Draught animals in ancient Mesopotamia and today: the invaluable donkey

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Abstract

Donkeys have commonly been undervalued in discussion of draught animals in antiquity, due partly to a traditional emphasis on oxen, but also a result of their general archaeological invisibility, with their remains only rarely found in food middens.

My work focuses on Mesopotamia in the 4th-3rd millennia BC. Donkeys, native to north-east Africa and brought as domesticates to Mesopotamia, were initially eclipsed in archaeological consideration by a powerful model of cattle traction proposed by Andrew Sherratt in his Secondary Products Revolution hypothesis. Cattle were indeed employed for traction in Mesopotamia from an early stage. Donkeys were acknowledged by commentators as long-distance pack animals, but recognition of their widespread use for traction from the 3rd millennium BC – as evidenced in cuneiform texts and depictions – is only now coalescing in archaeological discussion.

Modern development studies of working animal use, notably in sub-Saharan Africa, demonstrate the various virtues of working donkeys over cattle, for small farms in particular. While cattle have more tractive power for heavy soils, and can have value for milk and later meat, they require rich pasture and plentiful water. Donkeys are drought-tolerant and low-maintenance, requiring little herding and able to live on low-grade foraged materials; behaviourally, donkeys are far easier to train and handle. They are widely used for draught (ploughing and carting) in various regions, but working-animal use must be addressed holistically: donkeys are additionally invaluable for pack work, capable of carrying far more per live-weight than cattle.

Résumé

L'âne a souvent été sous-estimé dans les discussions sur les animaux de trait dans l'Antiquité, en partie à cause de l'accent traditionnel mis sur le bœuf, mais aussi à cause de son invisibilité archéologique générale, ses restes n'étant que rarement trouvés dans les dépôts de nourriture.

Mon travail se concentre sur la Mésopotamie du 4e au 3e millénaire avant Jésus-Christ. L'âne, originaire du nord-est de l'Afrique et domestiqué en Mésopotamie, a d'abord été éclipsé dans la considération archéologique par un puissant modèle de traction bovine proposé par Andrew Sherratt dans son hypothèse de révolution des produits secondaires. Le bétail a en effet été employé très tôt pour la traction en Mésopotamie. Les ânes étaient reconnus par les commentateurs comme des animaux de bât sur de longues distances, mais la reconnaissance de leur utilisation généralisée pour la traction à partir du 3e millénaire avant J.-C. – comme en témoignent les textes et les représentations cunéiformes – n'apparaît que maintenant dans les discussions archéologiques.

Les études modernes sur le développement de l'utilisation des animaux de trait, notamment en Afrique subsaharienne, démontrent les diverses vertus de l'âne par rapport au bétail, en particulier pour les petites exploitations. Si les bovins ont une plus grande force de traction pour les sols lourds, et peuvent avoir de la valeur pour le lait et plus tard la viande, ils ont besoin de pâturages riches et d'eau en abondance. Les ânes sont tolérants à la sécheresse et demandent peu d'entretien. Ils ne nécessitent que peu de gardiennage et sont capables de se nourrir de fourrages de qualité inférieure ; sur le plan comportemental, les ânes sont beaucoup plus faciles à dresser et à manipuler. Ils sont largement utilisés pour le travail de trait (labourage et transport) dans diverses régions, mais l'utilisation des animaux de trait doit être abordée de manière globale: les ânes sont en outre très précieux pour le travail de bât, car ils sont capables de porter beaucoup plus, pour un poids vif équivalent, que les bovins.

Kurzfassung

Esel wurden in der Diskussion über Zugtiere in der Vergangenheit häufig unterbewertet, was zum Teil auf die traditionelle Fokussierung auf Ochsen zurückzuführen ist, aber auch auf ihre allgemeine archäologische Unsichtbarkeit, da ihre Überreste nur selten in Speisegruben gefunden wurden.

Meine Arbeit konzentriert sich auf Mesopotamien im 4. bis 3. Jahrtausend vor Christus. Esel, die in Nordostafrika beheimatet waren und als Haustiere nach Mesopotamien gebracht wurden, wurden in der archäologischen Betrachtung zunächst von einem mächtigen Modell der Rinderzugkraft verdrängt, das Andrew Sherratt in seiner Hypothese der Secondary Products Revolution vorschlug. Tatsächlich wurden Rinder in Mesopotamien schon früh als Zugtiere eingesetzt. Esel wurden von Berichterstatter:innen als Langstreckentransporttiere angesehen, aber die Tatsache, dass sie seit dem 3. Jahrtausend v. Chr. in großem Umfang als Zugtiere eingesetzt wurden – wie dies in Keilschrifttexten und Darstellungen belegt ist – wird erst jetzt in der archäologischen Diskussion anerkannt.

Moderne Entwicklungsstudien über die Nutzung von Arbeitstieren, vor allem in Afrika südlich der Sahara, zeigen die verschiedenen Vorzüge von Eseln gegenüber Rindern, insbesondere für kleine Betriebe. Rinder haben zwar eine höhere Zugkraft für schwere Böden und können für Milch und später für Fleisch wertvoll sein, doch benötigen sie reichhaltiges Weideland und reichlich Wasser. Esel sind trockenheitstolerant und pflegeleicht, sie müssen nur wenig gehütet werden und können sich von minderwertigem Futter ernähren; außerdem sind sie viel leichter zu trainieren und zu handhaben. Sie werden in verschiedenen Regionen häufig als Zugtiere (zum Pflügen und für Fuhrwerke) eingesetzt, aber die Nutzung als Arbeitstiere muss ganzheitlich betrachtet werden: Esel sind außerdem von unschätzbarem Wert für die Arbeit als Lasttiere, da sie pro Lebendgewicht weit mehr transportieren können als Rinder.

Resumen

Los burros han comúnmente sido infravalorados en los debates sobre los animales de tiro en la antigüedad, debido en parte al énfasis tradicional en los bueyes, y por otra parte como resultado de su invisibilidad arqueológica general, con sus restos rara vez encontrados en basureros de comida.

Mi trabajo se centra en Mesopotamia de los milenios IV y III a.C. Los burros, nativos del noreste de África y llevados como animal domesticado a Mesopotamia, fueron inicialmente eclipsados en la consideración arqueológica por un poderoso modelo de tracción de ganado propuesto por Andrew Sherratt en su hipótesis de la revolución de los productos secundarios. De acuerdo que el ganado se empleó para la tracción en Mesopotamia desde una etapa temprana. Los burros fueron reconocidos por los comentaristas como animales de carga de larga distancia, pero no es hasta que la actualidad que el reconocimiento de su uso generalizado para la tracción a partir del tercer milenio a.C, como se evidencia en los textos cuneiformes y representaciones, solo ahora se está fusionando en la discusión arqueológica.

Estudios modernos sobre el desarrollo del uso de los animales de trabajo, sobre todo en el África subsahariana, demuestran las diversas virtudes de los burros en comparación con el ganado bovino, en particular para las pequeñas explotaciones. Aunque el ganado tiene más fuerza de tracción para los suelos pesados, y puede tener valor para la leche y más tarde para la carne, requiere ricos pastos y abundante agua. Los burros por el contrario son tolerantes a la sequía y requieren poco cuidados, ya que pueden vivir con materiales forrajeros de baja calidad; en cuanto a su comportamiento, son mucho más fáciles de entrenar y manejar. Se utilizan mucho para el tiro (arado y carreta) en varias regiones, pero el uso de los animales de trabajo debe abordarse de forma integral: los burros son además inestimables para el trabajo de carga, ya que son capaces de transportar mucho más por peso vivo que el ganado.

Introduction

This paper is less a setting-out of a hypothesis than an information piece offered to a draught-animal audience, bringing to notice the invaluable historic and present-day role of donkeys for ploughing and other traction, in antiquity and to the present day. For my doctoral thesis[1] and recent book[2] – 'Working Donkeys in 4th-3rd Millennium BC Mesopotamia: insights from modern development studies' – I have employed a novel interdisciplinary approach to examination of the day-to-day role and impact of working animals on communities in antiquity, through analogy with published studies of modern developing-world cultures using donkeys and cattle for work in circumstances bearing some relation to situations in antiquity. I focus on ethology (the study of innate animal behaviour) and animal physiology, placing the daily practicalities of the animals at the centre. I argue for modern analogical material, suitably used, forming a valuable guide to archaeological researchers through greater consciousness of the ubiquitous but often invisible presence of working animals from antiquity to today.

For my doctorate and book, I consulted several hundred published studies on modern use of working animals worldwide, for establishment of themes and analogy with the possible situation in antiquity. My research included brief study trips to Burkina Faso (2013) and Ethiopia (2014), less for the collection of significant original material than to gain understanding of the environment relating to the many studies which formed the data-set for my thesis and book.

I cite my open-access thesis[3] repeatedly in this paper as it contains the same material as my book[4] but is freely available online and provides a very large body of references to my subject-matter, without overly clogging this paper with references[5].

Draught animals in the Ancient Near East

Domestication of cattle and donkeys for work

The systematic adoption of animals for work constituted a new paradigm in human-animal relations, with a new focus on living individuals and the means of obtaining their cooperation[6], requiring entirely new skills in training and handling as well as of husbandry and maintenance. I describe below how in many discussions of early use of animals for traction in the Ancient Near East in particular, a Western-centric mindset has persisted in which ploughing and by extension all agricultural work is carried out with (male) cattle, applying mediaeval northern European (ox-ploughing) models to regions further East with very different soils, climates and available animals. This bias has contributed to the neglect until recently of study of the impact of both donkeys and (female) cows as plough animals in antiquity, despite the common worldwide use of both today for ploughing in arid, light soils in particular.

1 Goulder 2018.
2 Id. 2020.
3 Id. 2018.
4 Id. 2020.
5 Details of my other publications on this subject are given on my website, URL: https://jgoulder.com/archaeology/publications.html.
6 Meadow 1984, 310.

Sherratt's secondary products model

While donkeys were domesticated primarily for work, the majority (though not unchallenged) view is that cattle were initially domesticated for meat, in the 8th or even 9th millennium BC in the Ancient Near East[7]. Sherratt[8] took the view that although localised adoption of ploughing with cattle took place from perhaps the 6th millennium BC, with some possible earlier use for threshing, the systematic use of yoked oxen for ploughing in Mesopotamia emerged rapidly in the 4th millennium BC. This formed a central element of Sherratt's far-reaching Secondary Products model[9] concerning the exploitation of animal secondary products – labour, milk and wool.

He originally argued that these products were evolved or adopted as a package in the 4th millennium BC, including an ox-plough/cart 'traction complex, with its own technology, ideology, and attitude to domestic livestock'[10] (oxen being castrated male cattle), with a distinct but roughly contemporary enlistment of equids for long-distance pack transport[11] (***Figure 1***). Engels, Goody, Comaroff, Boserup[12] and others have also evolved high-level models of wealth disparity, social status, labour use, community and kinship interaction emerging from adoption of ox-ploughing, notably in relation to the role and status of women. It has become evident through my new research, though, that such approaches risk bypassing key findings, not least in relation to the use of donkeys and (female) cows for work.

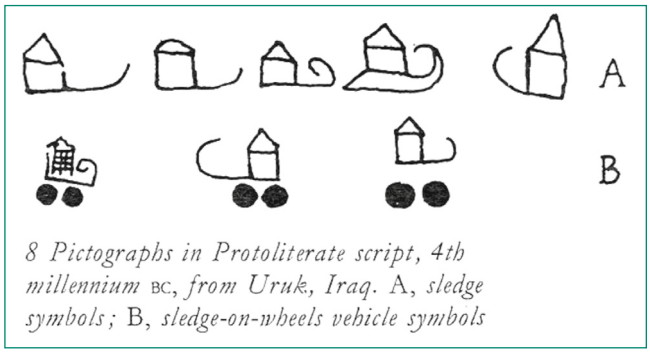
Figure 1 *– Sherratt's ox-centric view of early working animal use in 4th millennium BC Mesopotamia*

Original model and modifications

Sherratt's model focused on the transmission of specific hardware – the plough and the cart – between the Near East, Europe and the Central Asian steppe[13]. Sherratt initially included the horse in his model[14], suggesting a steppe 'package' of horse and ox-cart, and this may well have influenced Sherratt's relative neglect of pack-donkeys in Mesopotamia[15]. However, he later[16] withdrew horses from his scenario. Wheeled vehicles, as epitomised by the famous 4th-millennium BC Mesopotamian

7 Goulder 2018, 57.
8 e.g. Sherratt 1983, 98.
9 Id. 1981
10 Id. 1997a, 240.
11 Id. 1981, 295.
12 Boserup [1965] 2005; Comaroff 1985; Engels 1884; Goody 1976.
13 Sherratt 1981, 266, 288.
14 Ibd., 272pp.
15 Ibd., 295.
16 Id. 1997b, 31.

pictographs[17] (***Figure 2***), have been held up as an emblematic feature of the period; but Sherratt and others later concluded that wheeled vehicles at this early time were principally for ritual or prestige use.



8 Pictographs in Protoliterate script, 4th millennium BC, *from Uruk, Iraq.* A, *sledge symbols;* B, *sledge-on-wheels vehicle symbols*

***Figure 2** – Pictographs on clay tablets from Eanna IVa at Uruk-Warka, showing possible late 4th millennium BC sledges and wagons*

Archaeological thought now generally takes the view that there was not a moment of innovation or a package involving the close interrelation of several secondary products and traction modes diffusing as a unit. The preponderant use of oxen for early ploughing in Mesopotamia is also perhaps more assumed than indicated: Englund points out that in the earliest texts in the late 4th millennium BC

> *[o]nly several uncertain accounts register together the existence of both the plow represented by the sign APIN and oxen represented by the sign GU4. Whether oxen played a large role in field work in the Late Uruk period is thus a matter of conjecture.*[18]

A 4th millennium BC Mesopotamian cylinder seal illustration (***Figure 3***), of two men attempting to control a working bull, is much cited but may relate more to prestige than to mainstream farming practice.

***Figure 3** – Late 4th millennium BC seal showing two men controlling a working bull*

State-controlled working-animal activity in Mesopotamia in the 3rd millennium BC is meanwhile recorded in detail in the cuneiform texts, with increasing material being published on the use of donkeys for pulling ploughs and carts[19] (***Figure 4***). There is, too, growing archaeological evidence of small-scale independent farming in a region formerly thought of as fully under state control[20]; ample modern example indicates that a single animal (often a cow or a donkey) ploughing with a home-made ard or pulling a cart fulfils the subsistence needs of a small-scale farmer.

***Figure 4** – Impression of a cylinder seal, ED III (ca. 2400 BC). Upper register: equids (donkeys or hybrids) pulling a plough with a seed-funnel*

Invisible donkeys

Donkeys are native to north-east Africa, favouring rocky desert regions. Early *ad hoc* domestication of donkeys may have occurred there in the 5th millennium BC among mobile cattle-herding groups, for camp moves[21]. More intensive adoption may then have occurred where these mobile groups interacted with sedentary farmers, at the edge of the Nile valley[22]. Meanwhile, domesticated donkeys travelled from Egypt to the southern Levant, on the pack trail that famously became a vital artery for a time for supplies of wine and oil to Egypt[23].

The earliest potential indicators of use of donkeys for work in Mesopotamia, and indeed anywhere, are a depiction on a 5th millennium BC sherd from Fars in highland south-west Iran of a donkey with a possible blanket or pannier[24], and faunal remains from 4th millennium BC Tell Rubeidheh on the long-distance route east between southern Mesopotamia and the Zagros mountains[25]. While there is still debate on the presence of wild *Equus asinus* in Mesopotamia, working donkeys in this region are most likely to have been introduced as domesticates. In the 3rd millennium BC, faunal, textual and representational evidence of donkey use for ploughing and drawing carts has become common[26].

Detection of the presence of working donkeys in antiquity is considerably impeded by the low incidence of donkey skeletal remains. In the history of archaeology, most animal-bone finds come from food-refuse middens, often in urban environments. Such middens form for example a key source of evidence of working cattle, as the latter are almost universally used for meat at the end of their working lives, and their bones can be examined for work-related pathologies; but there is still a paucity of recognition of the different deposition processes that apply in the case of donkeys. In many regions through-

17 Piggott 1979, 5.
18 Englund 1995, 33.
19 e.g. Zarins 2014, 193-197.
20 Goulder 2018, 48-52.
21 Ibd., 58.
22 e.g. Zarins 2014, 109.
23 Goulder 2018, 59.
24 Potts 2011.
25 Payne 1988.
26 Goulder 2018, 60.

out history and to the present day, there is marked evidence of cultural (and practical) reluctance to eat working equids[27], with corresponding scarcity of bones in settlements. In addition to the issue of low incidence in food-middens, the remains of donkeys are unlikely to be found where they work (and die), as for practical reasons the carcasses may be dragged to unfrequented areas and their bones perhaps destroyed or scattered by predators. Archaeologically, the unique formation processes influencing deposition of donkey bones therefore result in a find-pattern that cannot be taken to reflect the living animals' incidence or distribution. The presence of animals used for work but not generally eaten can therefore be seriously underestimated, and one of my research aims has been to address this.

Draught animals today

Working animals are widely used in Africa and in much of Asia and Latin America, and still on a smaller scale in parts of Europe[28]. Use of working animals in sub-Saharan Africa has attracted particular promotional effort and study, and in this paper I focus on this region. The recent history and present-day usage of cattle and donkeys for traction in sub-Saharan Africa is authoritatively covered in this volume by Bertha Mudamburi and Paul Starkey's invaluable overview, 'Draft animal issues, constraints and opportunities in Africa'. As their paper describes, animal traction in sub-Saharan Africa featured very patchy adoption until the early 20th century AD, notably among small-scale farmers. While some pack donkeys had travelled through from north Africa, and although cattle were kept for meat, milk, blood and dung, there was very little use of working animals in many regions[29]. Commentators have put forward a range of reasons for this: the endemic animal disease in some regions, the persisting slave culture in many areas, the shifting hoe cultivation commonly used, and (though this is a debated issue) the wide physical and cultural separation between farmers and nomadic cattle-herders.

As Mudamburi and Starkey note, in the first half of the 20th century AD under various colonial and post-colonial official schemes, draught cattle were introduced into a number of regions, driven by a new emphasis on cash crops such as cotton and peanut[30]. Both early and later schemes often faltered or failed as a result of poor research, planning and cultural understanding: equipment was heavy and inappropriate, cattle died from the tsetse-transmitted disease trypanosomiasis, additional factors such as labour for other activities were not taken into account, too many changes were introduced at once, and adoption was hampered in some regions by heavy-handed regulation on local groups to protect the income of European settlers. Boserup[31] concurs that in many parts of the world colonial and independent governments drove overly towards commercial crops, but also blames the over-theoretical advice given and advisors often seeming 'to take it for granted that the cultivators have a preference for regular employment and are willing to give up seasonal leisure for a very modest compensation in additional output.'[32]

In some regions, these productivity-led initiatives then developed post-war into an emphasis on mechanisation, and this intensified in the post-colonial era as new governments worked to establish their modernising credentials[33]. Government authorities in various regions began reducing economic support for animal traction: Tibbs[34] alerts us to the attitude of organisations such as the World Bank, who in 1987 explicitly withheld research funding *'"[b]ecause of the simplicity of animal draft technology"'* which therefore was not perceived as requiring it. As Mudamburi and Starkey describe, this gap was filled by a series of major locally-generated research initiatives, international colloquia and expert consultations led instead by NGOs and the private sector[35]. The pioneering West Africa Animal Traction Network led on to the Animal Traction Network for Eastern and Southern Africa (ATNESA), which became an invaluable force for animal traction adoption in sub-Saharan Africa. By the start of the 21st century AD, hoe agriculture still predominated in sub-Saharan Africa but animal traction had become significantly more widely used than mechanical means[36].

The many studies published by ATNESA and others[37] highlight the complexity of farm and household systems which utilise working animals, and the central importance of their multifunctional role, of which ploughing is only a part. These studies chastise certain (urban) official bodies in Africa and elsewhere, who have often regarded donkeys as old-fashioned technology not in keeping with their modernising approach[38]. Traction with a pair of oxen was, though, a high-investment system, and some farmers turned to the lower-maintenance donkey, and to light tillage rather than heavy ploughing[39]. In heavy, damp soils as in northern Europe, soil inversion can be useful in killing off weeds and harmful insects; but in the light, arid soils common in the Near East and parts of Africa deep ploughing is increasingly considered to be damaging to soil structure and water content[40]. Meanwhile the donkey can off-duty be a far more flexible resource for pack and traction functions on and around small farms in particular.

Several commentators underline how adopters of working animals for ploughing may in practice take more interest in their use for farm transport or for income-earning transportation for others, particularly in the case of donkeys. Starkey[41] reports how some African farmers, having been encouraged to invest in animals for ploughing, return to manual cultivation and use their animals instead for profitable work transporting for others; in Zambia, Lubumbe[42] reports that farmers supplied with oxen on a loan basis for ploughing instead used them 'almost entirely for transportation in order to earn enough money to pay back their loans in the shortest possible

27 Ibd., 122-126.
28 e.g. Starkey 2011.
29 Ibd., 37,39pp.
30 Ibd., 39p.
31 Boserup [1965] 2005, 65.
32 Ibd., 66.
33 Goulder 2018, 40.
34 Tibbs 1989, 3.
35 Lhoste 2004, 128f.
36 e.g. Vall et al. 2002, 117.
37 Goulder 2018, 29,366-409.
38 Ibd., 29
39 Goulder 2018, 131.
40 Ibd.
41 Starkey 1994, 75.
42 Lubumbe 1994, 367.

time'. Authorities focusing on cash crops and a specific agricultural model made vain attempts to stem this shift: in Ivory Coast at one point ox-carts were even not issued to farmers because their use would divert cattle from use in cotton cultivation[43].

Hiring and sharing

This brings up a factor barely touched upon in studies of working-animal use in antiquity, of the very common practice in modern developing regions of sharing and hiring/renting of working animals[44], spreading the cost, responsibility and benefit. For working oxen, the economic importance of year-round utilisation levels is at least as much a driver for hiring out as is demand from non-owners, given the high investment/maintenance costs. This was an active process by at least the early 2nd millennium BC, with arrangements between owners and other users recorded in legal and commercial cuneiform texts.

Donkey hiring/sharing systems have a very different structure, given their much lower cost and maintenance needs, and relate more to their multi-purpose use for transportation, in a flourishing system of hiring, lending and communal ownership. This is a central part of the donkey-using industry, enabling wide access to donkey transport for low-income groups – notably for women.

The case of Ethiopia

A notable exception to the rarity of working animals in sub-Saharan Africa until recent times is Ethiopia. This large country has a growing human population of 80-100 million, 7-8 million oxen[45], and a growing donkey population of ca. 6.5 million[46]. Mechanisation of ploughing and transport activities is very low, and there is considerable NGO focus on working animals. The 'maresha' wooden ard-plough is thought to have been used here for at least 3,000 or even 5,000 years, possibly brought in from Egypt/Arabia or developed independently[47] (***Figure 5***).

Figure 5 *– Jill Goulder interviewing maresha ard-plough farmers in Western Ethiopia*

43 Landais/Lhoste 1990, 222.
44 Goulder 2016; Id. 2018, 172.
45 Starkey 2011, 12,33.
46 Donkey Sanctuary pers. comm. 2014.
47 Goulder 2018, 38.

Caveats for modern development studies

As Mudamburi and Starkey underline, the findings of modern studies should not of course be accepted unconditionally. Farnham[48] points out that African animal traction studies may range from anthropological modelling to accounts by agricultural engineers and agronomists, the latter sometimes based on trials at research stations rather than in the field; their agenda, often devised by urban-based official agents with little on-the-ground knowledge, is the promulgation of possibly isolated positive results in a drive to encourage local farmers to adopt new 'modern' agricultural systems. Meanwhile, NGO-commissioned studies of the use of working animals in developing regions specifically address social and economic aspects, but are likely to pitch their sampling and reporting in line with their worthy aim of improving conditions for animals and encouraging donations, with the potential result of polarising findings into pre-intervention (bad) and post-intervention (good)[49].

Working animals and women[50]

In many regions worldwide today, there are significant barriers to women ploughing with cattle[51] – though there is less of a taboo for use of female cows[52]. There is a large body of anthropological discussion on the exclusion of women from wealth and status through cultural barriers to their ownership and use of cattle, which I shall not go into here. Reports on agricultural studies of ploughing-animal use in sub-Saharan Africa and elsewhere commonly record entrenched local views that ploughs and cattle are too heavy and difficult for women[53] and that men consider it unsuitable for women to handle cattle; women themselves may feel culturally or physically deterred; there may of course be other factors such as the presence of young children.

Comaroff[54] underlines the long history of male ownership of 'prestige' cattle and argues the consequent ousting, though male plough use, of women from their traditional role as agriculturalists. Men may of course wish to ensure continuing labour for 'female' work such as transporting water and fuel and carrying out manual field tasks. Africa nevertheless has plentiful examples of female involvement in handling cattle, and women plough in parts of Botswana, Malawi, Tanzania, Zambia and Botswana[55]. Anthropologists hoping for overarching models are meanwhile defied by the intricate variations in sub-Saharan Africa in particular, where 'interdependent and complementary female and male farming systems exist alongside each other'[56].

In contrast to cattle, throughout history and to the present day donkeys are commonly despised – notably by non-users – and regarded as low-status. An FAO (Food and Agriculture Organization of the United Nations) working paper on animal traction worldwide notes that 'donkeys have fewer associations with masculine power

48 Farnham 1997, 29-34.
49 Goulder 2018, 34.
50 Id. 2016.
51 Id. 2018, 249-253.
52 Ibd., 81.
53 Ibd., 251.
54 Comaroff 1985.
55 Goulder 2018, 252.
56 Sylwander 1994, 261.

Figure 6 *– Woman transporting water, central Burkina Faso*

than most other work animals'[57]. This provides women with consequent (or possibly causative) freedom to employ donkeys without the cultural constraints attached to cattle (***Figure 6***).

Donkeys versus cattle for work: physiology

Donkeys and cattle often have complementary roles on the farm: donkeys for flexible use including pack, cattle for later meat value and (if female) milk. Oxen have greater absolute power (see table below) for heavy soils, but a higher purchase and maintenance cost, including the issue of theft due to their greater value. Donkeys are strong for their feed input (see table), low-maintenance and may have a longer working life; they are easy to train and handle and require little supervision.

Physiology

Oxen have powerful shoulders but a relatively weak chest, and a yoke is designed to be powered by the shoulders, with the yoke held forward by the ox's strong withers[58]. Donkeys have low, bony withers, with an equid's long slender thin-skinned neck and muscular concentration in the chest. Early depictions of state-controlled animal ploughing in Mesopotamia indicate that it was normally carried out with a pair of animals and a yoke, and this system persists in some regions to the present day; this militates against donkey use as the yoke is not suited to their body shape and restricts the power that they can deliver[59] (***Figure 7***).

Figure 7 *– Donkeys ploughing with an unsuitable yoke in Western Ethiopia*

Paired oxen are hard to turn as they are bulky and have relatively inflexible necks and insensitive hides; ploughing oxen generally therefore need to be led round turns, and the turning circles need to be large. In contrast, donkeys have a flexible neck designed for browsing and for watching for dangers while feeding; this, and their narrow bodies, allows them to turn sharply. Hagmann and Prasad[60] add that oxen, unlike donkeys, do not naturally tend to walk in straight lines.

Energy and work rates

Assessment of the relative benefits of using donkeys versus cattle in a farm environment is extremely complex[61]. Many published calculations, for example of hect-

57 Starkey 2011, 27.
58 Littauer [1968] 2002, 483.
59 Goulder 2018, 69.
60 Hagmann/Prasad 1995, 235.
61 Goulder 2018, 72.

ares cultivated per day, ignore a wide range of social and practical factors; but in practice, as is demonstrated daily in ancient and modern farm-based circumstances, farmers make rule-of-thumb decisions about the most suitable animal type and system to employ. *'A farmer will realise without any complex analysis whether using draught animals in a particular way (or at all) is profitable or not'*[62].

Calculating the comparative practical performance of working animals includes assessment of speed, force/output related to input in terms of investment, hours worked daily and coverage of the ground; this is influenced by particular empirical needs for the task in hand, such as a sustained hard pull, long hours, high speed, etc[63]. Figures are significantly affected by local situations and by the condition of the animals during the season, farmer skill, terrain and the work/rest cycle. Renger[64] concludes that in antiquity as now *'the human factor is decisive for increasing the effectiveness of animal power' in quality of 'training, guidance, feeding and care'*. Nevertheless, an attempt is made in the table below to provide comparative performance estimates and averages for ploughing donkeys and oxen from ethnographic and other information.

SPEED

- Ploughing speed (very contingent on local factors): oxen 2.3-2.5 km/hour, donkeys 2 km/hour[65]
- Balance to be struck between average speed, power output and number of hours of work (not a simple calculation although rules of thumb are habitually applied by users): *Equids are more suited to rapid low draught activities where their faster speed can be used to advantage. At higher draught forces, where speed is less important, the additional weight and power of cattle are an advantage*[66]
- Confusion in comparative accounts as donkeys (and female cows) generally plough more slowly than oxen but are faster for lighter work such as seeding and weeding[67], and for transporting items to and from the fields
- Oxen work slowly, at a single speed, but have greater endurance in heavy traction; donkeys have a wider range of speed, and better acceleration[68]
- The extent of rest periods, for the animals and the ploughing individuals, is a factor[69]
- In ploughing a key factor is the time that it takes to turn the animals (see above)
- Speed also decreases if the number of animals in a team is increased[70]: a trade-off is made between power and speed[71]

FORCE/OUTPUT

- Oxen are stronger for ploughing than donkeys in absolute terms[72] due to their extra weight
- Absolute weight can be better for tasks such as threshing
- However, the extra strength/weight is not necessarily required: farmers may shallow-plough, and the soil may be light and sandy[73], and not benefited by deep ploughing. Potts[74] notes that the 2nd-millennium BC Sumerian text *Farmer's Instructions*[75] recommends ploughing but is referring to a light ard, which would stir the earth to protect moisture but not dry out the ground as with a mouldboard plough
- Energy-rating studies conclude that donkeys can pull a larger percentage of liveweight than oxen[76]. Oxen are generally considered to be able to pull 10-12 % of their body-weight depending on breed and other factors such as harness and terrain; figures for donkey traction are rarer, but Prasad et al.[77] cite an FAO study stating that donkeys can pull 16-20% of their body-weight; Starkey[78] suggests a figure of 12-25 % of liveweight and up to 40% for short periods
- Unsuitable harness for donkeys (the yoke; see above) has a significant constricting effect

HOURS WORKED

- Oxen can typically plough for 4-5 hours/day, donkeys for 3-4 hours/day[79], though there are significant limiting factors including body condition
- The Prasad et al.[80] study cited above asserts that donkeys can only work for two hours before becoming exhausted, but as discussed this relates to unsuitably-harnessed animals. The authors themselves agree that it is very likely that use of a breastband would have increased the donkey hours worked, perhaps to equal those of cattle[81]
- Unlike cattle, donkeys do not require a rest period during the day for rumination; they graze more slowly than cattle, but graze at night

GROUND COVERAGE

- Accounts of ploughing with a pair of oxen and a simple plough indicate a normal coverage of c.0.2-0.4 hectares/day[82]
- Donkeys will cover less hectarage not only due to lower speed and possible earlier tiring, but because they can turn more sharply and so, crucially, plough more furrows per hectare[83]

***Table 1** – Energy and work-rate data for donkeys and cattle*[84]

62 Lawrence/Pearson 2002, 103.
63 Goulder 2018, 72.
64 Renger 1990, 275.
65 Goulder 2018, 537f.
66 Pearson/Vall 1998, 309.
67 Goulder 2018, 537.
68 Ibd.
69 Ibd., 424p.; Renger 1990, 269; Starkey 1989, 167.
70 Goulder 2018, 538.
71 Renger 1990, 271.
72 Goulder 2018, 475pp.
73 Ibd., 551pp.
74 Potts 1997, 73pp.
75 Black et al. 1998-2006.
76 Goulder 2018, 475pp.
77 Prasad et al. 1991, 237.
78 Starkey 1997, 193.
79 Goulder 2018, 475pp.
80 Prasad et al. 1991, 236.
81 Hagmann/Prasad 1995, 237; Prasad et al. 1991, 237.
82 Goulder 2018, 475-477.
83 Hagmann/Prasad 1995, 237.
84 Goulder 2018, 73p.

Feeding of working animals

A conundrum for keepers of working animals is how to allow them to graze for long enough (and on sufficient nutritious material) every day to replace weight lost through work effort[85]. A key differentiator between the husbandry methods appropriate for cattle and for donkeys is their physiology in relation to feed and water. Both cattle and equids process their food by fermentation; in cattle this occurs in the rumen, and in equids in the caecum – *'a blind sac at the junction of small and large intestines'*[86] – with an enlarged colon for storage. The rumen has limited capacity, and the rate of passage through the system is restricted by particle size, while the equid digestive system allows processing of bulky fibrous material: *'[d]onkeys' tough digestive system can break down near inedible vegetation and extract moisture from food more efficiently'*[87]. Donkeys, with their strong jaws, are more ready than cattle to browse on woody species, and there are accounts of donkeys surviving on bark, fish bones, kitchen waste, paper and equid manure[88].

> Left to their own devices, donkeys consume dry grass, bark, leaves, twigs and roots of preferred species of plants, even creosote bushes in desert areas – not because they are hungry, but because they like them. … Donkeys can become ill on rich food such as alfalfa/lucerne and lush spring grass.[89]

Jones[90] reports that while for (zebu) cattle almost half their intake must be high in carbohydrate and protein, for donkeys the figure drops to one-sixth, with much less need for total food and for high-nutrition food[91]. Barrett et al.[92] report from Burkina Faso that it costs four times more to feed oxen than donkeys.

Cattle graze by day, so the grazing area needs to be sufficiently near the working area and with access to plentiful water. Donkeys are slower feeders than cattle but habitually graze at night. Donkeys working today are commonly released after work and left to scavenge crop residue, dry grass and food waste[93]. Assessments of the length of time that cattle and donkeys can go without drinking are often speculative or anecdotal; both are said to survive at least 2-3 waterless days, but it is has been demonstrated by experiments that donkeys are significantly better able than cattle to withstand long periods between drinking without apparent stress or – importantly – loss of appetite, through a range of physiological and behavioural adaptations[94].

Practicalities of comparisons with antiquity

From earliest to modern times donkey-using cultures have encouraged free breeding with the wild and made little use of selective breeding[95]; unlike species kept for meat or milk, the size and vigour of wild donkeys were maintained during domestication as prized virtues, as were their low maintenance requirements. This gives grounds for confidence that the present-day standard medium-sized grey-brown donkey found worldwide bears performance comparison with those used in antiquity.

Concerning cattle, until the 4th millennium BC only *Bos taurus* was known in Mesopotamia. *Bos indicus* may have arrived at the eastern margins in the early 3rd millennium BC, and in southern Mesopotamia by the mid-3rd millennium BC. The reverse applies in Africa, where early domesticated cattle in Africa were taurines but from the 1st millennium AD these were increasingly hybridised with zebu (*Bos indicus*) stock from Asia. Zebu have various physiological advantages over taurines in hot, dry environments; but Galvin[96] notes that 100 % *Bos taurus* animals in modern Syria are fully heat-adapted, with convergence of characteristics with the zebu, and that *'genetic changes reflecting product specialization in bovids ... had taken place by at least 3000 BC'*[97] in Mesopotamia.

Donkeys versus cattle for work: behaviour

Donkeys are described by some as herd animals, but a better term is sociable: in the wild they form shifting associations with a small number of other individuals[98]; therefore, while they actively enjoy company, of their own or another species, and readily team up with other donkeys or humans, they also work well alone. In small groups as opposed to herds, signs of stress or pain are seen as indicative of dangerous weakness and the animal is excluded from the group, or if defending a territory is targeted for attack; in contrast in herds, reactions to threats alert the whole group so are seen as advantageous. The small-group characteristic translates into the well-known patience and stoicism of donkeys, as they are behaviourally adapted to showing few signs of pain. Unlike full herd animals, which have a strategy of fleeing from a threat (as predators should only catch the hindmost), donkeys become immobile or group and face a predator, as a good strategy in a small group under threat. They have a natural highly-developed sense of individual self-preservation, and their strategy is to 'freeze' and assess situations and obstacles cautiously before making a move, whether in dealing with a predator or if they do not understand what they are being asked to do or why[99]. This can be misunderstood in working situations as uncooperativeness or stupidity, and in the Western world and elsewhere donkeys are famously considered to be stubborn and difficult.

In studies of modern use in Africa and Asia, donkeys are widely agreed to be less demanding than oxen to control; they are not generally aggressive to humans and can be handled, harnessed and worked by a single individual, including women and children (***Figure 8***). Donkeys are also widely acknowledged to be quick to learn

85 Starkey 1989, 36.
86 Janis 1976, 759.
87 Yilmaz 2012, 17.
88 Goulder 2018, 169.
89 Yilmaz 2012, 69.
90 Jones 2008, 12
91 Yilmaz 2012, 35.
92 Barrett et al. 1982, 37.
93 Goulder 2018, 479-482.
94 Ibd., 171.
95 Ibd., 85p.
96 Galvin 1987, 123-126.
97 Ibd., 123.
98 Goulder 2018, 76.
99 Ibd., 76.

Figure 8 – Woman ploughing with a donkey in Ziniaré, Burkina Faso

from other donkeys and from humans, to remember their training longer than cattle[100] and to carry out tasks with minimal or no supervision[101].

Summing up

Working-animal practicalities

Robust ethnographic evidence demonstrates that key differences in maintenance needs between donkeys and cattle lead to very different trajectories as work animals, with implications from earliest use to today. The extra feeding and husbandry required by working cattle can provide eventual payback in terms of carcass value, but there has been a marked shift among farmers in parts of Africa to the lower-investment strategy of donkey power. Donkeys are physiologically more efficient than cattle at food and water processing and more behaviourally flexible in their feeding needs. Unless they are far from natural forage resources and engaged in full-time pack or vehicle work, they are often self-maintaining.

Accounts from throughout the African continent, of the expectations and actualities of adoption of working animals by farmers, give invaluable pointers to the learning curve experienced during their early systematic use in antiquity. The ethnographic evidence is that the drawbacks of adopting cattle for work (notably labour demands for foddering and penning) may have been outweighed by levelling factors such as hiring out. A different equation applies for the adoption of donkeys which, despite their more limited meat and milk potential, offer high work return on very low foddering and grazing outlay.

Working animals in ancient Mesopotamia

To date there has been very little archaeological focus on systematic use of working donkeys in late 4th and 3rd millennium BC Mesopotamia. A contribution to this lack of *'donkey-mindedness'* may be historical species availability, with donkeys not a feature of northern Europe, resulting in donkey-blind Western-centric models of early working-animal systems. There has also been undue reliance on elite-commissioned representations of oxen and ploughing in possibly ceremonial contexts. It is often insufficiently acknowledged that donkeys for traction appear in texts from the late 4th millennium BC and are commonly listed as employed in agricultural operations in the 3rd millennium BC. Their near-absence from the excavation record too readily results in their neglect in interpretation. Wider acknowledgement of the capabilities of working donkeys (and female cattle) opens a gate to better recognition of their likely role then and of the greater complexity of working-animal systems in antiquity than was envisaged in the early days of the Secondary Products model.

Working animals today

Initiatives by authorities in developing regions still tend to distort natural adoption and expansion of the most locally-suitable agricultural and rural transport systems, and to ignore established local practices such as use of donkeys. There has been a good deal of development literature recently about the complex and unexpected paths that working-animal use is taking now that the focus on imposition of Northern European models – with emphasis on investment in a pair of oxen – has lessened. Although in some areas a drive to modern mechanical options persists, with the more recent advent of flexible local systems[102] there has been a steady process in some regions of farmers switching from cattle to donkeys[103], preferring them for their low purchase and maintenance cost and greater suitability for the light ground preparation and

100 Kjaerby 1983, 159.
101 Goulder 2018, 77.
102 e.g. Barrett et al. 1982, 25,33.
103 Goulder 2018, 41.

general pack functions that form the basis of the African farmer's activities[104].

The use of data and observations from widely-available modern agricultural, social and economic development studies, in regions of significant working-animal use such as sub-Saharan Africa, is a largely-untapped resource for Ancient Near Eastern archaeologists. With suitable caveats it provides a means of rebooting archaeological thought and placing working animals within a newly-assessed social and economic framework focusing on practicalities and on household-level responses to change.

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104 e.g. Vall et al. 2002, 120.

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Figure 5-8 – J. Goulder.

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