from their source communities that the specific source communities no longer exist or cannot be easily found. Nevertheless, old traditions of plant knowledge still persist in many living communities, and for some collected artefacts, we can still learn (a) what plants were used, where they were obtained, and how they were transformed into artefacts that have been preserved or recorded, and (b) what the artefacts, materials, and plants mean for the people themselves (da Fonesca-Kruel et al. 2019). The entire process of creating an artefact has cultural and practical significance: from managing wild and cultivated plant communities to obtaining plant materials, transforming them, and living with the products.

The present is a very different world from the one inhabited just a few generations ago (cf. *The Past is a Foreign Country*; Murphy et al. 2017). Smil (2014) has highlighted the enormity of recent material transitions that have created the present world. From the late 19th century, new energy sources (fossil fuels), mass production of metals, and the use of modern machines greatly expanded the consumption of traditional materials such as clay, brick, gravel, and cut stone. Some uses of wood declined, while others expanded. Overall, there has been a vast decline in natural forest cover (Williams 2003). It is difficult to conceive of the full extent of the loss of traditional knowledge of materials, globally, following the industrial revolution. At the same time, we face an almost overwhelming range and depth of new knowledge of new materials and new ways of living, knowledge that is shared, integrated, and elaborated by an ever-increasing global population.

What we have lost is not just the traditional knowledge of recent centuries, but also the knowledge of more distant ancestors. Ethnological collections are far removed in space and time from the worlds inhabited by our distant ancestors, however many generations ago, yet they also have significance for archaeologists who struggle to peer into the deeper past. The practical and theoretical difficulties for extrapolation from the ethnographic to the archaeological are well-known among archaeologists (Currie 2015),

but ethnographic collections will be forever of interest for archaeology.

A central concern of my own research, for many years, has been the question of how we can learn about the human past from the living plants that we use, carry, plant, and cultivate. I have not been concerned with any pre-defined period of measured time, but rather with the kinds of relationships we have had with a particular plant species (Matthews 1996, 2014; Matthews and Ghanem 2020; Peñailillo et al. 2016; Spriggs et al. 2012), or with assemblages of plant species (Matthews 1995, 2006a, 2006b, 2017; Matthews and Gosden 1997; Yoshida and Matthews 2002). We can make very few assumptions about the time depths of these relationships. As someone trained in both archaeology and evolutionary biology, I am very conscious of — and dependent on — the measured time-scales used in scientific research. Yet, I find much to agree with in Gosden's (1994) book, *Social Being and Time*: when we think about human relationships with plants, we must also consider the social construction of time and history with it. There is also the biological nature of time to consider, in which plants live on spatial and chronological scales quite different from those of humans (Wohlleben 2016; see also Kingsland 2018). In the past, in the absence of measured time (or clock time), human time in general may have been more congruent with biological time, although time can be perceived in different ways by different members of a given society (Ton 2013), and biological time is also heterogeneous. Today, in the industrialised world, we are in conflict with biological time, pressing selected plants to produce ever more, ever faster, in ever smaller spaces, with their performance checked against the clock and calendar. Gammage (2012: 129) notes the disturbed reaction of Central Australian women when shown one of their wild foods, a 'bush tomato,' grown in 'neat horticultural rows' as a new potential cash crop. For these women, the plant is a living totemic ally and kin, identified as such in creation stories and the Dreaming.

Despite the historical and modern focus on economic development, there is also a long history of anthropological and ethnological research in which descriptions of human ways of living pay close attention to the economic, aesthetic, and symbolic roles of a diverse range of plants. This aspect of ethnological research is evident in the colonial era literature that coincided with the establishment of many ethnological collections, but it is not always possible to connect published observations and plant identifications with specific collected artefacts. Today, the broadest vision of the study of human and plant relationships is perhaps expressed in the mission statement of the Society of Ethnobiology (SEB), a non-profit professional organisation that is:

> ...dedicated to the interdisciplinary study of the relationships of plants and animals with human cultures worldwide, including past and present relationships between peoples and the environment. Our interests encompass ethnobotany, ethnozoology, linguistics, paleoethnobotany, zooarchaeology, ethnoecology, and other related areas in anthropology and biology (SEB 2020).

Emphasising the less material aspects of ethnobiology, Olsen (2013) noted that her field of traditional ecological knowledge (TEK) lies within ethnoecology, which, in turn,

lies within ethnobiology, which also includes the study of 'economic, cognitive, social, symbolic, psychological, spiritual, and ecological influences on ethnobiological knowledge.' Although the creation of archival records is not a commonly stated goal, there is no doubt that all research activities encompassed by ethnobiology are *de facto* creating archival records that are being managed in a multitude of ways, by private individuals, institutes, universities, and museums, including the National Museum of Ethnology, Japan.

3. Plant Materials in the Museum Collection

The National Museum of Ethnology was led for many years by Tadao Umesao, an ecologist who was also an anthropologist (Matsubara 2011), and since establishment, many staff have carried out research related to ethnobotany and ethnobiology, hunting and gathering, agriculture and crop history, or specific cultural traditions involving plants and animals. Such work is reflected in a permanent display of food plants and farming tools highlighting American crops (beans, chilli pepper, corn, potato, pumpkin, sweet potato, beans, tobacco, and others) (Figure 1), which have become part of a global biocultural diaspora known as the 'Columbian Exchange' (Crosby, Jr. 2003; Nunn and Qian 2010). Another permanent display of European textiles and textile plants emphasises the historical role of linen flax, *Linum usitatissimum* (Figure 2). Despite these important displays, there has not been any concerted or general effort, to the best of my knowledge, to identify the botanical sources of plant materials represented by artefacts held in our collections. A brief visit to our exhibition galleries or storerooms is enough to see that a very large proportion of the collected artefacts were made using plants, and they were

Figure 1 Crops and tools for farming and food preparation, in the permanent South America Gallery, National Museum of Ethnology. Actual plant products as well as plastic reconstructions are shown. (display designed by Norio Yamamoto and others; photo by author, 2019)

Figure 2 Production of linen textiles illustrated with raw plant materials, tools, processed fibres and finished products, in the Europe Gallery, National Museum of Ethnology. (display designed by Akiko Mori and others; photo by author, 2019)

often made entirely from plants.

Most artefacts are composed of specific plants for practical reasons related to construction and function, and also for ornamental or symbolic reasons. Plant materials are also often combined with other natural or synthetic materials. In most records associated with each artefact at the National Museum of Ethnology, the specific plants used are either not named at all, or are identified in generic plant terms — e.g., 'grass,' 'bamboo,' 'vegetable (= plant)' — or functional material terms such as 'bark,' 'wood,' 'straw,' 'fibre,' or generic product categories such as 'rope,' 'cloth,' 'mat.' In the Museum collections, 'bark' is recorded as a material for 1,359 objects from Africa, Europe, Asia, the Americas, and Oceania. Across these regions, the flexible and strong inner bark (bast) from various trees was previously used to prepare beaten or moulded fibre fabrics that were then used for mats, clothing, painting, printing, and writing. Recently, we examined part of a collection of 105 sheets of barkcloth collected by George Brown in Oceania from the 19th to the early 20th centuries. The plants used to make and colour these cloths were not identified at the time of collection and are difficult to identify today as different plants can be used to produce superficially similar cloths, and not all pigments used over a century ago are still used today (Richards and Matthews 2021; see also Section 4 below).

Some commonly and widely used plant materials in the Museum's collection can be identified because the Japanese-language material name used by Japanese collectors represents a specific plant. For example, rice straw (*ine-wara*) is a commonly recorded material, whereas crop straw that is not rice is often identified generically by the term

mugi-wara (generally wheat, barley, or oat straw). In the Museum's collection, at least 2,000 artefacts from Japan and other countries were made using 'straw' (*wara*) of one kind or another. Although this example appears quite clear, when vernacular names are used by collectors and source communities to identify plant materials, it is often very difficult to relate such names with certainty to specific botanically recognised taxa. This does not negate the need for collectors to record names with which they and their source communities are familiar with. The important point to note is that care and effort are always needed for translation between different naming systems and cultural traditions.

To survey the chronological sequence of materials used in artefact production, an electronic database covering the entire, globally sourced Museum collection was searched (National Museum of Ethnology 2020). The database (in 2019) had approximately 265,000 ethnographic objects registered, of which approximately 60,000 (23%) were accompanied by information on the materials used for construction and the date of construction. A random selection of 400 objects (chosen using a random number table) was studied to determine which construction materials appeared most frequently in which periods. Of these, 347 had sufficient information for the present analysis. Since the exact dates of construction are rarely recorded, we created broad time period categories that correspond to known broad or major shifts in the size and nature of industrial production globally (Table 1). The time periods were 1) up to the early 20th century, with a threshold date of 1925, 2) the 20th century (1926–1975), and 3) the late 20th century (1976 and after). Within each time period, the numbers in each column of 'material type' add up to more than the number of objects found, as many objects are made with more than one kind of material.

In Table 1, 'plant' is clearly the dominant basic material in all three periods, found in 89% to 65% of objects in the earlier to later periods, respectively, with a large decline between the early and mid-20th century. Other materials used in each time period are also shown. These appear in much smaller proportions, but there are clear increases in the use of metals and in two categories that may include plastics, namely 'other' and

Table 1 Changes in materials used to make objects collected in three different time periods. The period 'to early 20th century' includes objects collected before the 20th century (mostly during the 19th century). For each time period, the percentage of objects that include plant material is also shown, in brackets.

Time period	No. objects found	Plant, incl. paper, cloth	Not plant						Not plant' (Totals)
			Animal	Metal	Earth	Glass	Others	Artificial	
to early 20th c.	62	55 (89%)	4	7	1	0	1	0	13
mid 20th c.	82	54 (66%)	6	17	8	3	6	4	44
late 20th c. & after	203	131 (65%)	25	38	11	6	26	11	117
Totals	347	240	35	62	20	9	33	15	174

(Source: National Museum of Ethnology database 2020)

'artificial.' A larger sample set is needed to analyse the trends in other materials, and ideally with direct examination of each object, but this is beyond the scope of the present article. A study of collecting reports is also needed to learn what the main goals were while the museum assembled its collection, and how these may have changed over time. In the discussion that follows, I will return to the title of this paper.

4. Plants as Records of Human and Biological History

Currently, there are apparent disconnections between the historical study of living plants, plant remains in natural and cultural contexts, and plant materials in ethnological collections. Botanical gardens, palaeobotanists, and archaeologists all give close attention to the creation of reference collections used to assist plant identification, and thus to the identification of the materials that they collect in the field and manage in archival collections. The *Economic Botany Collection* at Kew Botanical Gardens (Kew 2020) may be the world's most accessible, large reference collection relevant to the identification of plants in ethnological museums. However, even at Kew, the range of ethnographic materials identified is limited, relative to the global diversity of artefacts produced by humanity, and the taxonomic level of identification is highly variable. When we consider the historical significance of plants used to construct artefacts, exact identification does matter, as the choice of plants used is often critical for practical and cultural reasons in the original physical and cultural contexts. Different systems of classification are used, in vernacular and scientific contexts, so effort is also needed to translate between what are often precise vernacular or emic identifications, and the current scientific or etic taxonomy: when neither the emic nor etic identification is known, it is difficult to discover the history and meanings embodied in material culture.

For institutions without direct access to physical reference materials, economic botany collections with online access can serve as useful starting points for identification. Other relevant information is likely to be scattered in the ethnological and biological literature and a great variety of online sources. An ideal approach is, of course, to consult the living communities where the same or similar artefacts are still made or at least known. The challenge is to find not only the source communities, but communities for whom the relevant plant resources remain intact and accessible, despite the global assault on forests and biodiversity within the last hundred years (Williams 2003).

A further practical problem becomes apparent when we consider what kinds of useful plants are collected. Ethnological collections are generally concerned with 'products.' Many useful plants are not incorporated into easily collected and storable products but are instead consumed or destroyed in the process of being used. The most obvious example is food. It is relatively easy to collect and preserve unprocessed raw food materials, using standard biological collection methods for example, but most food products are inherently unstable and easily degraded by fungi, yeasts, and bacteria: we process food plants to make them easy to consume, and this makes it easy for other organisms to consume them. The main exception may be dried foods and condiments that have been prepared for long-term storage (the basic problem of food decay led to the

invention of the common household refrigerator and freezer; I do not know of any ethnological museum that keeps a permanent collection of frozen food products, but our Museum collection does include two refrigerators collected in Korea and Japan). In my 30 years of fieldwork looking at taro and related plants in many different countries, I have not been able to collect any food products other than the peeled, dried, and smoked corms of taro (*Colocasia esculenta*) from Taiwan (a product called *korai* in the Rukai language, as reported by Matsuyama, 1973), and a dry, coarse flour made from kape (*Alocasia macrorrhizos*) in northern India.

Perhaps the other main use in which plants are consumed is fire-making: although the ashes of different plants have different properties that can be practically significant, it is not common for ethnologists to collect firewood or the ashes from fires lit for different purposes (forest clearing, soil modification, cooking, housewarming, metal making, pottery making, ash salt and lye making, ritual, and so on). Although small amounts and pieces of ash, firewood, kindling, match sticks, coal, or charcoal are easy to collect and store, only 27 examples of these materials can be found in our Museum collection (an approximate figure depending on how duplicates are counted, and not including incense sticks). Similarly, few examples are apparent in the Kew Economic Botany Collection (Kew 2020). Given the enormous role of fire in human life and global environmental change, this seems to be a neglected topic in ethnological collections.

Plants can also be used as living things that are neither consumed nor transformed into portable, storable products. Living plants, plant populations, and mixed plant communities can be managed and modified for various cultural and economic purposes. Examples include the creation of living fences to control animal movements or to create windbreaks for houses, gardens, fields, and settlements. Modification of living landscapes occurs on many spatial and temporal scales and has been dramatically outlined for the entire continent of Australia and its long occupation and modification by Aboriginal peoples (Gammage 2012). Along the shorelines of most Pacific islands, including those of islands in Southeast Asia and southern Japan, modified coastal plant communities of *Calophyllum*, *Cocos*, *Cordia*, *Hibiscus*, *Pandanus*, *Rhizophora*, *Terminalia*, *Thespesia* and others are widespread (Merrill 1945; Mueller-Dombois and Fosberg 1998; Whistler 1992, 2009). These common coastal plants are sources of useful raw materials (food, fibre, fuel, and timber), and form a salt-tolerant plant community that also provides living shelter and erosion control for coastal settlements throughout the Pacific. Many of these plants have been recorded at coastal archaeological sites (Lepofsky 1992; Matthews and Gosden 1997). Many collectable agricultural tools, including baskets, are made using wood, fibre, and leaves, but their uses as living things in the landscape are less known. Coconut palm fronds can be found in ethnological collections in the form of house thatches or baskets, but the fronds are also used to mulch wetland taro gardens in the Pacific islands. Although this use is important for taro production, it is doubtful that rotting palm fronds have ever been collected as ethnological artefacts; the fronds as mulch are another example of a cultural material that is consumed (in this case, by soil biota) and not collected or regarded as collectable.

Further challenges are presented by the sheer numerical abundance of useful plants,

currently estimated to be approximately 40,000 species, including those with known or potential utility as close wild relatives of existing crop species (Diazgranados et al. 2020). This list represents an initial global set of candidate taxa for the identification of source materials in ethnological collections. Candidate taxa for a particular usage can be narrowed down, as each species in the list is identified with one or more known uses. Use categories in the list are based on 'economic botany collection standards' published by Cook (1995) and include ten main ('level 1') categories: medicines, materials, environmental uses, human food, gene sources, animal food, poisons, social uses, fuels, and invertebrate food. Although 'gene sources' appears to be a very modern scientific category, many wild plants have contributed genetically to useful managed vegetation and crop development in the past, with or without deliberate human selection.

An example of 'animal food' is the use of mulberry trees as fodder for silkworms (Figures 3 and 4). Other plant materials depicted are wood or bamboo for the table, racks, vertical poles, ledge, knife handle, hairpins, baskets, chopped-leaf collection tray

Figure 3 Collecting, cutting, and feeding mulberry leaves (*Morus alba*) for silkworms (larvae of the silkmoth, *Bombyx mori*). Reproduction Ukiyo-e woodblock print (1916), based on a print by the artist Shunshō Katsukawa from the series, *Silkworm Cultivation* (*Kaiko yashinai gusa*) (1726, or 1743–1793) (c. 1772). (collection of the author)

with chopping block inside, leaf feeding trays, and the internal reinforcement of the wall, as revealed in the lower right. The mud plaster used for the wall surface likely contains straw, and the living tree outside may be an ornamental cherry tree (note the pointed, elongated leaves in contrast to the broader mulberry leaves in the basket at right). The farm women are clothed in fabrics that are not clearly identifiable, in part because they appear to be based on the styles of Ukiyo-e 'beauties' (*bijinga*), and also because actual farm clothing was made with a wide range of textile plants (S. Yoshimoto, pers. comm. 2020). Decorated clothes such as those shown must have been dyed with plant dyes, as the original picture predates the development of synthetic chemical dyes. The woman at the right carries a small pipe with a shaft of wood or bamboo, used to smoke tobacco, which was introduced to Japan from Portugal in the late 16th to early 17th centuries (Suzuki 2004). The method of cutting mulberry leaves into small pieces before feeding them to newly hatched silkworms was borrowed from China, and care of silkworms was typically the responsibility of women (Morris-Suzuki 1992). The print itself is made on paper (*washi*) made from paper mulberry (*Broussonetia* sp.) and may employ natural plant-based pigments and/or modern synthetic pigments. This example of just one scene related to sericulture (silk production) illustrates how intensively human life can be involved in multispecies relationships with plants and animals.

The range of candidate sources for a given artefact can also be narrowed down by considering the known geographical distributions of useful plants in the natural and introduced floras of particular regions, and modern patterns of trade in raw plant

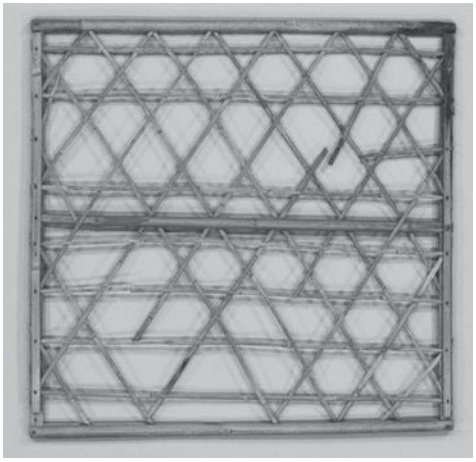

Figure 4 Sericulture equipment: a silkworm feeding tray collected in 1978 in Mie Prefecture, Japan (National Museum of Ethnology, H0035672, bamboo, approx. 80cm across, 691g). Trays made from cheap and light materials were easy to change or dispose of when dirty, an important consideration for maintaining hygiene and reducing the spread of disease among silkworms. (Morris-Suzuki 1992)

materials. The selection of candidates can then guide a search for the comparative data needed to identify a specific source plant (in an atlas of wood anatomy, for example).

From an anthropological perspective, the categories employed in a standard list are inherently incomplete and unsatisfactory. By definition, the list cannot incorporate non-standard categories of use recognised in diverse societies, and it assumes a universal set of relationships between humans and plants. This contradiction is inevitable, and is one of the reasons why anthropology, as a discipline, must engage more deeply with biological materials to perceive how people have engaged with them.

Just as anthropology and anthropology museums have struggled with how to preserve and present ethnological collections (Shelton 2018), biologists and natural history museums have struggled with how to preserve and present economic botany collections (Nesbitt and Cornish 2016). The latter authors recognised the diversity of ways of thinking about 'nature and culture,' and their stated desire was to 'increase awareness amongst researchers and museum practitioners of the richness of ethnographic material to be found in former and extant collections of economic botany.' They and others prefer to think of economic botany collections as 'biocultural collections' (Nesbitt and Cornish 2016; Salick et al. 2014). The present article is, in part, an attempt to increase awareness among biologists (and anthropologists) of the richness of plant materials to be found in extant collections of ethnological objects, including objects from the industrial period of world history. As shown in Table 1, even the relatively modern ethnographic collection at the National Museum of Ethnology is largely composed of plants and can be regarded as a biocultural collection.

History is embedded in ethnological collections, not just because of the broad historical context of their creation. It is embedded in the particular stories of each artefact, each plant, and each society. It is also embedded in how landscapes, plants, artefacts, and humans are bound together through multispecies interdependencies that have sustained our own existence until now (Rupprecht et al. 2020). Understanding these relationships requires engagement not only with human source communities, but also with biological source communities. The latter are just as significant for ethnological objects as human and cultural source communities, especially when emic views of relationships between humans and the living world are considered. The fact that the biological dimensions of ethnological collections have been neglected reflects the etic, utilitarian, and anthropocentric origins of most such collections.

Since biology is also embedded in ethnological collections, biologists interested in environmental history, biodiversity, and biocultural diversity can expect the unexpected when looking at large collections of materials that have not been studied from a biological perspective. I recently encountered the unexpected when looking at a series of blue-dyed barkcloths collected by George Brown in the Solomon Islands in the late 19th or early 20th century, as part of a larger collection of 105 cloths (Richards and Matthews 2021 and section 3 above). My expectation was that all or most would be derived from paper mulberry (*Broussonetia papyrifera*), a tree widely used to make paper and barkcloth in Asia and Oceania (Chang et al. 2015; Matthews 1996, 2006a; Peñailillo et al. 2016) (Figure 5). Instead, we found that all or most were made from *Artocarpus* sp.

Figure 5 Distribution of paper mulberry (*Broussonetia papyrifera*) in Asia and the Pacific, based on botanical literature and herbarium collections. Subsequent studies (cited in text) found that the Polynesian plants are derived from one or more female parents (through clonal propagation) and originate in southern Taiwan. (Matthews 1996)

(breadfruit), *Ficus* sp. (fig), and possibly (in one example) *Antiaris toxicaria* (upas). We also found that, internationally, uncertain identification is the rule rather than the exception for ethnographic collections of barkcloth. Despite their persistence from antiquity to the recent past or present, many barkcloth traditions and their source plants remain poorly understood. The barkcloth traditions of islands in Southeast Asia are especially intriguing as they involve diverse plant sources, suggesting a possible role for barkcloth in the origins of paper as a medium for writing (in the form of beaten bark paper), and might also have possible links with the beaten bark paper traditions of Central America (Sakamoto 2011). By investigating the George Brown Collection, we came to know of the widespread role of the breadfruit tree (*Artocarpus* sp.) in barkcloth production in Oceania (see also Mills 2020). This tree was likely domesticated in the region of Southeast Asia and Melanesia, but recent research on the origins, domestication, and dispersal of breadfruit has not considered the role of this tree as a source of bast fibre (Richards and Matthews 2021).

5. Conclusions

In this paper, I have highlighted the biological and predominantly botanical character of the ethnological collection at one museum. The degree to which this is apparent in the collections of other museums of ethnology and anthropology will vary, but older

collections are likely to have an even greater predominance of plant materials. I have not attempted to cover practical issues such as techniques for identification and conservation; the main point to be made in this regard is that many methods employed in natural history museums are likely to be relevant for ethnological museums, and vice versa, since the basic sources (plants and animals) are similar. However, conservation staff at ethnological museums face additional, complex issues arising from the fact that artefacts are often complex composites of many different kinds of materials, both organic and synthetic. To learn more about these issues, and many of the cultural aspects of managing biocultural collections, the volume edited by Salick *et al*. (2014) is highly recommended.

In this article, I have also emphasised that an ethnographic collection can be a starting point for learning about biological history, just as it is a starting point for learning about human history. In both the social and biological sciences, there is a strong tendency to specialise in areas where human interactions with the living world are not obviously relevant: a cultural anthropologist may focus on human kinship and genealogy, for example, while a plant taxonomist may focus on plant systematics and phylogeny. The exception is in cross-disciplinary areas such as historical ecology, archaeobotany, ethnobiology, and ethnobotany. In these areas, there are more obvious reasons to pay attention to ethnological collections and to consider how they can be used for research, education, and exhibitions.

Art history can be added to this list of cross-fields. In 2014, a surprising collaboration developed between the National Museum of Ethnology and Tokyu Bunkamura, a private cultural centre in Tokyo that displayed a collection of botanical art in an exhibition titled *Captain Cook's Voyage and Banks' Florilegium* (Bunkamura 2014; Johnston 2019). At the behest of art historians employed by the centre, the National Museum of Ethnology provided ethnological materials representative of areas visited by the first Cook expedition to the Pacific Islands and Indonesia, 1770–1773. The resulting exhibition included artefacts similar to those collected during the expedition, and displayed the botanical art created by Sydney Parkinson and Joseph Banks with captions indicating the cultural significance of each plant, if known. The exhibition thus highlighted the close connections between botany and ethnology early in the history of both fields of research, and suggested a model for integrating biology into the ethnological display, using historically salient art. The present tabulation of artefact materials and chronology (Table 1) shows that plant materials have been integral to the production of cultural artefacts throughout the history of ethnographic collections and remain important in the modern world.

Indeed, it can be predicted that as long as artefacts continue to be collected in ways that represent human life in general, plants will continue to be added to ethnological collections. This begs the question of how to collect modern materials and what to record in the biocultural world of the 21st century. How can new interactions with plants be represented through artefacts? The PCR (polymerase chain reaction) machine used to detect human disease (its major use in the current coronavirus pandemic 2020–2022) is also an indispensable tool in the modern identification of plants and the development of agriculture: should such a machine be introduced to the museum as a collected artefact

or a diagnostic tool for the museum laboratory, or both? To address anthropological concerns with biocultural interactions, can we discover new ways to choose, collect, and display ethnographic materials? Contemporary collection practices and the nexus of tangible (material) and intangible cultural heritage are major areas of discussion for modern anthropology museums (e.g., Feest 2013; Antoš 2014; Fromm 2016), but I have not yet seen detailed discussions of the biocultural aspects of contemporary collections among anthropologists.

As representations of how plants can be used and perceived, historical ethnological collections may help expand our understanding of useful plant 'archetypes' and 'ideotypes' (Matthews 2017). What is it that we wanted and now want from plants? What can we offer plants as co-creators of the biological communities to which we belong? What can plant breeders and other plant scientists learn from historical and anthropological understandings of their work and their roles in the construction of new ecosystems? In the modern world, how are plants perceived by urban peoples who have become divorced from direct and intimate contact with the biological world?

As humans become increasingly densely packed into treeless urban environments, the realm of the imaginary (Yamanaka 2019) may become larger, not smaller. This seems to be happening already. Many newly imagined regions and beings portrayed in popular culture are inhabited by creatures descended from the living world that we previously encountered in fields, forests, skies, rivers, lakes, and oceans. Ethnographic collections can help connect us to the actual biological world from which we came, and to which we still belong, even if we have built walls, literally and figuratively, that block our view and direct our attention inward.

Of course, without imagination and inward reflection, we would not be human, but we cannot live through imagination and reflection only. In ethnographic collections, evidence of our past relationships with the living world around us can help us understand our present limitations and potential. What any single museum can collect and exhibit is limited. Like all museums, the National Museum of Ethnology has biases and gaps in its collections, in the information associated with those collections, in its exhibitions, and in its ability to connect collections and research to the source communities (human and biological) that the Museum depends on. There is also no specific gallery for the global economy and globalised society, supported by collection of globally distributed cultural materials. Although modern materials have gradually entered the regional galleries of the Museum (Shelton 2018), the impression they give is not commensurate with changes that have taken place within the short lifetime of the Museum itself. Providing a stronger impression of these changes might require an exhibition with materials that represent office, factory, and plantation work, service industries, electrical engineering, manufacturing, public transport, urban housing, information technology, and other aspects of modern life.

As a botanist who loves plants, it goes against my own instinct to imagine such an exhibition, but perhaps this is why it is needed: to contrast the past wealth of our biocultural communities with the homogenising, destabilising effects of global deforestation, urbanisation, and industrialisation. As in the film *All Is Lost* (Chandor

2013), the end of this unbalanced scenario is ambiguous. In the film, a sinking boat and protagonist suggest an allegory for society, but the focus is on hope and resilience. To survive, we must imagine the possibility of living, and to live well, our future life will require plants. Museum collections demonstrate this.

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