DOMESTICATION: SOME FOOD FOR THOUGHT?
QUESTIONS TO EXPLORE THIS MORNING

What is domestication?

What do we know about origins and spread of domestication on different continents?

How can we study these processes today?

What came before domestication?

How should we define food production?
Domestication of plants and animals and the transition to food production often termed The Neolithic Revolution.

Phrase coined by Vere Gordon Childe in 1934.

Emphasised domestication of plants before animals, shift from a nomadic to settled/sedentary way of life, invention of pottery, changes in stone tool (lithic) technologies (polished stone).

A New Stone Age (Neolithic).

From which we see demographic increase, rise of political complexity, elaboration of arts and crafts – CIVILIZATION.

Long believed to have begun in the Near East – knowledge, people and domesticates spread from there.
Oxford English Dictionary (OED)

1. The process of taming an animal and keeping it as a pet or on a farm

As in: Domestication of animals lies at the heart of human civilization.

2. The cultivation of a plant for food

As in: The domestication of selected species of plants by deliberate human intervention marks a key innovation in human history, eventually leading to radical transformations of society.

3. The process of making someone fond of and good at home life and the tasks that it involves

As in: Despite her understanding of the pitfalls of domestication, however, she never gives up her claims to freedom or to a home for her family.
Domestication is “a sustained multi-generational mutualistic relationship in which humans assume some significant level of control over the reproduction and care of a plant/animal in order to secure a more predictable supply of a resource of interest and through which the plant/animal is able to increase its reproductive success over individuals not participating in this relationship” (Zeder 2013: 2184)

Listen: https://www.youtube.com/watch?v=mBuYUb_mFXA
COMBINING CULTURAL AND BIOLOGICAL PERSPECTIVES

- A biological process that involves changes in the genetic make-up (genotype) and physical characteristics (phenotype) of plants and animals as they become dependent on humans for reproductive success.
- Intentional versus unintentional
- Human versus non-human agency
- Selective pressures, intended and unintended consequences
- Human-Thing-Non-Human Species entanglements
- Not just about food production
- Human manipulation of other species may not always result in genetic or phenotypic changes
Animals have been domesticated on every continent that has developed a food producing economy.

Locations for initial domestication have been pinpointed by a combination of archaeology and genetics.

Surviving examples of early domesticated versions of animals have been found on some islands, e.g. Soay in Scotland, Sardinia, and west of Ireland.

All domesticated species started out as wild animals hunted for food (except wolf?).

Later some species became sources of meat, milk and wool and some were also put to work, i.e. became a source of traction.

Domestic animals may also be a source of comfort.

Physical evidence for the transition to domestication is often ambiguous.
SEEING DOMESTICATION IN ANIMALS

- Morphological Analysis
- Metrical Analysis
- Demographic Profile Analysis
- Genetic Data

Wild aurochs (*Bos primigenius*)

Cow (*Bos taurus*)
Faunal remains – i.e. bones – can be identified to species

Morphological analyses – changes in physical characteristics – size reduction, shape, mass, dentition

Demographic Profile Analysis – provides insights into the degree and type of management and slaughter patterns

Changes reflected by series of successive stages

EG Seasonal selective culling; the preferential killing of young and/or males (over breeding adults) of a free-ranging animal population but only during the one season of human contact

Year-round selective culling of a free-ranging animal population; the conscious preferential killing of the young, males, old, diseased, non-producing (non-pregnant) adult females

Subsequent sex- and age-based selection depending on herd management strategy (for meat, dairy)

Indirect evidence – corrals, dung spherulites & plant remains, fungal sores, drove-ways
Morphological changes in seed crops selecting for larger seeds and/or more seeds per head

*Pennisetum violaceum*
Wild progenitor

*Pennisetum glaucum*
Domesticated pearl millet

Artefactual evidence – such as grinding stones, sickles, and microscopic traces on these - starch residues, phytoliths, ‘sickle gloss’ – but can be ambiguous

The characteristic bushy architecture of wild progenitor species was altered and branch number strongly reduced

African domesticate – several locations across the Sahel/Sudanic Africa, earliest c. 4800 BP
Macrobotanical remains of seeds and fruits
Sizes of grains or fruits often increased under domestication
Shape, size, fruit or seed coat thickness, surface texture, and dehiscence mechanism
Charred plant remains have limitations for directly addressing ancient cuisine because they are carbonized and often represent waste rather than food
  - necessary to control for puffing & shrinkage
Paleofeaces have also provided some insights into ancient diets

Plant microfossils (starch granules, pollen, and phytoliths)
Recovered from human dental calculus, cooking residues on ceramic vessels, and on the surfaces of grinding stone tools
  - Phytoliths provide evidence of plant parts such as stems, leaves, and glumes, which are rarely preserved in the macrobotanical record
  - Pollen can be used to reconstruct the local environment and is especially useful for signaling changes in climate or landscape management
  - Starch granules are often used to document the presence of tuber crops that are poorly represented by seeds or fruits

Both are subject to different forces of deposition and post-depositional alteration – conflicting information, differential preservation
SEE(D)ING DOMESTICATION

- Selecting for seeds that rely on people to disperse them, rather than wind/animals/water etc. This allows people to more efficiently harvest.
- Non-shattering rachis
- May also see changes related to favouring easily de-husked seeds (these changes are later seen in sorghum and millets) call this free-threshing seeds.

Human selection focused on the seed and shaped the generally small-sized, naturally dispersed and coated wild seed into the typical cereal grain, large, naked, devoid of dormancy and dispersal ability
POTENTIAL AND DIFFICULTIES OF aDNA

- Success in identifying wild progenitors of domesticates and reconstructing phylogenies
- Challenges of greater levels of interspecific hybridization in plants compared to animals
- Success in identifying ‘domestication genes’
- Success using mtDNA to spot domestication in animals
- Challenges of using nuclear DNA to spot domestication in plants
SIMILAR TRAITS OFTEN SELECTED INDEPENDENTLY IN DIFFERENT WILD SPECIES

A genetic basis of this parallel phenotypic evolution – in maize and millet
Domesticated animals are those that were ultimately genetically modified from their wild ancestors by artificial selection for use by humans, whose breeding and maintenance is controlled, and whose use for food, secondary products and/or energy benefits a community or society.

A different process from mere taming of genetically unmodified representatives of wild species and maintaining them in captivity.

Degree of suitability of wild animals for domestication depends largely on the degree of their genetic variability and the match between husbandry conditions and species-specific behavioural patterns expressed in the wild.

BUT why begin with the WOLF?!
Dogs were the first domestic animal and the only animal domesticated before the advent of settled agriculture.

Two separate, independent centres of domestication – Asia & Europe.

The first remains confidently assigned to dogs appear in Europe ~15,000 years ago and in Far East Asia over 12,500 years ago.

An initial wolf population splits into East and West Eurasian wolves that were then domesticated independently.

The eastern dog population then dispersed westward alongside humans at some point between 6400 and 14,000 years ago, into Western Europe.

European Neolithic dogs have different genetic make-up to European Palaeolithic dogs.

https://www.youtube.com/watch?v=ejfRldqS-Nk
THE POWER OF GENETICS

[Diagram showing genetic relationships and domestication of dogs]

Tibetan mastiff
C. 40,000-10,000 years BP

- Neanderthals and Modern Humans in Europe – Neanderthals as a species had disappeared by 33,000 years ago
- Hunting-Gathering-Fishing – stone tool using
- Stone tools - primarily blade-based technology – sophisticated & elaborate; use of spear
- Other materials, including bone, antler, shell and wood were used for both artistic and working tool types
- Lived in caves, rock-shelters, also open air sites with huts or tents - most huts with semi-subterranean (dugout) floors, hearths and windbreaks
- Hunting became specialized, and sophisticated planning is shown by the culling of animals, selective choices by season, and selective butchery
- Occasional mass animal killings suggest food storage was practiced in some places
- Rock art, jewellery, symbolic elaboration – including around wild animals, such as bear
- Organised probably in small bands of 30-50 people
- Long-distance exchange of stone/stone-tools
DIVERSE AND COMPLEX TECHNOLOGIES OF THE
LAST GLACIAL MAXIMUM, C. 18,000 BP
INITIAL DOMESTICATION OF THE DOG IN EUROPE

Magdalenian (17,000-11,000 BP)
CANID DOMESTICATION: HOW AND WHY?

- Wolves (Canis lupus), the ancestral species, and behaviourally modern humans co-existed for thousands of years
- Earliest securely dated, unambiguous osteological evidence for dogs found in Eurasia, dated to < 15,000 BP
- Transitional examples c. 16,000-17,000 years ago
- How and Why?
  - The ‘town dump’ model
  - The thyroid hormone model
  - The self-domestication model
- Reduction of fear and aggressiveness; incorporation of some young wolves into or quite near a human social setting; subsequently growing up in that setting; formed some of their primary social bonds with people at a critical young age
- Niche Construction – a Mutual Entanglement
- A particular lineage of wolves successfully navigated changing ecological dynamics by becoming incorporated into human society – dogs are essentially grey wolves
Chicken, aubergine and pea pilaf

**Ingredients**
- 1½ tbsp sunflower oil
- 1 small onion, chopped
- 1 aubergine, cut into 1.5cm pieces
- 6 chicken thigh fillets, cubed
- 2 tbsp mild curry paste
- 250g essential long grain rice
- 500ml chicken stock
- 150g essential frozen garden peas
- 3 tbsp chopped dill

https://www.youtube.com/watch?v=MVVvF7PWo-I
Lepinski Vir, Iron Gates Gorge, River Danube, c. 9500/7200-6000 BC
Modern hunter-gatherers are precisely that – MODERN and not ‘Prehistoric remnants/survivors’
BUT they are marginalised – socially, economically, politically and often environmentally
They have long histories of interacting with farming and herding groups, and urban dwellers – they make choices about how they want to engage with these other populations
They typically can claim to be the autochthonous (Indigenous) inhabitants of the areas they inhabit
CROSS-CULTURAL COMPARISONS

Hunter-Gatherer Tool Kit Diversity & Time Budgeting
SEASONAL MOBILITY

Ju/'Hoansi (!Kung San) practice an immediate return system – moving their home base repeatedly over the year to ‘map on’ to resources as they become available.
NUNAMIUT SEASONAL SETTLEMENT DYNAMICS

Annual cycle - closely related to the annual migrations of caribou

Spring: The main caribou migrations happen in March and April, when caribou move north through Anaktuvuk Pass to feed on the plains.

Autumn: The caribou hunting cycle repeats in September and October when caribou retreat south again.

Nunamiut practice a ‘delayed return’ system – they move their camps less frequently because they store food and other resources. They also have more ‘logistical camps’ – such as for hunting parties.
Studies of present day hunter-gatherers indicate that they have considerable leisure time.

Until recently, the !Kung bushmen of the Kalahari desert were gatherers. They mostly ate 14 plants. They recognized 105 species of edible plants. Their diet was quite good in protein and in total calories. They worked about 2.5 days per week to gather food.

Agricultural societies work harder.

Populations of hunter-gatherer peoples usually are maintained below the carrying capacity.

Many people with hunter-gatherer life styles used fire to control or manage both plants and animals in their area.

Greater social equality in hunter-gatherer societies – common sexual division of labour, but strong social pressures on sharing.

Fluidity of group membership; can be territorial but can cross these boundaries

Complex belief systems, sophisticated artistic traditions

Fewer dependencies on material things

WHY BOTHER?
Cultivation
• Human action that enhances the survival, reproduction or growth of certain plants

Domestication
• Genetic and morphological changes in a plant population resulting from selective pressures imposed by cultivation

Agriculture
• Form of land use resulting from either cultivation and/or domestication

Pastoralism
• The practice of keeping and rearing sheep, cattle or other domestic grazing animal as a primary source of food. Often requires settlement mobility – seasonal basis called transhumance, year-round basis called nomadism
Cooking makes foods more edible
Cooking made more plants usable by humans
There is an association of cooking and detoxification of plants
Humans were using fire as much as one million years ago
Many hunter-gatherer societies know all they need to know about growing plants, but don't
Some gatherers plant seeds. Some replant parts of root crops. Some irrigate
**A LONG DRAWN OUT PROCESS**

- Increasing labour input per land unit
- Increasing size, density and duration of settlements
- Increasing population density

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When societies transition from hunter/gatherer/forager/fisher to agricultural/pastoral
• See increasing sedentism (settlement size, and duration of occupation)
• Increasing population density
• Increasing social complexity (inequality and entanglements)

“Domestication gave rise to food surpluses, and this led to craft specializations, art, social hierarchies, writing, urbanization, and the origin of the state” (Purugganan and Fuller 2009).

Hunter/gatherer/forager/fishers that don’t fit the mould:

• Jomon culture of Japan – sedentary complex hunter-gatherers growing a bit of millet sometimes, cultivating chestnuts

• Hunter-gatherer-fishers on Pacific North-West coast of America – sedentary complex hunter-gatherers cultivating hazelnuts, creating clam gardens
DOMESTICATION NOT ABOUT A FEW CENTRES

INDEPENDENT CENTERS OF DOMESTICATION

pepo squash 10,000 B.P.
Maize 9000-8000 B.P.
Common bean 4000 B.P.

Moschata squash 10,000 B.P.
Arrowroot 9000 B.P.
Yam (D. trifida) 6000 B.P.
Cotton 6000 B.P.
Sweet potato 4500 B.P.
Lima bean 6500 B.P.
Leren 10,000 B.P.

Potato 7000 B.P.
Quinoa 5000 B.P.

Peanut 8500 B.P.
Manioc 8000 B.P.
Chili pepper 6000 B.P.

Rye 13,000 B.P.?
Emmer wheat 10,000 B.P.
Einkorn wheat 10,500 B.P.
Barley 10,000 B.P.
Fig 11,400 B.P.?

Broomcorn millet 8000 B.P.
Foxtail millet 8000 B.P.

Rice 8000 B.P.
Foxtail 8000 B.P.

African rice 2000 B.P.
Pearl millet 3000 B.P.
Sorghum 4000 B.P.

Mung bean 4500 B.P.
Horse gram 4500 B.P.
Millets 4500 B.P.

Yam (D. alata) 7000 B.P.?
Banana 7000 B.P.
Taro 7000 B.P.?
EARLY DOMESTICATION IN SOUTHWEST ASIA

- Natufian – c. 15,000-12,000 BP
- PPNA – c. 11,700-10,500 BP
- PPNB – c. 10,500-8,700 BP
- PN – c. 9,000-6,900 BP

- Younger Dryas – c. 12,750-11,550 BP – a ‘temporary’ reversal of the onset of warmer conditions that began around 16,000 BP
- Ending of the colder conditions of the Younger Dryas around 11,550 BP / 9600 BC marks start of a new geological epoch – the Holocene
- Significant rise in global sea levels, but not a unilineal process

Uncalibrated dates BC/AD
- Calibrated dates BP

Radiocarbon dating – based on measurement of residual $^{14}$C in organic samples
- A radioactive isotope – known rate of decay – half-life of 5730 years
- Originally believed to occur in stable ratio to the stable isotope $^{12}$C
- Production of $^{14}$C in the upper atmosphere has fluctuated

Hence needs calibrating – use of tree rings – compare calendar age with radiocarbon age
- Larger herd animals – in decline since c. 40,000 years ago
- After c. 20,000 years ago see development of broad spectrum hunting – a mix of smaller (fox, hare, tortoise, birds, fish, frogs) and medium sized (especially gazelle) prey
- A corresponding increase in exploitation of wild grasses and pulses
- Decreased settlement mobility – less frequent moves provided opportunities, perhaps, for tending plants – e.g. removing competitors, selective planting; closer interactions with certain wild animals – such as the mouflon
- Direct evidence for cultivation – intentional preparation of fields, sowing, harvesting and storing seeds – from c. 11,500 years ago (9500 BC)
- Domestic forms of plants and animals present by c. 10,500 years ago
WHAT EMERGED FIRST SEDENTISM OR DOMESTICATION?

- An Epipalaeolithic culture – eastern Mediterranean
- Sedentary or semi-sedentary hunter-gatherers
- Semi-subterranean round houses, often stone foundation
- Sites typically in open Oak/Pistachio woodland belt
- Mircolithic stone-tool industry
- Exploited wild cereals, perhaps ‘cultivated’ them, also gathered nuts, emphasis on hunting gazelle – also deer, ibex, onagers, waterfowl, fish
- Broad spectrum exploitation of local resources
- Domestic dog c. 12,000 BP
A MOSAIC OF DOMESTICATION EVENTS

- Wild Einkorn Wheat
- Sheep: 11,000
- Cattle: 10,000
- Pigs: 10,500
- Goats: 11,000

Fertile Crescent

Wild Emmer Wheat
Wild Barley
Sheep - genus Ovis. Comprises between three and nine species

Three major groups of Eurasian wild sheep – mouflon (O. musimon), urial (O. vignei) and argali (O. ammon) major groups of Eurasian wild sheep – mouflon (O. musimon), urial (O. vignei) and argali (O. ammon) – all possible progenitors

Oldest domesticated forms of sheep c 11000 BP – Zagros Mountains

Goats – genus Capra - three distinct mtDNA lineages

Five distinct centres of goats domestication: the Euphrates valley (ca 11000 years ago); the Zagros Mountains (Iran) (ca 10000 years ago); the Indus Valley (Beluchistan, India, ca 9000 years ago); and the Southern Levant and the central Anatolia (ca 9-10000 years ago)

Cattle were domesticated in the Near East from the wild and now extinct aurochs (*Bos primigenius*), c. 8000 - 10000 years ago

Larger than *Bos taurus* - a form with long horns - oldest

First short-horns c. 3000 BC Mesopotamia,

Common in Europe by c. 1000 BC
EINKORN, EMMER, AND BARLEY

Domesticated wheat
Einkorn: *Triticum monococcum* subsp.

Emmer: *T. turgidum dicocum*

Triticum sp. Wild wheat – fragile spike with brittle rachis

Non-fragile rachis, free threshing
WHAT TRIGGERED DOMESTICATION?

- Oasis propinquity theory – Gordon Childe
- Culmination of increased specialisation in hunting and gathering more secure food supply, increased sedentism – Robert Braidwood
- Demographic pressure – climatic deterioration made the landscape less resource rich (resource depression), new ways of securing a food supply and storing it were needed, turn to under-exploited resources
- Social pressures – greater desire for communal living, drive first toward sedentism, then the means to support sedentism
- Niche construction – long-term consequence of humans deliberately manipulating environments & resources to increase overall biotic potential
- Behaviourally, they are gregarious, prefer to be in groups, defenceless against predators
- Develop more wool and less hair
- Colour of wool & hair changed from brown to whites and blacks
- Horns were weakened or disappeared

Mortality profiles of early herds reflect a meat-oriented herding strategy
Dairy use by about 6000 BC, northern Italy (sheep and goats), 5800 BC western Iran (sheep and goats), 5500 BC Greece (sheep), 4000 BC the northern Balkans and the alpine forelands of Switzerland (sheep, goats, and cattle), and 1000 BC in Britain but quite possibly as early as 3500 BC (cattle).
**ARTEFACTUAL EVIDENCE**

- **Rock art showing ploughing with cattle**, Capo di Ponte, Italy
- **Clay model of a wheeled cart**, from a grave at Szigetszentmárton, Hungary, late 4th millennium BC
- **Spindle whorl**, Tell Abu Hureyra, c. 6500-5500 BC
- **Linearbandkeramik ceramic sieves** (c. 5500-5000 BC), Central Europe
The remains of the earliest known African domestic cattle date to about 7,800 years ago.

Clay model of four cows was made in Egypt over 5000 years ago.

The figurine shows the form of the earliest domestic cattle in Africa, with high shoulders but without humps and graceful, lyre-shaped horns. They resemble modern Kuri cattle of Africa’s western Lake Chad.


Listen: http://www.bbc.co.uk/radio/player/b00q2p6b
MULTIPLE EVENTS, MULTIPLE PLACES, MULTIPLE TIMINGS