


Technological Developments in Wheeled
Vehicles in Europe, from Prehistory to the
Sixteenth Century.

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I hereby declare that this thesis was
written by myself and is the result of
my own research.



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ABBREVIATIONS

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- AJ Antiquaries Journal.
- AJA American Journal of Archaeology.
- Berg(1935) Gösta Berg, Sledges and Wheeled Vehicles, Nordiska Museets Handlingar IV (Stockholm 1935).
- Bona(1960) I. Bona, 'Clay Models of Bronze Age Wagons and Wheels in the Middle Danube Basin', Acta Archaeologica Hungarica XII (1960) pp 83-111.
- Boyer(1959) Marjorie Nice Boyer, 'Medieval Suspended Carriages', Speculum XXXIV (1959) pp 359-66.
- Boyer(1960) Marjorie Nice Boyer, 'Medieval Pivoted Axles', Technology and Culture I (1960) pp 128-38.
- Bulliet(1975) R.W. Bulliet, The Camel and the Wheel (Cambridge, Massachusetts 1975).
- CCR Calendar of Close Rolls.
- CPR Calendar of Patent Rolls.
- Casson(1974) Lionel Casson, Travel in the Ancient World (London 1974).
- Childe(1948) V. Gordon Childe, 'The Final Bronze Age in the Near East and Temperate Europe', PPS XIV (1948) pp 177-195.

- Childe (1951) V. Gordon Childe, 'The First Waggon and Carts - from the Tigris to the Severn', PPS XVII (1951) pp 177-194.
- Cockerell, James and ffoulkes (1927) S.C.Cockerell, M.R.James and C.J.ffoulkes, A book of Old Testament illustrations of the mid-thirteenth century sent by Cardinal Bernard Maciejowski to Shah Abbas the Great, King of Persia, now in the Pierpont Morgan Library (Cambridge 1927).
- Des Noettes, L'Attelage Richard Lefebvre des Noettes, L'Attelage et le Cheval de Selle à travers les âges (Paris 1931).
- EHR English Historical Review.
- ECHR Economic History Review.
- EDD English Dialect Dictionary (London 1904).
- Esperandieu (1908-38) Emile Esperandieu, Recueil général des bas-reliefs de la Gaule Romaine (Paris 1908-38).
- Flower (1915) C.T.Flower, Public Works in Medieval Law, Selden Society XXXII, XL (1915).
- Fox (1931) Sir Cyril Fox, 'Sleds, Carts and Wagons', Antiquity V (1931) pp 185-199.
- Galhano (1973) F.Galhano O.Carro de Bois em Portugal (Lisbon 1973).
- Rupert Hall (1976) A. Rupert Hall, A History of Technology (Cambridge 1976).
- Harbison (1969) Peter Harbison, 'The Chariot of Celtic Funerary Tradition', Marburger Beiträge zur Archaeologie der Kelten: Festschrift für Wolfgang Dehn (Bonn 1969) pp 34-58.

Haudricourt and
Delamarre (1955)

André G.Haudricourt and M.J.B.Delamarre,
L'Homme et la Charrue à travers le Monde
(Paris 1955).

Liberal Jurisdiction
Cardozo, Society of American Law, 1913,
London 1913.

Cardozo, Society of American Law, 1913,

London 1913.

- Pharr (1952) C.Pharr, A Corpus of Roman Law (Princeton 1952).
- Piggott (1968) Stuart Piggott, 'The Earliest Wheeled Vehicles and the Caucasian Evidence', PPS XXXIV (1968) pp 266-318.
- Piggott, Roman Vehicles Stuart Piggott, Roman Vehicles, the Lexical Evidence, unpublished draft.
- Pobé and Roubier (1961) The Art of Roman Gaul (Paris 1961)
- PPS Proceedings of the Prehistoric Society.
- PSAS Proceedings of the Society of Antiquaries of Scotland.
- Reinach (1922) Saloman Peinach, Répertoire des Reliefs Grecques et Romains. (Paris 1922).
- RMLWL R.L.Latham, Revised Medieval Latin Word-List from British and Irish Sources (London 1965 reprint 1973).
- Salzman (1926) English Life in the Middle Ages (Oxford 1926).
- Singer et al C.Singer, E.J.Holmyard, A.R.Hall, T.I.Williams, A History of Technology (Oxford 1956).
- Treue (1965) Wilhelm Treue, Achse, Rad und Wagen (Munich 1965)
- Vigneron (1968) Paul Vigneron, Le Cheval dans l'Antiquité Gréco-Romaine (Nancy 1968).
- White (1962) Lynn White Jnr., Medieval Technology and Social Change (Oxford 1962).

GLOSSARY

GLOSSARY.

axlebed	wooden case for the axle.
axletree	the whole axle, including the arms.
bogie	a turning train, a pivoted front axle.
bolt	a wooden bar at the back of shafts.
bond	iron ring around a hub.
box	the hardened centre of a wheel
carriage	part of the vehicle to which the wheels are attached. A wagon has two, fore and rear.
cart	a two-wheeled vehicle.
clote	a patch of iron to mend timbers. an iron patch to protect from wear. an iron plate fitted to the axle arm, on the underside, to prevent wear on the box when the wheel revolves. Lying flush with the wheels, it was fitted with special countersunk nails called clout-nails.
dish	wheel convexity.
dog-stick	forked stick used as a braking device.
dowel	a wooden peg between two felloes.
felloe	one of the wooden sections of the rim of a wheel.
fret	hoop fitted to the hub
hames	wooden or metal frame on a horse collar to which the traces are attached.
hub	central part of a wheel, rotating on or with the axle and from which the spokes radiate.

ladder light framework at front or rear to extend
loading capacity.

lock turning of the front wheels in relation to the
rear.

lynch pin peg to prevent the wheel from falling off the
axle arm.

nave hub, centre of the wheel.

perch or pole long beam joining the two undercarriages.

shoeing fitting strakes.

sole wooden surface of an unshod wheel.

square tongues tenons at the ends of spokes for mortising
into the felloes.

strakes iron plate fitted over the junction of two
felloes. Fitted as a set they formed a tire.

tilt an arched top.

tongue the end of a spoke prepared for insertion into
a felloe.

wagon a four-wheeled vehicle.

whippletree a wooden bar, hooked by the centre to the wagon
and attached by its two ends to traces. Often
called a singletree.

ABSTRACT OF THESIS.

The thesis assembles a substantial body of evidence from archaeological and documentary sources, in particular from Western European illuminated manuscripts and English manorial records, to investigate the development of land transport from prehistoric times to the end of the middle ages and to trace the origin, chronology and transmission of the major improvements in vehicle construction, harnessing, breeding and draught, wheelwrighting and farriery. It asserts that while there is general continuity in vehicle morphology and function throughout the period, the major innovations and sophistications of carriage design were the products of the skills of Western European Medieval wagonwrights. Moreover, it presents evidence for a rational harnessing system as early as the Roman period. Such conclusions challenge the chronological and classificatory schema previously advanced by historians of technology. If one accepts these conclusions, it is also necessary to accept that the belief in the degenerate and uninventive nature of Roman and medieval society is largely mistaken; that a more efficient form of land carriage may no longer be considered a post eleventh century development and that a thorough reevaluation of the assessment of the viability of wheeled transport and its relationship to sea and fluvial carriage in western medieval Europe is necessary.

INTRODUCTION.

'A study of land transport technology should consider such elements as motive power, speed, load capacity and manoeuvrability. In addition, people-moving and the transport of fragile goods require that attention be paid to comfort and the cushioning of shock'.¹ Using Leighton's statement as the basic outline therefore, this thesis will try to survey the archaeological and historical evidence of the development of wheeled vehicles, from the end of classical times to the central middle ages. It will consider both the use of land transport and the technological innovations introduced to improve vehicles, draught and method of control, and will seek a chronology and area of origin for these innovations. It will, moreover, try to do this without becoming involved with concepts so overlain with emotive associations that objective discussion ceases to be possible, in particular the issues of slavery and nationalism. As Daumas has pointed out 'the technical history of technology has suffered from the technicality and often the nationality of those who wrote it'.² Furthermore, it will try to compare the prehistoric, Roman and mediæval periods in terms of technical knowledge and ability, questioning the premise that 'Medieval Europe had a radically different orientation toward man and machine than did Classical Antiquity'.³

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1. Albert Leighton 'Eleventh Century Developments in Land Transport Technology', The Eleventh Century Acta I (New York 1974) pp 15-30, p.15. I should like to thank Professor Leighton for sending me a copy of this paper.
 2. 'The History of Technology; its aims, its methods, its limits' A. Rupert Hall (ed) A History of Technology (London 1976) pp 85-113, p 90.
 3. Albert Leighton 'A Technological Consideration of Early Medieval Vehicles' Actes du Cinquième Congrès International d'Histoire Economique. VI (Leningrad 1970) published La Haye-Paris 1977 p 340. I should like to thank Professor Leighton for this copy.

The main question is of course, why is such a study necessary? Hennell in British Craftsmen records that an old blacksmith, when set the riddle 'how did they make the first hammer' replied after deep thought 'they must have found an old 'un'.⁴ The simple answer to the first question would therefore be to set down a chronology for its own sake. However, there is a great deal of controversy surrounding the date of introduction of the main developments in vehicle construction, a controversy which is based on very little evidence. The use of wheeled vehicles, both ceremonially and functionally has been chronicled over a long period of time. The prehistoric evidence was surveyed by Gordon Childe in 1951⁵ and his interpretations have been reassessed by modern work such as that of Van der Waals⁶ in 1964, Bona in 1960,⁷ Piggott in 1968,⁸ Littauer and Crowel in 1973, 1974 and most recently by Littauer alone in 1977.⁹ At the other end of the scale, so to speak, ethnologists, while agreeing that a full corpus of comparative data does not yet exist, have already achieved much in the recording of those functional features of agrarian transport only discernable from a surviving tradition. These are normally imperceptible in archaeology and

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4. Thomas Hennell, British Craftsmen (London 1943) p 48.
 5. 'The First Waggon and Carts from the Tigris to the Severn', PPS XVII (1951) pp 177-193.
 6. Prehistoric Disc Wheels in the Netherlands (Gronigen 1964).
 7. 'Clay Models of Bronze Age Wagons and Wheels in the Middle Danube Basin', Acta Archaeologica Hungarica XII (1960) pp 83-111.
 8. 'The Earliest Wheeled Vehicles and the Caucasian Evidence', PPS XXXIV (1968) pp 266-318.
 9. 'Terracotta Models as evidence for Vehicles with tilts in the Ancient Near East' PPS XL (1974), pp 20-36, 'Rock Carvings of Chariots in Transcaucasia, Central Asia and China,' PPS XLIII (1977) pp 243-63.

only rarely come within the conceptual horizon of the historian but ergo cannot be taken to be non-existent. Wolfgang Putschke, in 1971,¹⁰ attempted to pull these two bodies of evidence together¹¹ by his novel concept of Sachprojektiv, a methodological approach thought generally to be stimulating but largely unsatisfactory. The shortcomings of Sachprojektiv has meant that for the intervening period between prehistory and the modern period very little information exists. It would be fair to say that the main features of the technology of wheeled vehicles, in particular the primary problems of origin and the chronology of the basic developments in construction, wheelwrighting, farriery, stockbreeding and road building, remain largely unknown but by no means un contemplated. Publications dealing with this central period may be said to fall into three categories : those valuable pioneer studies of the nineteenth century; large general volumes of the history of science and technology in which innovations in transport form only a very small section in the rapid catalogue of entries; those studies which present evidence on a small scale which normally serve to render the information in the other two categories out of date, but do little to construct a firm body of evidence. The work of Needham and Lu, though confined to harness and to China, with its clear presentation of firmly dated evidence, must be regarded as exemplary.¹² There is room, therefore for a survey of this kind for all developments in transport in western Europe.

10. Wolfgang Putschke, Sachtypologie der Landfahrzeuge Ein Beitrage zu Ihrer Entstehung Entwicklung und Verbreitung (Berlin 1971).

11. Alexander Fenton 'The Difficulties of Mapping the Distribution of Carts and Wagons, [Forthcoming]. I should like to thank Dr. Fenton for the copy of this article which he gave to me prior to publication.

12. 'Efficient Equine Harness; The Chinese Inventions' Physis 11 (1960) 'A further Note on Efficient Equine Harness' Physis VIII (1965)

The most crucial problem inherent in the study is that of definition. The choice of a number of technical and unambiguous terms has been adequately dealt with by Stuart Piggott and there seems little point in straying far from his guidelines.¹³ The real difficulty lies in how far it is justifiable to define cart and wagon as two distinct species. Geographically it is only possible by ignoring infinite regional variations. Morphologically it is only possible by ignoring hybrids, interchangeable parts, linked undercarriages and common features. Linguistically it is virtually impossible since even those working in the field are guilty of using the terms as if they were indistinguishable. However, it is crucial to bring precision to the expression of evidence. Since the appearance of vehicles with three or six wheels is radically restricted, (in the case of former probably radically reconstructed) the conventional division between wagon, as a vehicle with four wheels, and cart, as a vehicle with two, is sufficient to encompass most needs. Chariot on the other hand is used exclusively to describe the light fast, spoked, two wheeled vehicle of antiquity, used for war, hunting or personal transport.

Chronological limits are also difficult to define.

It is possible to take the European dissemination of the Flemish spindle wagon in the sixteenth century as representing a watershed in the history of wheeled transport.¹⁴ This is therefore a convenient terminal date. The search for chronology, however, makes any choice of a date at which to begin the study very difficult. Any examination of origin must take into account preceding periods. The study begins therefore at the end of prehistoric times but on certain occasions will refer to prehistoric evidence.

13. Piggott (1963) p 267.

14. J.G. Jenkins, The English Farm Wagon: Origins and Structure (Reading 1961) pp 8-11.

The aims of the study demand a consideration of as wide an area as is practicable. However, it will focus primarily on western Europe using Asia and the Orient as a source of comparative data only.

The primary evidence to be used in this study comprises actual remains surviving in exceptional natural circumstances. For the period from the third to the second millenium B.C. it has been estimated that over fifty actual vehicles or parts thereof survive. No such calculation has been made for the later periods.

Secondary evidence comes from representations from c 2300 B.C. to the sixteenth century A.D. For the early period these take the form of bas reliefs, mosaics or wall paintings, while for the medieval period they are concentrated in illuminated manuscripts. For the historic period documentary sources, chronicle, legal, governmental and manorial, record both technical, economic and linguistic evidence. Lexical evidence is important in the consideration of origin. However, apart from the imprecise use of technical terms, the evolution of objects is not necessarily paralleled by the evolution of words. Vocabulary may be renewed without the necessary modification of object, and words often become fashionable. As Haudricourt has said, 'Ne parlons pas des linguistes qui étudient les mots sans les objets! Il en est malheureusement!' ¹⁵ For the medieval period it must also be remembered that there were implements for which there was no Latin equivalent and in these cases the scribe had to invent, often with curious results.

Thirdly, a great deal of practical advice was given by experienced craftsmen, blacksmiths, carpenters and wheelwrights, or those who had worked in their youth in any of these trades, particularly in North Yorkshire. Folk museums have also helped in the understanding of modern survivals, without which it is difficult to create a synthesis from prehistoric, Roman and medieval material.

15. André G. Haudricourt and Mariel Jean-Brunhes Delamarre, L'Homme et la Charrue à travers le Monde (Paris 1955) p 49.

A major concern is of course how far the sources for this study may be said truly to represent practical contemporary vehicles. It is not the object of this thesis to discuss at any great length the validity of the interpretations of prehistoric evidence. It seems useful, however, to reemphasise the convictions of Bona¹⁶ and Harbison¹⁷ that too many archaeologists in the past were content to fall back on the term 'cult wagon' and that though many objects may have been of cult destination their cultic background was undoubtedly related to the normal form of contemporary transport. As far as the use of medieval illuminations is concerned, convention, artistic licence, copying, deliberate archaism and the use of a fixed iconography create problems when one is considering realism. How far, in any case, can we rely on the strange medieval visual image which saw past time only in terms of its own. However, being aware of these problems, it is possible to compensate for them. In any case, while an illuminator's primary function was not realistic observation, many miniaturists achieved great accuracy and by the end of the period were experimenting with light and perspective.¹⁸ As Etienne Gilson remarked in the Gifford Lectures in 1931, 'The truth here as elsewhere, is that if we seek our modern conception of history in the middle ages we may make up our minds at once that we shall not find it there'.¹⁹

16. Bona (1960) p 83-111.

17. P. Harbison, 'The Chariot of Celtic Funerary Tradition', Marburger Beiträge zur Archäologie der Kelten: Festschrift für Wolfgang Dehn. Otto Hermann Frey (ed) (Bonn 1969) pp 34-58.

18. David Diringer The Illuminated Book, its History and Production (London 1958) new edition revised with assistance of R. Regensburger (London 1967), The Hand-Produced Book (London 1953).

19. Etienne H. Gilson, The Spirit of Mediaeval Philosophy translated by A.H.C. Downes (London 1936), reprinted (London 1950).

Finally, Lucien Lefebvre once set down three objectives to be met in a history of technology. Although his ideas have now been rejected by historians of science in favour of a Mumfordian view, yet Lefebvre's three points are relevant to this study. They were; to create a technical history of techniques; to evaluate the role of science in advancing technology; to place technology in its human context within the context of other human activities. It is the first and last categories with which this thesis is concerned - the origin, chronology and transmission of techniques relevant to wheeled vehicles and the social and economic role of land transport in western medieval Europe.

20 Daumas, in A. Rupert Hall (1976) p.113.

SECTION ONE : BASIC VEHICLE TYPES

Section one will try to isolate certain types of vehicle which were common in prehistoric, classical and medieval times to try to decide what was the general range of vehicles and whether any continuity in vehicle form may be traced or conversely whether any particular construction is characteristic of a particular time or area.

CHAPTER ONE : PREHISTORIC VEHICLES.

There has been in the past much speculation as to the origins of wheeled vehicles. The cart has been seen to have evolved from the travois or the sledge. Haddon¹ and Fox² have supported the former and Berg³ points out that confirmation for their thesis is to be found in the fact that the method of control of the single horse cart in Europe and Asia, namely by postillon, is also the common method for controlling a slide car or travois. He himself, however, sees the origin of the pair cart in the sledge not the troika or the childhood toy, but the functional vehicle, the north east European manure carrier, the central European harvest carter. Certainly the sledge has been used for a variety of carrying functions including town carting in Amsterdam in the eighteenth century and in a number of climates as varied as Scandinavia, the Philippines, Orkney and Turkestan.⁴

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1. 'The Evolution of the Cart' The Study of Man (London/New York 1898) pp 161-199
 2. 'Sleds, Carts and Waggon's' Antiquity V (1931) pp 185-199
 3. Sledges and Wheeled Vehicles, Nordiska Museets Handlingar 1V (Stockholm/Copenhagen 1935) pp 24-25, p64, pp 84-85
 4. Berg (1935) pp 24-25, p64, pp 84-85, p.79

One may say that as long as the cart existed so did the propensity for the creation of the wagon. In other words that the wagon was built by simply joining two carts. Evidence from second millenium B.C. Transcaucasia ⁵ shows the clearest relationship between the two because the draught pole of the wagon is an A-shaped cart frame. Such construction presupposes the greater antiquity of the cart. However, since carts and wagons appear together, both in the sepulchral and representational evidence, it is not possible to produce evidence to confirm this supposition.

There are those who would maintain that the wagon is in fact older than the cart and in this they are referring to a vehicle with a distinctly different construction. In this case it is the superstructure which holds the wheels together, the undercarriage therefore being a simple square as opposed to the 'double triangle' of the Caucasian wagons. This is a form which would be, for example, the prehistoric ancestor of the medieval Italian pageant wagon. ⁶ Model vehicles have been brought forward as examples of this type. ⁷ Square-bodied carts are also represented in the Near Eastern pictograms. However, models are largely unsatisfactory in their depiction of undercarriages. ⁸ In the absence of excavated evidence, it is impossible to confirm that this construction can be proved to have been normal in south eastern Europe far less the archetype wagon. It is only fair to say, however, that ethnological evidence for

5. Stuart Piggott (1968) p.290, fig. 8, fig. 9.

6. G. Berg (1935) p.163.

7. Bona (1960) pp 83-111, Berg (1935) p.163, p.169.

8. Littauer and Crowel (1974) p. 27, p. 29.

wagons without a central beam, characteristic of the central European 'double triangle' wagon, is normally found outside the great wagon zone proper, namely, in Scandinavia, Serbia and Hungary, the latter being one of the areas with pottery models.⁹

Clearly all these suggestions as to the origin of wheeled vehicles must remain suppositions. Hypotheses can only be achieved by postulating backwards from modern survivals of primitive forms in remote areas. Under these conditions a successful definitive conclusion can never be achieved. A firm conclusion, of course, is hardly necessary. One or all of these origins are likely in different areas with similar results. []

Draught was made possible by the castration of bulls by fifth or fourth millenium B.C., but the earliest true evidence for wheeled vehicles is the Uruk pictograms of fourth millenium Sumer.¹⁰ Both carts and wagons are represented in the Near East before 3,000 B.C. Corrected radiocarbon dates for Transcaucasia, however, give little chronological priority to the Near East.¹¹ Whatever the source of transmission - this is still a debateable point - acceptable evidence for wheeled transport in eastern Europe before 2,500 B.C. and in central Europe before 2,000 B.C., may be presented. The features of the eastern European wagons of the middle Bronze Age would appear to represent a transitional phase between Neolithic and early Iron Age north

9. Berg (1935) p 163

10. Stuart Piggott (1968) p.271, fig.2, L. Woolley, Ur Excavations II (London 1934) Littauer and Crowel (1974) fig.9, 'Early Metal Models of Wagons from the Levant' Levant V (1973) pp 102-126, Childe (1951) pp 177-193

11. Piggott (1968) p.309, S. Foltiny 'The Oldest Representations of Wheeled Vehicles in Central and Southeastern Europe' AJA LXIII (1959) pp.53-8, Bona (1960) p.93.

European types. ¹² The burial of oxen in pairs, indicating vehicle draught, from late Neolithic contexts in eastern and central Europe (perhaps also Denmark) confirms the third millenium evidence. ¹³ In northern Europe both wagons and carts are represented in Bronze and early Iron Age contexts. ¹⁴ From 700 B.C. onwards, burials from central Europe contain wagons with spoked wheels. By the sixth century, these Celtic wagons had spread as far west as the Marne. ¹⁵ Chariots of the La Tène funerary tradition are found from England to Bulgaria with some overlap with the Hallstatt wagons. ¹⁶ They are attested from the fifth to the first century B.C. but in Ireland they appear to have survived in insular form until the ninth or tenth century A.D. ¹⁷

Can particular forms be isolated, therefore, and related to function?

RAILED WAGONS

This is a type of four wheeled vehicle with sides. It is found in prehistoric times in Anatolia, Transcaucasia, and in Siberia where in extreme form the rails are extended to the roof of the wagon, giving a cage-like appearance. ¹⁸ In the Near East, the sides could be closed by the attachment of screens, probably of wicker. All prehistoric railed wagons have a central draught pole. ¹⁸

12. Bona (1960) p 98.

13. Piggott 'Heads and Hoofs' Antiquity XXXVI (1962) pp 110-18, (1968) pp 267-318, J.Mellart, The Chalcolithic and Early Bronze Ages of the Near East (Beirut 1967).

14. Childe 'The Final Bronze Age in the Near East and in Temperate Europe' PPS XIV (1948) pp 177-95.

15. Childe (1951) pp 177-193.

16. Harbison (1969) pp 34-58, I.M.Stead, 'The Celtic Chariot' Antiquity XXXIX (1965) pp 259-265.

17. Harbison *ibid.* H.S. Crawford, A Handbook of Carved Ornament from Irish Monuments of the Christian Period (Dublin 1926) p,7, Fig.1, pls.XLIX,L.

18. Littauer and Crowel (1974) pp 20-30, Piggott (1968) pp 285-6

TILT WAGONS

These are fourwheeled vehicles with arched tops or covered cabins, similar to the Kobelwagen of Central Asia and the Conestoga wagons of North America. They are represented in the third millenium B.C. by the terracotta models from Syria and Iran. There are four tilt wagons from Lchashen and one probable wagon with a tilt from Trialetti in Transcaucasia. The tilt itself is made of straw, reed, wicker or lattice and perhaps supported by hoops. Lchashen barrow 9 had a tilt made of wicker, the hoops being horizontals of the wicker. Such tilts would not therefore be easy to dismantle. ¹⁹

TILT CARTS

Of similar construction to the wagons, these two wheeled vehicles were present in third millenium B.C. in Iran and North Syria. This may be inferred from the terracotta and metal models and by 1779 B.C. from representations on cylinder seals. They were also present at Tri Brata and the Kura River in second millenium Transcaucasia, to judge from surviving models. This was also the kind of vehicle present in tomb 2 at Salamis dating to the tenth century B.C. Such cart models were also found in Soviet Azerbaijan and Iron Age Cyprus, as well as in the Crimea. ²⁰

19. Piggott (1968) pp 273-35, Childe (1951) pp 134-6, Littauer and Crouwel (1974) pp 27-29.

20. Littauer and Crouwel (1974) pp 22-25, Piggott (1968) pp 302-3, Bona (1960) pp 83-111.

BOX WAGONS

This is the most typical heavy duty fourwheel vehicle. It has solid walls, either planked or of wicker. Syrian models of the third millenium have solid sides while Anatolian wagons tend to be open. The most distinctive shared feature, though it varies, in form, is the high front. It is also the most distinctive vehicle of central Europe in the Bronze Age and of the Celtic Iron Age and is found either as a votive deposit or as a funerary vehicle. In many cases the wagon has a bier or raised seat within. They have been regarded as in some way related to the processional car of the goddess Nerthus, described by Tacitus 'Nec quicquam notabile in singulis, nisi quod in commune Nerthum id est Terram matrem, colunt eamque intervenire rebus hominum, invehi populis arbitrantur...est in Insula Oceani castrum nemus dicatumque in eo vehiculum veste contactum: attingere uni sacerdoti concessum is adesse penetrari deam, intellegit vectamque bubus feminis multa cum veneratione prosequitur ' 21

BOX CARTS

This is the normal type of two wheeled vehicle for transporting goods and people. They are found throughout southern Europe from the third millenium B.C. 22

LADDER CARTS

This is one of the most simple forms, being a ladder laid across the axle of a pair of wheels. It is represented in prehistory by petroglyphs from Los Buitres, Iberia. [2] These carts are quite unlike the European vehicles which had A or Y frames or staves over longitudinal beams. 23

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21. Littauer and Crowel (1974) pp 26-36, Piggott (1968) p.274, Hutton, Ogilvie, Warmington, Peterson, Winterbottom, Agricola, Germania, Dialogus (Cam. Mass. 1946) Germania XL.
 22. Childe (1951) pp 177-193.
 23. Jenkins (1961) pp 3-5, J.G.D. Clark, Prehistoric Europe, the Economic Basis (London 1952) p 304 fig. 167

SIMPLE PLATFORM CARTS.

These tend to be processional vehicles rather than practical carts because of the difficulty of loading. Such a form is depicted on an Assyrian relief as simple fighting platforms mounted on wheels. Moreover, cult models from Bronze Age central and northern Europe tend to be mounted on wheeled platforms. ²⁴

THE CHARIOT

The appearance and development of the war chariot has been well catalogued for the Near East and the southern Mediterranean by Childe. [3] It is present in eastern Europe in the second millennium B.C., [4] had reached the Danube Basin by c1000 B.C., and northern Europe by the ninth or tenth century B.C.. [5] Its form is well known; high fronted, open backed, it became the popular mode of personal transport as well as the vehicle of war, 'a phenomenon of material culture quite extra-environmental'. By the seventh century the form had changed slightly and the open fronted Celtic chariot with a seated charioteer took over. It is, however, possible that open fronted vehicles were depicted on eighth century B.C. Attic vases but in a conventionalised way. ²⁵

24. J. Curtis Wheeled Vehicles in Ancient Western Asia (London 1975), R. Forrer, 'Les Chars Culturels Préhistoriques et Leurs Survivances aux Epoque Historiques', Préhistoire I (1932) pp 19-123.

25. Childe (1951) pp 177-193; T.G.E. Powell, 'Some Implications of Chariotry', Culture and Environment: Essays in honour of Sir Cyril Fox, I. Li Foster and L. Alcock (eds) (London 1963) pp 153-169; D. Greene 'The Chariot as described in Irish Literature', The Iron Age in the Irish Sea Province, C. Thomas (ed), CBA report IX (London 1972) pp 59-75.

The first point which may be made is that all of these forms which have been selected, have central draught poles. Secondly, it may be possible to illustrate continuity of these particular forms and to indicate modifications where these are suggested. Thirdly, while it is possible as early as the second millenium to see a distinct distribution of wagons and carts, the former stretching throughout central Europe but including the Balkans, the western Baltic and eastern France and the latter in southern Europe from Iberia to the Caspian,²⁶ influence of regional topography and local economics should not be entirely neglected. Distribution zones are interesting but should not be accepted unquestionably.

26. Jenkins (1961) fig. 10.

CHAPTER TWO : ROMAN VEHICLES

There exists for the Roman period not only excavated material and representations but also literary sources which provide lexical information as to the typology of ancient vehicles. When using this kind of information, it must be remembered that the work of many of the technological historians of the nineteenth century should be regarded with caution, not least because they linked literary nomenclature with graphic representation on the basis of very little evidence. It is only in very exceptional circumstances that the name of a vehicle can be linked to actual representation. Therefore one of the main questions of this chapter is how one may recognise morphological distinction from appellative alone. The answer is perhaps to be found by examining the information actually provided by the Latin authors for each individual vehicle name, for indications of function. Secondly, of the dozen or so Latin vehicle names, more than half have an origin which is demonstrably Celtic, introduced into Roman vocabulary in the period following the Gallic wars and the conquest of Britain,¹ indicating wholesale adoption of the vehicles themselves. This group of vehicles is distinct in itself and will be treated as such 'The popularity in Rome of fast light Celtic two-wheelers pays a similar tribute to the high regard in which the nameless Celtic coachbuilders were held by its men of fashion'². Moreover it would also be interesting

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1. K.H.S. Schmidt, 'Keltisches Wertgut im Lateinischen', *Glotta* XLIV (1966-67) pp 151-74, p.168
 2. Stuart Piggott, 'Roman Vehicles; the Lexical and Literary Evidence', unpublished draft. The 'similar tribute' is a reference to the analogous adoption of French terms to England with the automobile. I should like to thank the author for access to this unpublished material.

to discover whether there is a case for the modification of certain vehicle types by the Romans which would indicate that they did more than merely put the technological achievement of other peoples to their own uses.

From the representations, therefore, it is possible to isolate recurring types;

TILT WAGONS

This is a vehicle type known in the prehistoric Near East.³ It continues to be constructed into the Roman period but modified variations do also appear on a number of pictorial representations. A tilt wagon very like those shown by the Levantine prehistoric models is shown for example, on a relief from Klagenfurt in Austria.⁴ The reconstructed 'sleeping' carruca^[6] published for the exhibition of 1938 and a 'closed' carruca from a Pannonian relief^[7] also resemble Near Eastern second millenium B.C. models. All⁵ three examples have side windows, however, unlike the prehistoric terracottas. Strabo⁶ in the first century A.D. refers to the custom of the Cimbri of beating the stretched hides of their wicker wagons which would seem to indicate that the eastern wagon had tilts made of hide. The side windows of the Roman vehicles argues for another material, perhaps wicker, reed or lattice as in the surviving second millenium Russian vehicles.⁷ Modifications of the tilt appear at Vaison⁸ [8] and on the western face of the Igel monument.⁹ [9] On these examples, the tilt itself

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3. Littauer and Crowel (1974) pp 20-22.
 4. C. Singer, E.J. Holmyard, A.R.Hall, T.I. Williams A History of Technology, henceforth Singer et al (Oxford 1952) II fig.494
 5. M.Cagliano de Azevedo, I Trasporti et Il Traffico, Civiltà Romana IV (1938) p.12 p.13
 6. Théodore Reinach, 'Les Chars Armés de faux Chez les Ancien Gaulois' Revue Celtique X (1889) pp 122-133.
 7. Stuart Piggott (1968) pp 226-318.
 8. P.Cobé and Roubier, The Art of Roman Gaul (London 1961) pl.203 p.73
 9. Salomon Reinach, Répertoire de Reliefs Grecs et Romains 3 vols, (Paris 1909-12) I p.168.

has gone and the wagons are enclosed, 'double decker' passenger vehicles. The influence of the tilt wagons may be adduced, however, it might be interesting to add that the latter bears a remarkable resemblance to a medieval carriage from a manuscript from St. Denis.¹⁰ [10] Finally, further modification of the idea of a covered wagon may be seen on a relief from an infant's sarcophagus from Rome,¹¹ [11c] where the place of the tilt has been taken by a simple canopy and the sides are completely open.

TILT CARTS.

These vehicles were common throughout the prehistoric period in the Near East and southern Europe. It appears in the Roman world, primarily as the carpentum, much used by noble ladies and at the sacred games. It is illustrated most frequently on commemorative coins [12] struck in the mint at Rome, for example, sestertii of Gaius (14-37 A.D.), Titus (80 A.D.), and Domitian (90-1 A.D.)¹²

BOX WAGONS

These vehicles had become, by the Roman period, the common utility wagon, transporting goods and passengers throughout the Empire. Such vehicles with solid planked or wicker sides are depicted, for example, from the columns of Marcus Aurelius and Trajan for carrying army baggage and victory spoils. A curious variation is seen in the boat-shaped wagons of the same reliefs [13-14b] As shown from these monuments, box wagons may have both solid or spoked wheels, [15] the former pulled by oxen, the latter

10. Singer et al, 11 fig. 496.

11. Reinach (1909) 111 p.269.

12. Wilhelm Treue, Achse, Rad und Wagen (Munich 1965) p 169; A.S. Robertson, Roman Imperial Coins from the Hunter Coin Cabinet (Glasgow 1962) I pls 46 no 69, 56 no 185, 14 no 36; Mattingly and Sydenham, Roman Imperial Coinage (London 1923) 5 vols, I pl 8, 123 p 118. It should be noted that both Robertson and Mattingly and Sydenham leave the Gaius coin to Agrippina undated.

by a pair of horses.¹³ All have central draught poles, as does the box passenger quadriga from Langres^[16] and the elephant quadriga from Rome.¹⁴ ^[17a] It is also the type of vehicle reconstructed by Venedikov from remains at Thrace.¹⁵ ^[18a and b] The use of the box wagon for carting tasks contrasts with use interpreted for wagons from Celtic Europe which it is assumed from the context of their discovery were processional, funerary hearses.¹⁶ However, it has been suggested that these wagons were simply extensions of those used in everyday life, so it is possible to maintain that the distinction between function in prehistoric and Roman times is a false one. Finally, there are the box wagons from Ostian mosaics which are shown as passenger and personal vehicles.¹⁷

BOX CARTS.

This type of vehicle is most commonly represented in the Roman period. Here it is difficult to draw a distinction between the box cart and the chariot except in terms of function, the latter being used for battle and triumphs as well as for racing in the circus and at the sacred games. The word chariot may also be used to describe that swift vehicle used for personal transport. However, this is in form purely a solid sided vehicle with no modifications, as for example at

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13. Reinach (1909) I. fig.43, fig.134, P.Vigneron, Le Cheval dans l'Antiquité Gréco-Romaine: des Guerres Médiques aux Grandes Invasions. Contribution à l'histoire des Techniques (Nancy 1963) pl. 60a, pl.60b, pl.57a.
 14. Esperandieu Recueil général des bas-reliefs de la Gaule Romaine IV 10 vols, (1907-33) p.282, Treue (1965) p.163.
 15. Ivan Venedikov, Trakiiskata Kolesnita (Sofia 1960).
 16. Childe (1951).
 17. Treue (1965) p. 172.

Trier, Arles, Arlon and Metz.¹⁸ [16a] The cart is primarily a working vehicle as depicted on reliefs from the columns of Trajan and Aureli, and the vehicle from the mosaic at Sta. Costanza, Rome. Heavy duty carts are also depicted in Sicilian mosaics.¹⁹ Several points may be also made about Roman box carts. Firstly, they are depicted with both fixed and revolving axles and with spoked or solid wheels depending on the level of sophistication. By and large, farm carts, drawn by oxen tend to have revolving axles and solid wheels. Secondly, the relief from Arlon²⁰ which shows a dung cart would tend to suggest that some box carts had detachable bodies made of wicker of the kind described by K.D. White.²¹ Thirdly, distinctions have been made between the prehistoric and medieval periods in terms of characteristic animal draught, in other words, that the prehistoric period had central pole and yoke, the medieval period shafts and single animal draught. Shafts, however, appear in the late Roman period on the box carts used for personal transport particularly, and poles and yoked oxen draught continue into the middle ages.

THE CHARIOT

This is the most frequently represented and admired vehicle of the Roman world, It is similar in form to those depicted on the prehistoric reliefs of Egypt and

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18. Bulliet, The Camel and the Wheel (Cam.Mass.1975) fig.99, P.Obé and Roubier (1961) pl.180, Reinach (1909) ll p.95, Esperandieu (1907-38) V 4030.
19. Vigneron (1968) Lehmen-Hartleben Trajanssäule (Berlin/Leipzig 1926) Walter Oakshott The Mosaics of Rome (London 1967) pl. 38, George Jennison Animals for Show and Pleasure in Ancient Rome (Manchester 1937).
20. Esperandieu (1907-38) V 4030.
21. Casson Travel in the Ancient World (London 1974) p.161 K.D.White Agricultural Implements of the Roman World (Cambridge 1967), Roman Farming (London 1970), Farm Equipment of the Roman World (Cambridge 1975), Bulliet (1975) fig.99, Esperandieu (1907-38) V 4034, Jope in Singer et al ll fig. 544, Reinach (1909) p 95, Esperandieu (1907-38) V 4030.

Assyria. Pictorial reliefs and mosaics illustrating chariots are found throughout the Roman world and as far north as Britain. Drawn by a variety of animals, real and fabulous, circus racing and triumphal chariots are the most popular motifs.²²

22. J.M.C. Toynbee Art in Roman Britain (London 1962) see for example fig. 227, the Horkstow villa mosaics, Lincolnshire which compare to those in, for example, the Piazza Armerina in Toynbee, Animals in Roman Life and Art (London 1973) figs. 9, 11, 133 and B Pace, I Mosaici di Piazza Amerina (Rome 1955) For the relevance of the Horkstow pavement to the area, notably the circus of the colonia at Lindum see I. Richmond, Archaeological Journal 1946 p.68

It may now be useful to consider Latin etymology.
The names of the vehicles will be considered in alphabetical order.
Functional significance will be discussed later.

1. ANGARIUM

R.E. I ; Column 2184-5 ²³

Codex Theodosianus, VIII; V; XI. ²⁴
(fourth century A.D.) 360 A.D.

Ne qua posthac legio
amplius quam duas angarias
et hoc eorum si qui aegri
sunt causa usurpare conetur,
cum ad destinata proficiscitur
ita tamen ut pro singulis
angariis bina tantum
broum paria consequantur.

" " VIII; V:XXVIII
ca. 370 A.D.

Quod iam Gallis prodest
ad Illyricum etiam Italiaeque
regiones convenit
redundare ut non amplius
reda quam mille pondo
subvectet angariae mille
quingenta sufficiant
veredo ultra tri-genta
nullus imponat.

23. Der Kleine Pauly Lexicon der Antike auf der Arundleg e, von Pauly's
Real encyclopadie der classischen Altertums wissenschaft. edited
by Konrad Julius F. Zeigler and W. Southeimer (Stuttgart 1962-75)
XIV vols.

24. Pharr, Corpus of Roman Law I. (Princeton 1952), Theodor Mommsen,
Theodosiani libri xvi cum Constitutionibus Sirmondianis (Berlin 1905).

" VI;XXIX: V.
359 A.D.

In his dumtaxat provinciis in quibus cursus a provincialibus exhibetur quoniam avaritiae occurri paene iam non potest singulos solidos per singulas redas id est quas quadrigas vel flagella appellant percipiat per id tempus quo curaram et cursus tuendi sollicitudinem sustinebitis. E cursu vero clavulari singulas angarias in his scilicet amplius accipere aut sperare quicquam aut aliud excusare ultra quam continet forma praecepti.

Hence the angarium may be taken to mean a heavy duty freight wagon.

2. BENNA.

R.E. III : column 276

Sextus Pompeius Festus, Epistola ²⁵
(second century A.D.) XXXII: XIV. (506)

Benna lingua Gallica genus vehiculi appellatur unde vocantur combennones in aedum benna sedentes.

Therefore the benna may be taken to be a form of personal transport

25. M. Nisard, Collection des Auteurs Latins (Paris) ^{2ed.} 1956-67) XXVII Vob.
Unless otherwise stated, all quotations come from this source.

Du Cange²⁶ defined it as a 'genus vehiculi lingua Gallica veteri, quod Vulgo beneau appellamus seu benneau Germanicus etiam num benne est carrus cum corbe in quo aliquid commodius vehi potest'.

3. CARPENTUM

R.E.: 11 :column 1606-7

Ovid Fasti I; DCXIX.
(first century B.C.)

Propertius Elegies V:Vlll
(first century B.C.)

Tacitus Annales XII:XLll
(first century A.D.)

Livy Historia Romanorum X :XXX
XXXI,XXI/XXXII,XXX/XXXIX,VII.
V,XXV.
(first century B.C.)

Nam prius Ausonius matres
carpenta vehebant...

Appia dic quaeso, quantum te
teste triumphum

Egerit effusis par tua saxa
rotis

Ausa per inpuros frena morare
locos

Serica nam taceo volsi carpenta
nepotis.

...suum quoque fastigium
Agrippina extollere altius
carpento Capitolium ingredi
quimos sacerdotibus et
sacris antiquitus concessus.

mille carpentorum
Grata ea res at quae
maxime senatui unquam fuit
honorem que ob eam munificen-
tiam ferunt matronis habitum
ut pilento ad sacra ludosque
carpentis festo profesto que
uteretur.

26. Du Cange Glossarium Mediae et Infimae Latinitatis VI vols.

(Paris 1846) henceforth D.C.

27. Livy, henceforth H.R.

H.R. I, XXXXV

Suetonius De Vita Caesarum
Claudius XVII. (first century
A.D.)

" " XXV

" Caligula XV

Florus, Epitome bellorum
omnium annorum (second
century A.D.) I: XVIII
" " III; III

Juvenal, Satires VIII CXLVII
(first to second century A.D.)

Ibi ei carpento sedenti cu uxore
(Lucimo et Tanaquil) Aquila sus-
pensis demissa leniter alis
pilleum aufert superque carpentum

...curru ejus Messalina uxor
carpento secuta est.

...matri carpentum quo per circum
duceretur.

...eo amplius matri circenses
carpentumque quo in pompa
traduceretur.

carpenta Gallorum
Tam conspicuum in triumpho quam
rex ipse Bituitus discoloribus
in armis argenteoque carpento
qualis pugnauerat.

...praeter avasorum onores atque
os a volucris carpento rapitur
pinguis damasippus.

Thus a carpentum was a war chariot, and the vehicle used at the
sacred games both for display and for personal transport particularly
for Roman matrons. D.C. says, Pompaticu vehiculi genus carrum.

CARRUCA.

R.E. --

Martial, Epigrammaton Libri XII
(First century A.D.)

O, Jacunda, covine
solitudo carruca magis,
essedoque gratium.

" " XLVII

Nec feriatus ibat ante
carrucam (In.XI the word
was reda)

Suetonius, Nero XXX

Numquam minu ille carrucis
fecisse iter traditur
soleis mularum argentes.

Thus the carruca may be considered as a vehicle of personal transport, probably owner-driver. D.C. calls it a 'rheda honoratum vehiculum opertum' . It has been described as an aristocratic reda.

CARRUS.

R.E. : II column 1615

Livy H.R. X,XXVIII: LX

...in essedis carrisque

The carrus may be considered an army supply vehicle. D.C. referred to it as a 'vehiculum minus quod funibus trahitur ad operariis. Huiusmodi frequens usus est in saxis mole majoribus transvehedis inter aedificandum' .

CISIUM.

R.E. ; lll column 2588-9

Vergil, Catalepton VIII, lll
(first century B.C.)

...nec ullius volanctis
impetum cisi.

Cicero, Pro Sextus Roscio Amerino
VII. (second century B.C.)
-first century BC.

Decem horis nocturnis sex
et quinquaginta milia passum
cisiis pervolavit.

Cicero, Philippicae 11; XXXI.

Inde cisio celeriter ad
urbem advectus.

Seneca, Epistulae LXXII : 11
first century B.C. to first
century A.D.)

...quaedam enim sunt
quae possis et in cisio
scribere quaedam lectum et
otium secretum desiderant.

Cisium therefore, may be regarded as a form of rapid personal
transport for town.

COVINUS

R.E. : --

Tacitus, Agricola XXXV
(first century A.D.)

...media capi covinarius
et eques strepitu ac
discursu complebat.

" " XXXVI

Covinarii peditum se
praeliomiscuere...

Martial, Epigrammaton XII

O, Jocuna, covine,
solitudo...

The covinus therefore may be regarded as a Gallic war chariot
adapted for personal town use by the Roman owner-driver.

CURRUS

R.E. : --

Festus, Epistola CLIV;XLII

Curriculo pro cursim
ponebant.
Plautus 'licet' inquit
'vos abire curriculo'
Curriculus diminutivum a
curru.

Tacitus, Agricola XXXVI

Covinarii peditum se
praelio miscuere ac saepe
vagi currus exterri sine
rektoribus equi transverso
aut obvio incursabant.

Jordanis, Bellum Gothicum II
(sixth century A.D.)

Curribusque falcatis quos
more vulgari essedas vocant.

Pliny²⁷ Naturalis Historia VIII;XIX
(first century A.D.)

...rotarum orbes circumacti
currusque inanes...magis
terrent...

Vergil, Georgics III;CCCLXII.

...praecipitem oceano rubro
lavit aequore currum.. /atque
jam tergo ferratos sustinet
orbis.

Sidonius Appollinaris, Carmina II
CDXC-III
(fifth century A.D.)

Repartis Pisa...quem fraude
cadentum cerea destuit
resolutis exibus obex. (as
applied to currus).

Ovid, Tristia IV. II

...super in curru Caesar
victore veheris...quadrigos
cernes saepe restare equos..
curros spectat eburnos.

" Amores III,II

...Currum vitricius ipae
dabit inque dato curru
populo clamante triumphum.

Suetonius, Claudius XXV

Avia Liviae divinos honores et
circensis pompa currum elephant-
orum.

Therefore the currus was a two wheeled chariot for private use,
for the sacred games and for the battle field. D.C. says
'Machinae bellicae species rotis imposita inde nomen qua muri
urbium et castrorum tuto appropinquantur et oppugnantur.'

ESSEDUM.

R.E. : VI I column 687-9
Cicero, Ad Atticum VI, I

...cum duobus essedis et raeda
equis uncta et lectica et
familia magna.

27. Henceforth N.H.

Cicero Ad Familiares VII,VI

Martial, Epigrammata. X,CLV

" " CV.

" " XXIV

LVII

Ovid, Amores II,XVI

Propertius, Elegies II,1,XVI
(first century BC.)

Vergil, Georgics III CCLV

Sidonius Apollinarius, Carmina
(fifth century AD) II X

Suetonius, Caligula LI

" XLX

" Octavian LXXVI

" Galba XLV

Tu qui ceterius cavere
didicisti in Britannia ne ab
essedariis decipiaris, caveto.

Illinc te rota tollet et
citatis
Attam Bibilin et tuam sabnem
Quinto forsitan essedo videbis

Turpes essedae quad trahunt
bisonets...essedo tracente...
ne blando rota sit molesta sono.

Intraque li enclausus essedo
cursus et in profundo somnus...

Parvaeque qua primum rapientibus
essedae mannisipsa per admissas
concute iora jupas.

Quandocunque igitur vitam mea
fata reposit
Et breve in exiguo marmore
nomen ero
Maecenas, nostrae pars invidiosa
iuventae

Et vitae et morti gloria iusta
meae

Si forte meo ducet via proxima
busto

Esseda caelatis siste Britannia
iugis

Taliaque in lacrimis utuae iace
verba favillae

Huic misero fatum dura puella fuit

Belgica vel molli melius feret
essedae collo

...stridentem moderator essedorum.

Iter essedum faceret...

...in essedis cohorta..

Nos in essedo panem et palmulas
custavimus.

Taurus sucuris iuctu
consternatus rupto vinculo
essedum ejus invasit.

Suetonius, Claudius XXXIII

...solutis etiam in gestatione ledere it essedo alveo adaptus ne lusus confunderetur.

Pliny, N.H. XXXIV

Coopere deinde et essedas colisataque ac petorita exornare.

Caesar, De Bello Gallico V, XX

Ille equitatu atque essedis ad flumen progressis.

Livy, H.R. X, XXVIII IX

Essedis, carrisque superstans armatus...

Seneca Epistulae LVI

In hiis quae me sine advocazione circumsrepunt essedas transcurrentes pono.

Jordanis, Bellum Gothicum II

Non tantum equitatu vel pedite rerum etiam bigas, curribusque falcatis quos more vulgari essedis vocant.

Claudian Epistola I
(Fourth century A.D.)
(De Mulabus Gallicis.)

Esseda concordēs multisonora trahunt...

Thus an essedum was a Celtic war chariot or a Roman town vehicle. D.C. records that an essedasunt Gallorum vehiculum quibus reges victu captivi ducuntur. It has also been described by one author as the slang word for currus.

PETORRITUM

R.E. : XIX 1 column 1163-4.

Festus Epistola CCCXV, CCXXVII

Petorritum et Gallicum cum vehiculum esse et nomen eius dictum esse existimant a numero iij rotarum.

Horace, Satires I, VI, CIII-IV

Ducenda petorrita nunc mihi curto.
Ire lecet mulo vel si libet usque. Tarentum mantica cui lumbos onere ulceret atque eques armos.

Ausonius, Epistola XXI, XIV, XV
(Fourth century A.D.)

Cantheris moneo male nota petorrita vites nec celereo mulas pise Meliscus agas.

" " XXI, VIII, V.

Cornipedes rapiant imposita petorrita mulae.

" " V, XXXV.

Invenies praesto subiuncta petorrita mulis.

Horace, Epistulae 11,1, CXCI

...essedae festinant, pilenta,
petorrita, naves...

Pliny, N.H. XXXIV, XLVIII

essedae ea petorrita exornare...

Thus petorritum was a Gallic four-wheeler used by the Roman for long distance travel. It would seem to be similar to the reda and 28
Daremberg and Saglio have suggested that the family might travel in the reda while the servants follow in the petorritum. However, with all the connections with adornment and luxury which the petorritum seems to have had rather than the reda, it might possibly have been the other way round.

PILENTUM.

R.E. : XX 1 column 1324-6

Festus, Epistola. CCCXIII, CCXXV.

Vehicula gens quo matronae ferebantur.

Vergil, Aeneid VIII, DCLXVI

...castas ducebant sacra per urbem

Pilentis matres in mollibus...

Claudian, Epithalamium CCLXXXVI

...ante feres iam pompa sonat pilentaque sacra praeadiant ductura nurrum.

Livy, H.R. V, XXV, IX.

Grata est res at quae maxime senatii unquam fuit; honoremque ob eam munificentiam ferunt matronis habitum ut pilento ad sacra ludosque carpentis festo que uteretur.

Prudentius, Contra Symmachum 11 (fourth century A.D.)

Fertur per medias ut publica pompa plateas pilento residens molli.

Macrobius Saturnalia. 1, VI, XV. (fifth century A.D.)

Verrius Flaccus sit eum populus Romanus pestilentia laboraret essetque responsum id accidere quod di despiceretur anxiam urbe fuisse quia non intelligeretur oraculum, evenisse que ut circensium die puer de cenaculo pompam superie despiceret et patri referret quo ordine secreta sacrorum in arc pilenti composita vidisset.

28. U.V. Daremberg and E. Saglio, Dictionnaire des Antiquités Grecques et Romaines. V. vols. (Paris 1873-1919) S.V. reda

Fortunatus, Carminae VI, V.

...hinc pilente petens loca
Gallica stabat fixa oculis
tristis eunte rota.

Thus pilentum may be taken to mean a four wheeled travelling carriage. However, Livy makes a nice distinction between pilentum and carpentum, the former for riding in to the sacred games, the latter for travel in town on normal working days and holy days.

PLAUSTRUM.

R.E. XX : column 2551-6.

Varro, Rerum Rusticarum 1, XIII, 11
(first century B.C.)

Faciendum etiam plaustris
ac cetero instrumento omni in
cohorte.

" 1, XVI, VI Eundem fundum fructuosiore fac-
iunt vecturae silviae sunt qua
plaustra agi facile possint.

" 1, XX Quos ad vecturas item
instituentem ut iania primum
ducant plaustra et ibi
possis oper vicum oppidum
creber crepitas ac varietas
rerum consuetudine celeberrima
ad utilitatem adducit.

Ovid, Amores III, X.

Perque noves pontes subter
iabentibus undes
Ducent Samatici barbara plaustra
boves
...stridentia plaustra...

" Metamorphoses XII, CCLXXXI

...onus plaustra...

Vergil, Georgics II CCVI

Plura domum tardis decedere
plaustra juvenis...

" " CDXLIII-VI

Navigiis pinos domibus
cedrumque cupressque
Hinc radios trivere rotis, hinc
tympana plaustris Agricola

" " (CLXXIII)

(caeditur et tilia aute iuga
levis)

(CLXXV)

(Et suspensis focis explorat
robera fumus)

" " II DXXXVI

...stridentia plaustra...

- Vergil, Aeneid XI, CXXXVIII. ...ferro sonat icta bipenni
Fraximus evertunt actas ad sidera pinus
Robora nec cuneis et olentum scindere
cedrum
Nec plaustris cessant vectare
gementibus ornos.
- Ovid, Fasti VI, DCLXXX ...in plaustra skirpia lara fuit.
- Cato, De Agri Cultura III, X, 11
(second century B.C.) ... plaustrum maius...
- Cicero, De Divinatione I,
XXVII. Se interfectum in plaustra a caupone
esse...ut are ad portam adesset
priusquam plustrum ex oppido exiret.
- Vergil, Georgics II, DXXXVI. Puppibus illa prius patulis nunc
hospita plaustris.
- Horace, Ars Poetica CCLXXV Ignotum tragicæ genas invenisse
canoene dicitur et plaustris vexisse
poemata Thepsis quæ canerent
agerentque peruncto faecibus ora.
- Caesar, De Bello Gallico III
(first century B.C.) Ipse cum expedita manu proficisitur
circum villas frumentum oppidarisque
imperat ut plaustra iumenta omnia
sequantur.
- Valerius, Flaccus, Argonauts
(second century B.C.) VI,
LXXIX Quin et ab Hyrcanis Titanius
expulit antris Cyris in arma viros
plaustrisque ad praelia cunctas
coraletæ traxerere manus.
- Amianus Marcellinus, Rerum
Gestarum XXXI, 11, XVIII Plaustris supersidentes currantis
(fourth century A.D.) quæ operimentes curratis cortam
per solitudines conferunt sine fine
distantas.
- " XXXI, VII, V. Ab orbis rotundi multitudine
digesta plaustrorum tamquam ultra
muraris cohibitum spatii.
- Juvenal, Satires III, CCLVI Modo longo coruscat sarraco veniente
abies atque altera pinum plaustra
vehint.
- Vitruvius, De Architectura
(first century B.C. XI.
to first century A.D.) Nisi plaustrorum seu sarracorum
per terram...

Suetonius, Vespasian XX11

In quibus et haec Mestium Florum
consularem admonitus aber plaustra
potius quam plostra dicenda.

Varro, Rerum Rusticarum 1, L11.

Aut ex axibus dentalis aim
orbiculus quod vocant plostellum
poenicum in eo quis sed eat atque
trahunt iumenta.

Cato, De Agri Cultura 111, X, 11

...plostra et treblae...

The plaustrum, therefore, with its diminutive plaustellum and
its vulgar form plostrum is a farm or heavy duty wagon. D.C. says
it is a 'Currus quattor rotis constans'.

REDA

R.E. : --

Martial, Epigrammaton 111, XLV11

...plena in reda omnes beati
copias trahens ruris.

Quintilian, Institutio, 1, V, LV11
(first century A.D.)

Plurima Gallica evoluerunt
ut raeda ac petorritum quorum
tamen Cicero alitrio Horace
utitur.

LXV111

Spiraedium; Nam cum sit praeposito
Graeco raeda Gallicu; neque
Graecus tamen neque Gallus utitur
composito Romani suum ex alieno
utroque fecerunt.

Fortunatus, Carmina 111, XV11-XX

Curriculigens est memorat quod
Gallia rheda
Molliter incedens orbita sulest
humum
Exiliens duplici bijugo volat
axe cotato
Atque movet rapidas juncto
quodrigas rotas.

Cicero, Pro Milone 11

Obviam fit ei Clodius expeditus
in equo nulla rheda nullis
impedimenti Graecis comitibus
ut solebant.

" " X

Cum uxore vehetur in rheda
penula^{tis} magno et impedimento
et muliebri ac delicato ancillar um
peullorumque comitatu.

" " XX

Uter nihil cogitaret mali
quum alter veheretur in rheda
penulatus una sederet uxor.

" Ad Atticum VI, 1

Hic vedius mihi obviam venit cum
duobus essedis et raeda equis
uncta et lectica et familia magna.

<u>Cicero, Ad Atticum</u> V, XVII	Hanc epistolans dictavi sedens in <u>raeda</u> .
<u>Philippicae</u> II, XXIV	Vehebantur in essedo tribunis plebis sequebantur rheda cum legionibus comites nequissimi.
<u>Codex Theodosianus</u> VIII, V, 368 AD. XXVIII.	Quod iam Gallis prodest ad Illyricum etiam Italique regiones convenit redundare ut non amplius <u>reda</u> quam mille pondo subvectet...
<u>Caesar, De Bello Gallico</u> LI	...omne que acie suam <u>rhedis</u> et carris circumdederunt.
<u>Suetonius, Caesar</u> LVII	...meritoria rheda centena passuum millia in singulos dies.
<u>Horace, Satires</u> , V, LXXXV	Quatuor hinc rapimur viginti et millia <u>rhedis</u> .
<u>Juvenal, Satires</u> , III, X	Sed dum tota domus <u>reda</u> componitur subsistit ad veteres arcus.
<u>Vitruvius De Architectura</u> X, III, IX	Cum haec ita ad centrum porrectionibus et circinationibus reciperunt motos tunc vero etiam plostra <u>raeda</u> tympana rotae cocleae, scorpionis, ballistae prela ceteraeque machinae isdem rationibus per porrectum centrum et rotationem circini versantum faciunt ad propositum effectus.

Thus reda meant a rustic cart or wagon, the standard vehicle for long journeys.

SARRACUM

R.E. II A 1, column 49-50

<u>Quintilian, Institutio</u> VIII, III, XXI.	An cum dicet in Pisone, Cicero 'cum tibi cognatio <u>serraco</u> advehatur' incidisse videtur in sordidu nomen noneo contemptu hominis quen destrustum volebat auxisse.
--	---

<u>Sidonius Apollinari's Carmina</u> IV, XVIII	Nulla <u>serraca</u> , nulla esseda subvehendis oneribus adtrahebantur
---	--

<u>Juvenal, Satires</u> , III, CCLIV, VI.	Modo longa coruscat <u>sarraco</u> veniente abies.
--	--

" " V, XXII Frigida circumagunt pigri sarraca Bootae.

<u>Vitruvius De Architectura</u> X, 1.	...plaustorum seu <u>sarracorum</u> ..
---	--

Amianus Marcellianus, Rerum
Gestarum, XXXI, 11, XVIII

Serracis et carpentis
civitates impositas vehunt.
(Scythians).

Thus sarracum appears to have been a vulgar equivalent of plaustrum
used for heavy carting.

TENSA.

R.E. : V A 1 : column 533-6

Festus, Epistola CCCXIII

Vehiculum quo exuviae deorum
ludicris circensibus in circu
ad pulvinar vehuntur.

Cicero, In Verrem II LIV

...tensae...quod ante ipsas lor
a tenduntur quae gaudent manu
tenere et tangere qui eas deduavit.

Diomedes Ars Grammatica I,
CCCLXXII

Non ostensus nec tensus sed quia
cacemphaton videtur.

Suetonius, Caesar LXXVI, 1.

Decerni sibi passus est...tensam
et ferculum circensi pompa.

The tensa therefore appears to have been a vehicle used for the
circus, triumphs and the sacred games.

VECTURA.

R.E. VIII A1 : column 56-7

Caesar De Bello Gallico III, XL1

...vecturasque frumenti descripsit.

Though extremely rare, vectura would appear to be a generic term
for vehicle.

VEHICULUM

R.E. VIII, A0 : column 581

Tacitus, Agricola I, LXXX

vehicula cohortis incipente nocte
onerari aperto armentario jubet.

Vegetius Epitoma rei Militaris
(fourth century A.D.) III, VI.

Primi ego equites iter arripiant
inde pedites; impedimenta,
sagmarum, calones, vehiculaque in
medio collocentur ita ut expedita
pars peditum et equitum
subsequantur.

Livy H.R., X, XXVII1

Multi impetu equorum ac
vehiculorum raptorum per agmen
obtriti antisignani...

" XXXIV, 1

...ne qua mulier plus semunciam
curi heberet neu iuncto vehiculo
in urbe oppidore aut proprius
inde mille passus nisi sacrorum
publicorum causa veheretur.

Pliny N.H. XXIV, XLVIII

Coopere deinde et esseda sua
colisata et ac petorita
exornare similmodo quae iam
luxurea ad aurea quoquo non
modo argentea staticula
pervenit quaeque in scyphis
cERRU prodigum erat haec in
vehiculis adteri cultus
vocatur.

Suetonius, Caligula XXXIX

...reprehensio ac retento
vehiculo...

"

XXXIX

...comprehendis ad deportandum
meritorius quoquo vehiculis et
pistrinensibus jumentis...

Codex Theodosianus VIII, V, IV,
326 AD.

Neglegentia idem supplicium
luitaris non inprobrum tamen
est si is qui angarialem
habet copiam ad tutelam vitae
vel labores adeundum itineris
pro solacio quendam sociaverit
namque hoc factum meretur
veniam nec latere potuerit
explorantes, illud polena
superius dicta plectendum est.
Super quare proconsules
rectores provinciarum
praefectos vehiculorum adque
omnes qui cursui publico
praesunt admoneri conveniet,

Thus vehiculum appears to have been a general term for vehicle
by land and sea.

DISCUSSION

Several points may therefore be raised from the literary sources. Firstly, it is possible to illustrate a dichotomy of major Roman vehicle types: freighters and personal cars. In the first category may be included the angarium, the carrus, the plaustrum and its diminutive plostellum, the serracum, the tensa, and perhaps the bennus. It would have been very pleasant to have been able to divide these heavy duty vehicles into two groups as cart and wagon. This, however, has proved impossible, although some vehicles do seem to be consistently four wheeled. In the second category, the carpentum, the currus, the reda, the petorritum, the pilentum, the cisium, the covinus and the essedum may be placed. These were used for both long distance and town transport. Secondly it is possible to further subdivide these into eight groups according to specialised functions:

Group one: for transporting baggage and passengers.

This includes the bennus, carrus, carpentum, essedum, petorritum, plaustrum, reda and sarracum. Benna comes for the Celtic root meaning basketry or wicker²⁹ and has been generally assumed to have had four wheels, though there is absolutely no evidence for this. It has been suggested by Daremberg and Saglio that bennus is cognate with the baggage wagons illustrated on the Aurelian column.³⁰ However, the literary evidence that does exist would tend to suggest that it is in fact not an army vehicle but a passenger carriage. The carrus seems to be a more common army transporter. Petorritum, from the Gallo-Brittonic³¹ petuor meaning four and redo to travel would seem to have been used for long distance travel only or for travelling to festivals and games. The reda on the other hand would appear to have been the normal vehicle for long journeys and there are no references to a reda being highly ornamented, unlike the petorritum. An interesting point on

29. S.Piggott, Roman Vehicles, unpublished draft, Schmidt (1966-67) p. 170.

30. Daremberg and Saglio (1873-1917) sv bennus.

31. S.Piggott, Roman Vehicles unpublished draft, Schmidt (1966-67) pp. 169-172.

the matter of travelling cars, both in this group and in others, is the predominance of references to mules. Clearly this was the most frequently used draught animal in Roman times.

Group two: fast, light personal vehicles for town use.

This includes the cisium, currus and the covinus.

The predominant theme of references of this nature is the element of speed. It may also be assumed that these vehicles were driven by the owner and like the modern sports car, not intended to carry any passengers.

Group three: war chariots

Under this heading comes the covinus, currus, essedum and the carrus. The covinus, according to Pomponius Mela, was the word used by the Britons for their own chariots. It was adopted by the Romans for private use. Currus, is the word most frequently used to describe the Gallic chariots. The last literary record of the use of war chariots on the continent appears in 225 B.C.

However, they continue in Britain until the third century A.D. and in Ireland until the early Christian period.³² According to references given by Caesar it would appear to have been capable of operating in rough country. Carrus is rarely used in a military context but one reference to the battle of Sentium in 295 B.C.

suggests that it may have functioned as a baggage wagon and been used in the field only in emergency. Carpentum, in a military context, is used to describe vehicles which cart away victory spoils. Thus it is far likelier to be carpenta depicted on the

32. Schmidt (1966-67) p.169, Reinach (1889) pp.122-133, Caesar De Bello Gallico, IV,XXIV,XXIII,V,XIX, Richard Langhorne, British Iron Age Warfare, M.A.thesis University of Edinburgh 1970(unpublished); F.E.Adcock, The Roman Art of War Martin Classical Lectures (Oxford 1940); Kenneth Jackson, The Oldest Irish Tradition: A Window on the Iron Age(Cambridge 1964); David Greene, 'The Chariot as Described in Irish Literature' Charles Thomas (ed.), 'The Iron Age in the Irish Province' (Council for British Archaeology Research Report LX London 1972); Crawford,(1926) p.7 fig.1, pl.XLIX, pl.L No. 155.

Aurelian column than benna. Finally the essedum was frequently used in the field and would appear to have been a vulgar word for currus. Though carrum is equated with essedum in Livy's passage relating to 295, this need not necessarily imply that carrum had two wheels as the essedum had. On the contrary a commentator on Horace links the four wheeled petorritum with carrum, indicating that petorritum was called carrum by the 'common people'.³³

Group four: ceremonial cars.

In this group may be included the carpentum, carruca, essedum, tensa, and currus. The carpentum was not only an urban carriage, it was also according to the literary evidence, a covered two-wheeler, used for the sacred games. It is of Celtic origin, cognate with the old Irish carpat. Carruca is etymologically cognate with carrus and was used as a state vehicle.³⁴

Group five: vehicles used by women.

Only certain types of vehicle were used by women and these include the carpentum, reda, pilentum and basterna. The latter is used to describe a covered litter. All these vehicles could be particularly sumptuous - silk-lined, curtained or gilded - and were used by women mostly to travel to the games or on state occasions.

Group six: for the public post and heavy duty transport.

This group includes the reda and the angarium both specified by the Theodosian Code of the fourth century A.D.³⁵ The word angarium appears to have been borrowed from the Persian with the postal system itself. According to Xenophon, Cyrus had invented the system as an answer to the administrative needs of

33. Figgott, Roman Vehicles, unpublished draft.

34. *ibid.*, Greene (1972).

35. Pharr (1952).

his vast empire.³⁶ This was copied by the Roman cursus publicus, (regulated by Theodosian) with the angarium, the service angaria and the courier, angarius. The vehicle itself was not allowed to carry more than 1500 lbs. The reda, also used by the cursus publicus,³⁷ carried lighter loads of up to 1000 lbs., being drawn according to the law codes by eight mules in summer, ten in winter. By contrast, the angarium was drawn by oxen, the codes specifying only two yokes per vehicle when appropriated by the army, only two vehicles being allowed to each legion for carrying the sick and wounded. Angariae was to become the word for general villein services in the middle ages.

Group seven: vehicles for use on the farm.

These include the plaustrum and the carrus. It also includes the sarracum which with plaustrum was often used to describe the constellation Ursa Major, suggesting that these vehicles were wagons. Varro describes the freight which it carried, which suggest that they were open-topped.³⁸ It is also possible that they had solid wheels and rotating axles from the descriptions of the noises which accompanied their movement. The plaustrum according to Vergil (Georgics) had spoked wheels, a yoke of lime and parts of cedar and cyprus, seasoned by smoke after being hung inside the chimney. He says that it was often seen in areas of dark soil and was oxen-drawn. Ovid also uses plaustrum to describe a platform upon which was placed a wicker basket, perhaps as illustrated by Esperandieu V 4035.³⁹ Cato uses the description plaustrum maior, which is more frequently associated with medieval records than Classical Literature, However, at least for the Roman period, there is no way of distinguishing the plaustrum from the plaustrum maior.

36. Cyropaedia VIII, VI, XVII.

37. F.K. De Vos, 'Cursus Publicus; Transportation in Ancient Rome' Public Affairs (1953) pp.8-17.

38. Piggott, Roman Vehicles (unpublished draft), this thesis s.v. plaustrum and sarracum.

39. Daremberg and Saglio (1873-1917) sv skirpea; Esperandieu (1907-38) V no 4034; K.D. White, Farm Equipment of the Roman World (Cambridge 1975).

The name is Gaulish from the root pleu, to float or sway, ⁴⁰ which may indicate that for some purposes it may have been suspended. The sarracum is often used to impute vulgarity, for example in Cicero, so it may be that it was a less sophisticated vehicle than the plaustrum. ⁴¹

Group eight : general vehicle terms.

This group consists vectura and vehicula. The latter is used for land and sea freighters, for baggage wagons, personal chariots, war chariots and the public post vehicles. The warrant issued by the governors to permit transportation of supplies by public post was a subvectus. Vectura is extremely rare but becomes more popular in the twelfth century when the European professional carrier was called the vectuarius, ⁴² transporting cargo 'cum super bestiis meis absque correctis'.

Finally, how do these names fit into the categories chosen for the representational evidence? It may be possible that for tilt wagons the names reda, pilentum, bennus, petorritum may have been used; tilt carts may have been called carri or carpenta (certainly the latter if the coins are anything to go by); box wagons plaustra, sarraca, angaria, reda, pilenta; box carts and chariots carpenta, esseda, carruca, curri, cisia, tensa, covini. However, it must be stressed that with the possible exception of the carpentum, it is not possible to distinguish these terms by morphology but only by function and therefore any comparison between vehicle terminology and representation is tenuous. It may, in the end, be safer to use the terms biga and quadriga to describe representations of Roman vehicles, being indicative of the number of draught animals or yokes. It is only in the middle ages that these terms become confused, being descriptive sometimes of the number of wheels, sometimes of draught.

40. Piggott, Roman Vehicles, unpublished draft

41. ibid.

42. R.D. Face 'The Vectuarii in the Overland Commerce between Champagne and Southern Europe', Economic History Review X11 (1959-60) pp 239-246, p. 239, p. 241.

CHAPTER THREE : MEDIEVAL VEHICLES.

It is now possible to discuss how far medieval vehicles fit into our categories. It must be emphasised that the representations enumerated here are by no means exhaustive. However, a survey of vehicle miniatures from manuscripts in the major British public collections has been attempted. Published facsimiles of important western European manuscripts were also consulted. What is presented here is merely a selection of those miniatures which illustrate chosen features to best advantage.

RAILED WAGONS.

Here the medieval period shows some continuity with prehistory, although it must be noted that with one exception, no illustrations, as far is known, exist for the Roman period. However, it is possible to suggest that railed wagons continued to be used in certain local areas where this type fitted the environmental requirements. A mosaic from Orbe, Switzerland¹ from the Roman period would seem to indicate that such wagons survived further north.

One of the earliest medieval examples comes from the Bayeux Tapestry.² Here the staves are wide apart and it is drawn by human traction. On the same principles, the baggage wagons from a biblical manuscript of 1260³ have straight-sided staves and neither tapestry nor manuscript illustrate the means of draught, namely, whether they had shafts or poles.

A thirteenth century German manuscript of Saxon laws shows a similar vehicle, but here, rising from the axlebed is

*1 Toynbee (1973) fig. 73

*2 Stenton The Bayeux Tapestry (London 1957) fig. 41-43.

*3 Cockerell, James and Ffoulkes A Book of Old Testament Illustrations (Cambridge 1927) min. 54

*4 Der Sachsenspiegel, Bilder aus der Heidelberger Handschrift, eingeleitet Von E. Freiherrn von Kunssberg, Insel-Bucherei 347 (Leipzig 1952) I should like to thank Dr. John Higgitt for bringing this manuscript to my attention.

Letts, Malcolm The Sachsenspiegel and its Illustrators (1933).

what would be called in England, a dog stick, a wooden pointed stick - sometimes tipped with iron - which is let down to prevent the vehicle from slipping backwards. It is often called a scout according to Wright. Along with roller scotches and drag shoes, which do not appear to have been illustrated anywhere, the dog stick was a major braking device.⁵ It is also illustrated on an Italian manuscript of the fourteenth century, British Library Manuscript Egerton 943, folio 80 from Padua or Emilia. A particularly good example of a straight sided wagon comes from British Library Manuscript Sloane 398 folios 12 and 18 [2.2-23] Though no dog stick is present, these vehicles do have sway bars beneath the undercarriage, indicating the presence of a bogie. This fourteenth century manuscript is Flemish. The wagons are called currus and plaustrum respectively. Up to the fourteenth century, there is a tendency for the wagons illustrated to have a central pole. By the later period, however, there is an increase in the number with shafts.^[24] This is a result not so much of a definite change in wagon morphology but of the greater variety of wagons depicted (rather than simply heavy farm wagons drawn by oxen) and of the increased use of the horse for agrarian labour. However, a definite morphological change does appear by the fifteenth century suggested by miniatures depicting V-shaped wagon bodies.⁶ [25-27] This distinctive shape occurs on wagons illuminated throughout western Europe, particularly on harvesters, with no distinction of draught animal, pole or shafts.

5. Jenkins (1961) pp.99-100 Hartley and Ingilby Life in the Moorlands of North-East Yorkshire (London 1972) Wright EDD For example Florence, B.N.B.R.39 fol 185r, c1400, illustrated in Lombardy in Breiger, Meiss, Singleton Illuminated Manuscripts of the Divine Comedy (London 1970) Treue (1965) p.215 German c1420, woodcuts of the sixteenth century from Germany illustrated by L.Tarr, The History of the Carriage (Hungary 1969) pl.XX1C-XXXIV The Grimani Breviary c 1500, Italian facsimile, Gianfranco Folena, Gian Lorenzo Mellini, Bibbia istoriata padovana della fine del Trecento (Venice 1962)

Both forms continue in use until the introduction of the spindle-wagon from Holland in the sixteenth century.

RAILED CART

This is the most frequently illustrated medieval vehicle and the frequency of its appearance is indicative of its popularity for all major carrying tasks. One of the earliest illustrations is British Library Cotton Tiberius B V, an [28] eleventh century English manuscript which depicts staved carts carrying hay and timber. The majority of medieval farm carts had light railed sides and it has been suggested that these may sometimes have been filled with wicker⁷ in the manner of the prehistoric vehicle. Eleventh century staved carts also appear in the English manuscript British Library Cotton Claudius B IV, folios 66, 67, 67b and 91b. However, they are not particularly an English phenomenon and occur throughout Europe. They all have two things in common, however; they all have shafts⁸ and all are drawn by horses, whatever their function. An Italian Bible History of c 1400 shows a⁹ dog stick or a support similar to those found on the wagons. [29] Moreover a particularly interesting example of a camouflaged hunting cart - a charrete - is illustrated in a French Livre de la Chasse [30] of the fourteenth century.¹⁰

One interesting group of vehicles can be distinguished amongst the railed carts, namely the tumbrils or prison carts, distinguished by function. These are illustrated in miniatures of many French and English manuscripts for example, British Library Harley 4375, folio 140, a fifteenth century French illumination. However, they are most popularly illustrated as

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7. E.M.Jope in Singer et al, see Tarr (1969) pls.XX1C-XXXIV
 8. except Cotton Claudius B IV
 9. Bibia Istoriata Padovana, British Library Add 15277, Catalogue of Additions to British Manuscripts in the British Museum 1841-45, (London 1850), facsimile Gianfranco Folena, Gian Lorenzo Mellini (Venice 1962).
 10. British Library Add 27699 fol. 108.

marginals of Gothic manuscripts, for example, the English fourteenth century British Library Royal 10 E 1V, folio 65, or the French manuscript Verdun 107 folio 157, executed for Marguerite of Burgundy in Lorraine in c 1304. They are also illustrated as part of the Lancelot legends. According to Chretien de Troyes, who demonstrated a very detailed knowledge of contemporary legal practice, those guilty of a capital offence were taken by cart to be executed, the cart being crux and, therefore also an instrument of humiliating punishment in itself. Radzinowicz further indicates that the cart itself was often used as a drop. The tumbrellum was used also as a means of punishing crimina minora. A part from their respective uses, the only major difference was that one was horse drawn, the other manual. Both of these vehicles are fused into Chretien's charette representing the double standard of Lancelot's morality.¹ What is more interesting from the social point of view is that the prejudice and ill luck associated with the cart as an instrument of punishment was applied to all carts so that for a healthy adult male, riding in a cart was considered a disgrace, the term karrenritter one of the greatest of insults. This attitude changed slowly and was not fully eradicated until Beau Nash's circle made coach travel fashionable. Tumbrils themselves ceased to be an instrument of punishment with the increased uses of the pillory and they became seen more commonly on the farm.

*1. Randall Images in the Margins of Gothic Manuscripts (Berkeley and Los Angeles 1966) G. Hutchings, 'An Edition of that part of the Prose Lancelot du Lac which corresponds to Chretien de Troyes Conte de la Charette' Bodleian MS. D. Phil. d 230/1-2, Bodleian MS. Rawl. Q b 6 fol. 160, David J. Shurt 'Chretien de Troyes and the Cart', Rothwell, Barron, Blamires and Thorpe (ed) Studies in Medieval Literature and Languages in memory of Frederick Whitehead (Manchester 1973) pp 279-303, L. J. Jewitt, 'A Few Notes on Ducking Stools' Reliquary 1(1861) pp 145-58, W. A. Andrews, Bygone Punishment (London 1931) Radzinowicz A History of Criminal Law and its Administration (London 1948) Vol. 1 p. 171 ff. 35 / from 1750

TILT WAGONS

This is the vehicle most commonly illustrated as a means of personal travel, (that is of ladies) in the middle ages. The tilt of the wagon is made of canvas or more expensive, sumptuous material, supported by a circular frame with horizontal cross bars. The entrance is found at the front and windows at the side, as in the French manuscript of St. Augustine, La Haye Museum Meermannno-Westreemannum 10A 11 folio 33v² or in the Luttrell Psalter, folio 181b, c1340,³ a south German chronicle of 1360, [34] The Toggenburg Bible from south west Germany [35]⁴ or the French Roman de la Rose, Bodlian Seldon Supra 57 folio 112. In the Luttrell, the open front and back entrances are protected by chains. Sometimes, however, the entrance is found at the side as in the Flemish manuscript of the fifteenth century British Library Cotton Augustus A V folio 45v. [33] Such wagons not only afforded protection from the weather, they became status symbols in the fifteenth century.⁵ They continue into the next century virtually unchanged and many of the coaches of the late sixteenth century bear a remarkable resemblance to these chars.⁶ Perhaps the last glimpse of this type is in the description of the celebrated leather Gee Ho of the Earl of Shrewsbury in the eighteenth century.⁷

2. A.W. Bryvanck, Les Principaux Manuscrits à Peintures de la Bibliothèque Royale des Pays Bas et du Musée Meermannno-Westreemannum à la Haye (Paris 1924).

3. Millar The Luttrell Psalter (London 1932)

4. Treue (1965) p.205, p.8

5. Marjorie Nice Boyer, Medieval Suspended Carriages, Speculum XXXIV (1959) p.360ff.

6. Gay and Stein Dictionnaire Archéologique du Moyen Age et de la Renaissance, s.v. coche.

7. J. Crofts Packhorse, Waggon and Post. Land Carriage and Communications under the Tudors and Stuarts (London/Toronto 1967)

TILT CARTS.

These are constructed in exactly the same way as the wagons but they are almost half the size. It is possible that the tilt wagons were two carts joined together as on prehistoric wagons. However, normally the vertical beams on tilt wagons, where these are shown, do not divide in the centre, except in the case of a middle entrance. Moreover the wheels of the cart are normally shown as a good deal larger than those of the wagon to take the more concentrated axle weight. Such a cart while still fit for normal work, would be very suitable for travel. A Flemish manuscript of the fifteenth century shows the tilt as a dropped curtain.³ Furthermore, the tilt carts and wagon bodies bear a remarkable resemblance to those covered litters which appear frequently in Flemish, French and English manuscripts of the fourteenth and fifteenth century which are carried between two horses. Such vehicles of personal transport display surprising continuity in form with those of antiquity.

BOX WAGONS.

Such wagons with reinforced planked sides appear in the miniatures as biblical¹⁰ and war chariots,¹¹ baggage vehicles and passenger carriages, particularly of the sick or wounded.¹² They are rarely farm wagons but are represented equally

8. British Library Cotton Nero E 111 folio 15

91. British Library Egerton 3277 fol.41b,Harley 5256 fol.9,Add 18350 fol.89,Add 15263 fol.69,Royal 20C V fol.144b,Royal 16 G V fol.111 Add.10294 fol.88

10. British Library Royal 19D VI fol.160,Royal 19D 11 fol.174 Add 18350 fols. 4b,38,108,91.

11. British Library Yates Thompson 16 fol.39,Add 18350 fol.94b,280 Cotton Julius F VII fol.5 Harley 4331 fol.158,Burney 169 fol.75 Royal 20 B CC fol.92

Add 24945 fol.139,Burney 257 fol.122 Add 19669 fol.218 Harley 2338 fol.36,44,Bodleian Library Land Misc.751,fol.203 Lyall 67,fol.81V Rawl.B 214 fol.199 v 198

12. British Library Harley 326 fol.90,Burnley 257 fol.91,93,Royal 20C V fol.112b,Harley 1413 fol.1 Cockerell,James,Ffoulkes (1927) min.10 17,23,42

as having shafts or pole. An interesting and distinctive group in this section is the Acre 'hexagonal wagons' of the thirteenth century. These are four wheeled vehicles simply depicted two-dimensionally. Canopied and decorated, they form a distinctive group, being illuminated in the Latin Kingdom of Jerusalem but sharing a common ancestor with thirteenth century French biblical histories such as *Bibliothèque Nationale fr. 20125* which show normal box wagons.¹³ [34-37]

BOX CARTS.

This group is used by the illuminators to illustrate ancient chariots,¹⁴ personal carts,¹⁵ and, rarely, instruments of punishment.¹⁶ They are mostly found in biblical manuscripts and the English *Elijahs* form a distinct section within this group. Bodley [38-41] manuscript 264 fol.152 (English c 1400) shows an unusual castellated war cart, while folio 109 has an exceptionally good illustration of a mule cart.

LADDER CARTS.

This type of vehicle is just as popular in the medieval period as the box cart. It had changed little from the prehistoric representations, being still a simple ladder but with shafts in place of a central pole. Obviously the bodies were added separately depending on the particular need. These vehicles appear almost exclusively in farm contexts, although in sixteenth century woodcuts, they take on a variety of different forms such as wine carts and even pie vending carts. They are therefore common in English, French and Flemish miniatures and German woodcuts.¹⁷

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13. Hugo Buchta, *The Miniatures of the Paris Psalter* (London 1938).
 14. Singer et al fig.503 British Library Royal 1E IX fol.87, Royal 14EV fol.110, Stowe 54 fol.22 Cotton Cleopatra C VIII fol.18,19,21, 21b, Arundel 66 fol.36, Add 19587 fol.77v, Royal 10VII, Add 24199 fol.17, Bodleian Library Bodley 614 fol.17v Laud. Misc.752 fol.134v Cambridge Corpus Christi 3 fol.161, T.S.R. Boase *English Art* (Oxford 1953) pl.61,
 15. Bodleian Lyell 67, fol.65v, British Library Burney 169 fol.100 Royal 20 D 1 fol.332 Yates Thompson 8 fol.192b
 16. British Library Royal 14 EV fol.110
 17. British Library Add 35313 fol.34, Add 27699 fol.102 *Très Riches Heures du Duc de Berry* facsimile (London 1969) pl.54 Singer et al

TRIUMPHAL CHARIOTS.

For the most part, ancient chariots are depicted by the medieval scribe as box carts. However, this does not take into account those vehicles which are shown in the manner of Roman chariots, in particular, those of the fifth century Vatican Virgil,¹⁸ the Utrecht Psalter c 850 A.D., folios 85 and 17,¹⁹ British Library Arundel 339 fol. 77 and Bibliotheque Nationale Manuscrit Latin 8840,²⁰ which are thirteenth century, Flemish and executed in the same manner as Utrecht, an eleventh century bible, illustrated by Treue and Merton College H 2 2 folio 123. However, the fifteenth century saw the introduction of a distinctly new type of triumph wagon - though admittedly based on ancient models - to illustrate the triumphs of Petrarch, for example, British Library Yates Thompson 10, folios 151, 163, 167, 173b, 183b, Add 20916 folio 12, Harley 3567 folios 149, 162, 166, 175, 104 and Add 38125 folios 33b and 67b. These have deliberately archaic features such as throat and girths and central poles. Vehicles which consist of a simple platform and pole are also following classical form for example British Library Harley 270, folio 2 and Add 19669 folio 58.

18. Des Noettes L'Attelage^{et} le Cheval de selle à travers les âges
(Paris 1931) vol.11 fig.115

19. De Wald, The Illustrations of the Utrecht Psalter(Princeton/
Leipzig/London n.d.)

20. Des Noettes (1931) fig. 152 vol.11

SLEDGES

Sleds appear to have continued in use in medieval times as much as they did in prehistory. The Oseberg finds seem to have been of the type recognised by Berg as used for portage rather than for passengers.¹ In Flemish manuscripts of the fifteenth century, they often form a border but are of a type used for personal transport. In British Library Add. 18852 folio 2, sledges are depicted with high seats and cushions, being propelled by a pair of sticks in the manner of the modern skis. Each passenger is, therefore, also his own driver. A similar method is shown in British Library Add. 24098 folio 30, which also shows sledges with passengers being pulled along by humans in folios 18b and 19, and a border of folio 29b shows a tug-o-war with sledges. In every case, the sledges are recognisable to a modern reader. The Hours of King Manuel of Portugal² show sleds put to agrarian use in much the same way and of similar morphology as those used in Yorkshire in the last century.³ [43-46] They also bear a striking resemblance to two-man barrows recorded from North Yorkshire.⁴ It might be interesting to note here that sleds were also used as instruments of punishment, though in extreme cases, the sled was dispensed with and the accused dragged to his execution without aid.⁵

1. Foote and Wilson, The Viking Achievement (London 1970) p.258-262 Berg (1935) p. 69
2. Gálhano O Carro de Bois em Portugal (Lisbon 1973)pl.120,121
3. Hartley and Ingilby (1972) Mr.RaymondHayesMr. Bertram Frank Rydale Folk Museum, Hutton-le-Hole, Yorkshire, personal communication.
4. Rydale Folk Museum.
5. British Library Royal 10E IV folio 94.

It may now be useful to consider medieval etymology.

BASTERNA

RMLWL ⁶ 7: a carriage, 690
Isidore XX, XII, V.

Vehiculum itineris quasi vide sternax
millibus stramentis composita a duobus
animalibus deportata.

Gregory of Tours ⁸ Historia
Francorum III, XXVI

Deutoria vero cernens filiam suam
valde esse timens ne eam concupiscens
rex sibi adsumeret in basterna
posita indomitis bubis coniunctis
eam de ponte praecipitavit quae
in ipso flumine spiritum reddidit. (c580).

Capitularis de Villis LXIV ^{8a}

Ut carra nostra qua in hostem
pergunt et basternae bene factae
sint cum cooperta. (c800).

BIGA.

RMLWL : a cart 1184 ⁹
Isidore ; XXXV, I.

Quadrigae et bigae et trigae et
sigiugae a numero equorum et iugo
dictae.

Matthew Paris Historia Maiore V

...bigis multis et quinquaginta
sumariis (1250).
...undecim bigae longae. ¹⁰

CARECTA

RMLWL. : a cart 1150

Household Roll Edward I, 1281 ¹¹
Rhuddlan.

D' Martis proxima ante fm. beate marie
Magdal. p. Vj carectis qual. cum
IIIJ equis conducti p. feno cariando
de pratis usq. castru de Rothel
I, p. unum diem 6/10d.

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6. R. E. Latham Revised Medieval Latin Word List London (1965, reprint 1973),
henceforth RMLWL.
 7. W. M. Lindsay Isidore Hispalensis Episcopi Etymologiarum Sive
Originum (Ononii 1911) henceforth Isidore.
 8. Monumenta Germaniae Historica: scriptores rerum Merovingicarum I
8a *ibid.* Legam II, I Capitularia Regum Francorum, Capitularis de Villis
 9. see also Latham: Fasc. I p. 193, Dict. of Medieval Latin from British Sources (Lon. 1975).
 10. Giles, Matthew Paris: Chronica Maiora (London 1852) III vols.
Chronica Maiore, Rolls series, Henry Richards Luard (ed)
(London 1877) VII vols.
 11. Lysons and Brand, A Copy of a Roll of Expenses of King Edward
at Rhuddlan Castle, Wales, in 10th and 11th years of his reign
remaining among the records in the Tower, Archaeologia XVI
pp. 32-79

<u>Bishop of Swinfield's Household</u> ¹²	...pro j <u>carecta</u> camerae...
<u>Roll 1280</u>	
	¹³
<u>Liber Quotidianus Contrarotularibus</u>	...pro ferruris quorundam
<u>Garderobae (LQCG).</u>	coffrorum garderobe, tamapud
	Turrim London quam in <u>carectis</u>
	<u>garderobe cartiatorum...</u> (1299)
" p.77	... <u>carecta</u> butell... ¹³
" p.78	... <u>carecta</u> lardar...
" p.77	... <u>carecta</u> coquin...
" p.79	... <u>carecta</u> scutell..
" p.78	... <u>carecta</u> panetrie rege..
"	Domino Johanni de Drokenford pro
	una <u>longa carecta</u> ejusdem
	garderob apud Novum Castrum
	super Tynam.
"	Waltero de Molesworth vic
	Bedeford et Buk.pro X <u>carectis</u>
	ferr..... 14
<u>PRO E 101 5/18.</u>	C <u>charettes</u> e LX carres e XXX
	bateaux portant pirres e
	charbon de met.(1296)
<u>Inventaire de la royne Anne de</u> ¹⁵	Deux couvertures pour deux
<u>Bretagne.</u>	<u>chariotz branslans.</u> (1498)
<u>Inventaire du Duc de Bourgogne</u> ¹⁵	Pour le facon d'un <u>char</u>
no. 5690.	<u>branlant</u> qui doit se faire pour
	paintre de vert claire le
	dit <u>char.</u> (1398)
<u>Villani's Chronica IV, LXVI</u> ¹⁵	... <u>carroccio</u> ...(1038) ¹⁵
<u>Inventaire de Jean de Bourdeille</u> ¹⁵	Ung petit <u>carosse</u> monte sur
1595.	111J roues et double de drap
	vert.
<u>Comptes de Charles le Temeraire</u> ¹⁵ 1473	Une paire d'armons peur servir
	au <u>chariot</u> d'une bombadelle
<u>Comptes des menus plaisirs de la</u> ¹⁵	A Jehan Lenatier pour le louage
<u>reine 1416.</u>	d'un <u>chariot</u> de fer...

12. Webb, 'A Roll of the Household Expenses of Richard de Swinfield bishop of Hereford 1289-90' Camden Society (London n.d.)
13. Compare to Ordinances of L'Hotel de Philippe de Valois in XIVth c (1322) Bibliothèque de L'Ecole de Chartres LV (1894) pp.465-487, pp.598-626
14. Liber Quotidianus Contrarotularibus Garderobae, Society of Antiquaries of London, facsimile (London 1787) henceforth LQCG
15. Marjorie Nice Boyer (1959) pp.359-60

Comptes de l'Hotel de Paris 1480

A Jehan de Paris charron,
Bernard Bertrand et Jean Veau,
la somme de ? a la quelle a
este estime un chariot complet
a la facon de Hongrerie..

Martial d'Augergne

Puis y avoit cinq grans chevaux
couvers de beau noir valente tirans
le chariot a cerceaux ou le roy
(Charles VII) si fut apparte (1465)¹⁶

CARRUS

RMLWL : a cart c1000

D.C.

Vehiculum minus quod funibus
trahitur^{ad} operariis. Huiusmodi
frequens usus est in saxis mole
majoribus transvehendis inter
aedificandum.

Isidore XII, 11

Carrum a cardine rotarum dictum
unde et currus dicti, quod rotas
haberedentur.

Symeon of Durham Gesta Regum¹⁷
(1093)

Corpus regis...duo ex indigenis
carro impositum in Tynemouth
superfuerunt. (1093)

LCCG.

...et carriand tam ad naves
versus Edeneburgh quam in carris
et carectis usque Rokesburgh et
Jedeworth pro municionibus eorum
locorum.

Manipulus Vocabulorum 1570

carre, currus (col.29)

COVINS.

chariots à combatre et armes.

Martene et Durand Veterum
Scriptorum V. (11th century)

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16. Gay and Stein (1928) S.V. Char, D.C. S.V. char, chariot.
E.E. Viollet le Duc, Dictionnaire raisonné du mobilier
français 1V vols. (Paris n.d.) S.V. Char.
17. Rerum Britannicarum Medii Aevi Scriptores, Rolls series LXXV
(London 1882, 1885).

CURRUM

Julius Pollux of Naucratis.¹⁸

X

Currus praeterea partes sunt, sella, rabulatum exterior et interior potarum circumferentia ...Rotarum porro circa axim circumlutarum ferrum extremam cingens circumferentiam canthus Circumferentia ipsa sostra et in hanc infixi baculi radii...

XIX

...Verum si quis vehiculorum vectura uteretur. Notandae vehiculorum sunt species sive currus, sive vehiculae, seu plaustra vel lecticas has nominare conveniat.

Gregory of Tours LX

De haec civitate rex ad persequendum Hebraeas cum exercitibus currum ac multi pedestri anu directus est.

LOGG.

...currus...pro cuffinis...pro curru ejusdem Regine.

Household Roll 1281, Rhuddlan.

Pro uno curro conducto p. auxil cariaq harnes.

Old Testament Miniatures 1250¹⁹
(text.)

Niat ducem et circuitum et omnes currus Jabm. regis...

LOGG.

XXIJ pre-equitatoribus vallettriis de currubus Regine...

MARTYMELE.

British Museum Royal 19B XVIII
156/16

...litel cartes called Martymelles for to carye the mantelles and the tymbre...(1403)

PLAUSTRUM

RMLWL : a wagon c833

Currus quatuor rotis constans. Agrestium autem instrumentorii necessaria sunt aratra e aripartes plaustrum...

D.C.

Pollux XXIX

18. Onomasticon, Rudolphus Gualtherus Tigurinus (ed.) (Basle 1541)
National Library of Scotland Manuscript Gray 930.

19. Cockerell, James and Ffoulkes, (1927).

Gregory of Tours V,11,XXXV

Nam impositis plastro ad Burgigalensium urbem in quo orbus fuerat

LOCG.

...pro XXIIJ plastroru cariandum farrinam, vinum et alia victualia diversa de Cariolo usque castrum de Dumfries pro municione.

Matthew Paris V.

Camelos videlicet, mulos, et assinos...et quaedam plustra cum suis bubalis et bobus quaedam victualia...invenerunt. (a caravan from the east).

"

Super quo soldanus praesonitus iussit (the sultan) illus naviculas in plastris a bubalis festinanter tractis afferi...

Cronica Fratris Salimbene 1248

Tantum curo de loachym quantum de quinta rota plastre.²⁰

QUADRIGA

The Bolden Book 1183

Villani de Southbydyk tenent villam suam ad firmam et reddunt V libras et iuveniant VIII^{XX} homines ad metendum in autumpno et XXXVI quadrigas ad quadriganda blada apud Octonam.

RHEDA.

William of Malmesbury de Gestis Regum Anglorum IV CCCIII

Pauci rusticanorum cadaver in rheda caballaria compositum wintoniam in episcopatum devexere cruore undatim per totiam viam stillante.

²⁰ Monumenta Germania Historia, Scriptores XXXII (1905-13) p.239, Lynn White Jr. Medieval Technology and Social Change (Oxford 1962) p. 67

Several points may now be made concerning medieval vehicles. Firstly it is even more impossible to link representation to literary evidence because information on the specialisation of function which was present for the Roman period is rare. Secondly, function has been reduced to personal transport and heavy carting and many of the terms are used indiscriminately. Thirdly, while plaustrum must on occasion mean a four wheeled wagon,²¹ this is not always the case. It should be noted that the common measures such as a plaustrata, charrus or carecta of lead are all the same weight.²² There is no evidence to support the contention that a longum plaustrum, any more than a longam carecta is a term used for a wagon.²³ This is probably indicative of the presence of side ladders to increase the load rather than an indication of the number of wheels. However, currus and char are used consistently of passenger vehicles and it is perhaps possible to see these as terms for tilt wagons or carriages. There is no answer to the question of the terminology of cart and wagon in the middle ages. Though there is general continuity between the major types of vehicle in prehistoric, Roman and medieval times, there is in the latter period a genuine reduction in the number of vehicle names used and carecta and plaustra become ubiquitous. Fourthly, while it is impossible to distinguish carecta and plaustra in terms of the number of wheels, plaustrum is used so often of an oxen drawn wagon that the distinction could lie in the means of draught. Fifthly, while wagons cannot be isolated in the literary evidence, the representative evidence is so substantial that it is impossible to agree with Jenkins that a 'farm wagon must have been a rarity' or with Parkes that 'the rarity of four wheeled vehicles has led some writers to believe that these were not introduced into

21. British Library Sloane MS 398 fols. 12 and 18

22. Edward Nicholson, Men and Measures (London 1912) E.M. Jope, 'Saxon Oxford and its Region' D.B. Harden (ed) Dark Age in Britain: Studies Presented to E.T. Leeds (London 1956) pp 234-258, p.25 (note 67)

23. Lynn White Jr. (Oxford 1962) p. 66

the country until at least the beginning of the sixteenth century.²⁴ Sixthly, while epiraedium in the classical authors meant a means of attachment to a vehicle, epiredium, according to the Promptorium Parvulorum²⁵ of c 1440 meant a wheelbarrow. Finally although it has proved impossible to link terminology and representation, it should not be forgotten that in any case the craftsman's skills were always directed towards achieving the perfect vehicle and that the most important technological developments in wheeled vehicles, those whose end products were minimum weight, maximum strength and easiest possible handling capacity were never recorded and probably varied with each individual vehicle.

24. Jenkins (1961) p.7, J. Parkes Travel in England in the Seventeenth Century (Oxford 1925) p. 7.

25. Harleian MS 221, Albertus Way, Camden Society (London 1743) British Library.

SECTION TWO : TECHNOLOGICAL ACHIEVEMENTS.

A : CONSTRUCTION OF THE UNDERCARRIAGE.

Section A will try to deal with three of the main aspects of early vehicle construction; articulation, suspension and costs. The dates of the achievement of articulation and suspension are fundamental to any consideration of the technical skills of the medieval wagon wrights, while raising, moreover, the larger questions of the viability of transporting, in the case of former, goods, of the latter, passengers, overland, and the assessment of the relationship between the prehistoric, classical and medieval worlds in terms of practical knowledge and ability. The costing of specific parts of the chassis may be expanded here to take into account the range of spare parts available to the medieval consumer, the maintenance and running costs he might be expected to meet.

CHAPTER ONE : THE PIVOTED FRONT AXLE

In a four wheeled vehicle a pivoted front axle, turning train or bogie, may be defined as a bolt, pin or disc holding the front axle to the chassis in such a way as to allow it to revolve freely around an angle of up to ninety degrees, the degrees of turn being limited by the coupling pole, axle length, wheel size and body characteristics. However, irrespective of the presence of such a fitment, the pivoting of a front axle is only practical when at least one of three conditions are present; small front wheels, long axles or a locking arch to prevent the wheel felloes from crashing into the wagon sides; a mechanism to stop the wheels before they reach the body sides, allowing in modern terms four fractions of lock; a means of raising the body far enough above the chassis to allow the wheels to turn under comfortably. Undercarriage morphology is a useful indicator only in terms of defining absence of articulation. The fact that a wagon's chassis could allow for the fitting of a pivoted front axle in no way guarantees its presence.

The date at which the fitting of a pivoted front axle may safely be considered to have been included in the European wheelwright's repertoire of skills is one of the major problems to be encountered in any study of the technical development of wagon construction. The use of a turning train is crucial, since without it, a wagon when changing direction is forced to skid round under limited control. Such a manoeuvre subjects the wagon to intolerable lateral pressures. Practical experience of this problem may be less unfamiliar than might at first be thought.¹ What is less obvious is why it should be thought necessary to use a wagon at all. The wagon is favoured as a more practical vehicle than the cart because of its greater capacity, stability and ease of loading. Local court records are full of pronouncements of death by misadventure, involving carts and their loads.² The Eyre of Wiltshire in 1249 made six judgements about death by crushing when carts overturned and heard one case where a young woman, travelling as a passenger in a cart, was killed by a shifting load. The Kent Eyre roll for 1313 records the death of Robert of Keston, crushed by a cart loaded with oaks and that of a driver, who, having fallen asleep, was killed when his cart overturned in a stream. Furthermore, since it is important in any two wheeled vehicle to have the weight of the load balanced over the wheels to prevent overturning, the most attractive aspect of the wagon with its more evenly distributed burden, was its ability to use highways impracticable for the cart with its heavy axle load. Iron-shod carts with their great capacity

1. Marjorie Nice Boyer, (Medieval Pivoted Axles' Technology and Culture 1 (1960) She points to the analogy of trying to turn a baby's pram. in a confined space.

2. P.D.A. Harvey, A Medieval Oxfordshire Village: Cuxham 1240-1400 (Oxford 1965) p 105 and footnote 1; C.A.F. Meekings, Crown Pleas of the Wiltshire Eyre 1249, Wiltshire Archaeological and Natural History Society XVI (Devizes 1961); F.W.Maitland, W.V.Harcourt, W.C.Bolland The Eyre of Kent, Six and Seven Edward II, 1313-1314, Selden Society XXIV (1909) pp 64, 72, 152-155.

for churning up the streets, were frequently banned from towns by ordinance. Beverley for example, imposed fines upon carters who persisted in bringing shod carts into town.³ In the country, carts carrying specially heavy loads were frequently diverted off the main roads but were nevertheless fined heavily for the privilege of using the meadows. At Cuxham, a cart carrying millstones paid five pence for permission to drive in the fields adjacent to the road.⁴

Given, therefore, that the wagon is extremely useful for long distance transportation, it is indeed strange that such confusion surrounds the introduction of an invention of such cardinal importance. The general opinion persists that the turning train was used in the European late Iron Age and the classical period but lost during the Dark Ages, to be rediscovered by the wagonwrights and military technicians of central Europe in the fifteenth century. Behind this belief lie three basic assumptions; that the prehistoric Celtic wagons pivoted; that since these became fashionable and were adopted wholesale by members of Roman society, the Romans automatically became familiar with the principle; the longstanding acceptance of the conviction that Roman and early medieval inventiveness was of a conservative if not degenerate nature. Recent studies of medieval economic documents, however, have tended to suggest that land transportation was so extensive as to have ruled out the possibility of ignorance of so obvious a technical necessity.⁵ Moreover, the certainty that the first undoubted representation of a turning train was to be found in a German

3. Beverley Town Ordinances, Selden Society XIV (1888) p.21.

4. Harvey (1965) p. 104.

5. Marjorie Nice Boyer (1960) pp.123-33, James Field Willard, 'Inland Transportation in England in the Fourteenth Century' Speculum 1 (1926) pp.361-374 'The Use of Carts in the Fourteenth Century' Historical Revision no.LXIII History XVIII (1932-33) pp.246-250.

manuscript of 1430⁶ has been shaken by the presentation of representational evidence dating to 1396,⁷ 1335,⁸ and 900 A.D.⁹ The time is ripe, therefore, for a reconsideration of the evidence of pivoting and for speculation on the possibility that existing interpretations of articulation in antiquity may prove to be fanciful. If this conclusion is acceptable, old notions of medieval regression and rediscovery may no longer constitute a viable alternative: the possibility that the articulated foreaxle was not reinvented but invented by some skilled Dark Age craftsman should not be overlooked in the enthusiastic search for continuity.

6. Singer et al 11 fig. 502.

7. Bertrand Gille, 'The Seal of Francesco de Carrara' The Evolution of Science G. Vetraux and F. Crouzet (ed) (New York 1963) p.170 fig. 3

8. A. Rupert Hall 'More on Medieval Pivoted Axles' Technology and Culture 11 (1961) pp.17-21

9. Lynn White Jnr. (1962) pp. 66 n.4

THE PREHISTORIC EVIDENCE

Some understanding of essential elements involved in the pivoting of a front axle of a vehicle may be seen to have existed in prehistoric times. The fundamental - true rotary motion, defined by Childe as the ability of an instrument to turn in the same direction indefinitely - was achieved at least by the fourth millenium with the spindle and potter's wheel and the technically more sophisticated idea of vertical pivoting by the Graeco-Roman period.¹ Moreover, since some of the Bronze Age late European wheeled cinerary [47] urns were raised to allow for unrestricted passage of the wheels, it is remotely possible that one of the essential preconditions for articulation was comprehended and met.² One could therefore maintain a knowledge of first principles in antiquity.

This argument can only be accepted, however, if it can be proved that such principles were in fact perceived as abstract conceptions, divorced from the object in which they were initially utilised. This alone would account for their application to transport technology and the successful solution to the problem of transferring a wooden pivot, rotating smoothly in a fixed socket, to that area of a vehicle most subjected to irregular movement and the greatest of stresses and strains. However, since such evidence cannot be forthcoming,

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1. Vere Gordon Childe (Rotary Motion) Singer et al, 1 pp.187-216
R.J. Forbes 'Chemical, Culinary and Cosmetic Arts' Singer et al, 1 pp.290-3, 'Food and Drink; Early Evolution of Disintegrating Techniques', Singer et al 11 pp.106-121, A.A. Caruana 'An Ancient Greek Building in Malta' American Journal of Archaeology 1V (1888) pp 450-4, fig.18
2. R. Forrer, (1932) G. Kossack, Studieren zur Symbolgut der Urnenfelder und Hallstattzeit Mitteleuropas (Berlin 1954)
J. Jones Spoke-wheeled vehicles in Prehistoric Europe, North of the Alps to circa 700 B.C. M.A. dissertation, Edinburgh 1970 (unpublished).

articulation in antiquity can be proved or disproved only by a consideration of actual vehicle remains or their representation.

In the past, prehistorians have suggested that the wagons depicted on the petroglyphs of Scandinavia, Spain and North Italy (c1000-700 B.C.) may have been articulated [43] since they appear to have been constructed by joining two triangular carts.³ If this union was effected along the front axle by means of an open bolt, this would easily allow foreaxle articulation. However, it has been argued that the only practical method of constructing such a vehicle was to pin the frames together, thus rendering the forecarriage immovable in relation to the rear.⁴ In any case morphology alone is not evidence of a pivoted front axle. None of the preconditions previously outlined are present in the earliest wagon representations. Furthermore, the excavated evidence offered for the third and secondmillenium B.C. wagons from the Near East and Transcaucasia show rigid front axles.⁵ There has been a claim for a third millenium swivelling axle from Lolinsky barrow 4, grave 7, in the Kalmyk A.S.S.R.⁶ The photographic evidence upon which it is based [49] is not entirely satisfactory, however, and the excavators themselves at the time seemed to be unaware of the unusual nature of their claim. It would be not only

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3. G.Berg (1935) p.99 pl XXVII, pl. XV, E. Anati, Camonica Valley (London 1964) T.G.E.Powell 'Southwestern Peninsular Chariot Stelae' To Illustrate the Monuments, Essays on Archaeology Presented to Stuart Piggott (London 1977). A.G.Haudicourt and M.J.B. Delamarre (1955)
 4. J.G.Jenkins, (1961) p.5
 5. M.Littauer and J.M.Crouwel (1973) pp.102-126, (1974) pp.20-37 Piggott (1963) pp.266-313, pp.297-99
 6. S.Piggott *ibid* p.300, I.V.Sinitsyn and E.Erdinev New Archaeological Excavations in the territory of the Kalmyk of ASSR (Elista 1962-3) pp.31-33.

'unique and anomalous'⁷ - no claim has been put forward for the remaining Caucasian evidence - but distinctly useless since the wagon itself belongs to that class of vehicle whose forecarriage rests directly upon its chassis. Skidding, overturning or indeed disintegration would be bound to occur with the presence of some mechanical device to aid turning without the relevant prerequisite of allowing space for lateral movement of the wheels. In this case, the possibility of articulation may be discarded.

The argument is controversial when one turns to a consideration of Celtic wagons. There is general, if somewhat vague agreement that the vehicles of the North European Iron Age had a pivoted front axle. On examining surviving evidence, however, it would be reasonable, if unpopular, to comment that as a basis for the various interpretations so far built upon it, it is far from convincing.

The discussion centres upon the wagon remains from Bell, Vix, Ohnenheim and Dejbjerg and the validity of their reconstruction.⁸ These vehicles are recognisably Celtic because of their technical and decorative detail and since as they stand, as Childe has pointed out, in the tradition of the Hallstatt hearses, whatever conclusion is reached upon their articulation

7. Stuart Piggott (1963) p.300. I should like to thank Professor Piggott for access to the Russian material and for his opinion on the validity of the material.

8. William Rest 'Das Grabhügelfeld von Bell im Hunsrück' Bonner Jahrbuch CXLVIII(1948) pp 133-190, Forrer (1932), Rene Joffroy, Les Sepultures à Char du Premier Age du Fer en France; Oppidum de Vix (Paris 1958. Rene Joffroy, Tresor de Vix (Paris 1954), Ole Klindt-Jensen; Foreign Influences in Denmark's Iron Age: The Vehicles' Acta Archaeologica (1949-50)

applies equally to that whole extensive group of continental European burials.⁹

As already indicated, the fact that the Celtic wagons were the 'correct shape' may be laid aside. The Y-shaped undercarriage construction, as distinct from the "double triangle" cannot be considered a characteristic Iron Age feature and not, therefore, related exclusively to the introduction of some form of articulation. Moreover, the possibility of turning a wagon with an unjointed central beam, perch or Langbaum, connecting the axletrees, such as existed on the Celtic wagons, is limited.¹⁰

Since the central part of a prehistoric wagon has never survived intact nor any actual pivoting mechanism such as a kingpin, there is no direct evidence for articulation. The viability of the pivoting of Celtic wagons, therefore, depends entirely on how far the evidence for raising the sides of the wagons above the wheels is acceptable. Of course wood has a very low survival rate under normal conditions and it would be unreasonable to demand complete recovery. However, it is surely reasonable to expect a reconstruction to honour the indications of surviving evidence rather than being a work done largely by imagination.

Rest has constructed the Bell wagon with a swivelling axle. [50a] He felt that he had managed eine einleuchtende und stabile Rekonstruktion der Drehvorrichtung but as Childe has pointed out, had to postulate a lot of woodwork undocumented in the original excavation report, to raise the body clear of the wheels.¹¹ Joffroy, like Rest, estimates that his reconstruction of the remains from the tumulus of Vix [51] has produced a wagon certaines dans la proportion de 90%, claiming

9. Childe (1951) pp.177-193.

10. Gosta Berg (1935) p.153.

11. Rest (1943) p.147, Childe (1951) p.190-2.

that seuls des points de detail d'une importance secondaire peuvent laisser subsister quelques doutes.¹² One of these details, unfortunately is the reconstruction of the fore-carriage with a pivoted front axle, the body being given sufficient elevation to allow wheel clearance as far as the crossbar. He further claims a completely objective reconstruction on the grounds that it was undertaken by an outsider unfamiliar with the controversy over Celtic vehicle construction. There are, however, a number of objections to the Vix reconstruction. Firstly, the stones forming the tumulus had fallen into the burial chamber and dislodged a number of objects from their original position.¹³ Plotting the material in situ, therefore does not give a probability rating of ninety per cent. 52 Secondly, so little wood survived as to make any kind of reconstruction doubtful and such as Joffroy claims impossible. Any reconstruction of surviving bits and pieces by adding connections of materials which have perished must remain problematical.¹⁴ Thirdly, the use of a specialist in another field in no way guarantees objectivity.¹⁵ There is a very real danger that an outsider might assume that a wagon should have a bogie as a matter of course, especially if not informed otherwise. The light, delicate nature of the Vix remains, the indications that it was held together by wooden pins, the complete absence of harnessing gear seems to rule out harsh practical handling. As Vigneron has pointed out Ce petit chariot funéraire, fait pour transporter ceremonieusement un cadavre sur quelques dizaines de metres, n'avait certainement pas à effectuer ces virages qui necessitent la mobilité du train-avant.¹⁶ There is no acceptable

12. Joffroy (1953) p.105

13. Joffroy (1954) p.40

14. Albert C. Leighton (1974) p.15-30

15. Rene Joffroy L'Academie des Inscriptions et Belles-Lettres: Comptes Rendu la séance du 26 Avril 1957

16. Paul Vigneron (1963) VII.

evidence to the contrary.

The most promising hypothesis is that interpreted by Klindt-Jensen for the Dejbjerg wagon. [53] He stresses, correctly that not only is a method of raising the body above the chassis a precondition of the axle being able to turn at all, but also that the construction of the wagon body was such that the presence of a pivoted front axle without some form of suspension would quickly result in the destruction of the wagon itself. He postulates that the sides were suspended by leather straps from iron rods rising from the axle bar.¹⁷ His argument is supported by wear marks on the upper, slightly protruding nailheads of the body.¹⁸ If suspension by straps was applied the perch would be the only rigid part of the wagon and there would thus be no static body to hinder the turn.

The chronology of suspension will be dealt with later. However, it is enough to say here that suspension in fourwheeled vehicles either by chains or leather, existed at a very early date in Europe and not, as historians once assumed, introduced as part of the vehicle which is commonly called a coach, originating in Hungary or Germany.¹⁹

Given that there is early, though not in fact, prehistoric, evidence for suspension, however, much one might agree with Klindt-Jensen on the potentiality of his theory, as he himself points out, 'it is difficult to visualise this part (of the reconstruction) with as little evidence available'. This is in fact the very heart of the matter - available evidence. There exists according to Klindt-Jensen, one complete set of rods and one complete set of sides. However, the rods do not reach above the sides and are, therefore in no position to suspend them. His explanation that the various pieces lifted from the peat bog in 1881 and 1883 belonged to two vehicles and that what did not

17. (1949-50) fig. 60.

18. (1949-50) Fig. 63.

19. W. Bridges Adams English Pleasure Carriages (1837, reprint Bath 1971), Marjorie Nice Boyer (1959) pp.359-60.

survive was one set of sides a little lower, one set of rods a little higher, than the material used in the reconstruction is certainly plausible, the more so since there is slight discrepancy in the size of the surviving crossmembers. However, decomposition in the past is normally more arbitrary, the accident of discovery a little less selective. Clearly the wear marks do exist and their position may be connected with the placing of the iron rods, it is impossible to imagine how the correlation, which Klindt-Jensen sees existing on the present surviving material, would be affected by the introduction of a completely new set of body planks. In the absence of at least a few of the rods of the proper size to allow suspension or for that matter, pieces of the sides of the other vehicle, another explanation must be sought for the rubbing, perhaps one might consider the presence of a tilt.

Robert Forrer's reconstruction of the Ohnenheim hearse with rigid axles has been called scarcely tenable by Klindt-Jensen. [50b] It is not beyond the bounds of possibility that all this striving to produce Celtic pivoted axles is simply a result of the fact that people cannot believe that these wagons would be capable of functioning without one. Joffroy alone, is willing to concede that perhaps les éperons des manchons d'une préhension facile ont du constituer l'appareil à tourner le char.²⁰ Since no direct, unequivocal excavated evidence for a pivoted front axle exists or is shown clearly on early representations, manhandling is the only answer: such as Forrer has suggested may be interpreted from the figures on the urn from Sopron Burgstall and Berg has postulated as being the purpose behind the projecting ends of the central beams of the Ohnenheim and Bell wagons, a feature shared by the Dejbjerg wagon

20. Joffroy (1958) p 110; W. Schmid Der Kultwagen von Strettweg (Leipzig 1934). To many researchers the omission of detailed discussion of the Wagon from Strettweg might seem curious. In my view the method of its excavation and its reconstruction make it unreliable. I therefore prefer to discuss the controversial reconstructions of evidence from Vix, Bell, Ohnenheim and Dejbjerg.

and those depicted by the Bronze Age petroglyphs. It is the method envisaged by Vigneron for turning the Vix wagon and Chapotat for the Vase wagon from La Côte-Saint-André. It is the method of turning which has survived into this century in the Grojec district of Poland and in Sweden for the wicker Jutwagn, which also exists in Germany and Southern Russia. ²¹

The manhandling of Celtic hearses would have been comparatively easy. Without wishing to return to old notions of ritual cult wagons, excluding the interpretation that these wagons-for-the-dead were simply extensions of those used in everyday life, it must be emphasised that the real need for a pivoted front axle may be seen in the heavily loaded baggage wagons of the overland transport of the historic period, where a heavy demand for goods resulted in increased pressure to be on the right spot at the right time and availability of profits which could be diverted into improvement of transportation. Situations where space is limited, spills crucial and time lost measured in terms of money lost, these are the conditions under which articulation is important and the stimulus for its invention great. For the prehistoric period, however admirable the logic of Klindt-Jensen's interpretation or the imagination expended on the reconstructions, it is more possible to agree with Gordon Childe that there is no more positive evidence for pivoting in European Iron Age wagons than in the Sumerian hearse. ²²

This is not to deny that the Celts were superb carriage builders and wheelwrights. In any case so much evidence exists to the contrary from both archaeological and literary sources. However, it is unreasonable to expect them to be cognisant with all aspects of transport technology. It is much easier to see Celtic wagons as hearses, standing in the tradition of the Neolithic and Bronze Age wagons, being a logical extension of that basic prototype. It is indeed fortunate that this is what the evidence in fact indicates.

21. Forrer (1932) Berg (1935) pp.158-9, Vigneron (1968) p.115
G.Chapotat, 'Le Char Processionel de la Côte-Saint-André',
Gallia XX (1962) pp.33-73, Jenkins (1961) p.5

22. (1951) p.192 He also records Miss Seton Williams' account of a wagon in Turkey which could be manoeuvred without difficulty albeit slowly, despite absence of any pivoting for the front axle p182.

THE ROMAN EVIDENCE.

' It is well established that the Romans knew and used the pivoted front axle.' 'According to all the sources the pivoted front axle was an invention of Rome'. 'Based on the available evidence it would appear difficult to credit the Romans with a pivoting front axle'. 'The problem then would not be to invent the pivoting axle but to determine if it survived (that is from the prehistoric through the Classical to the medieval period)'.¹ These conflicting statements sum up the three basic questions to be considered here; did the Romans know about articulation; did they invent it; did it survive continuously into the early medieval period?

In the report of the Smithsonian Institution for 1934, Albert Chatelier Rose insisted that further research on Roman vehicles was no longer necessary.² The reason for this pronouncement was the rediscovery of the work of Johann Christian Ginzrot, the master coachbuilder, the man responsible for that 'work of technological history quite extraordinary for the time it was written'.³ Die Wagen und Fahrwerke der Griechen und Römer und anderer alten Völker is his major contribution to transport technology, which most scholars have treated with misplaced confidence as the standard authority. Only Des Noettes, apparently, mistrusted the soundness of Ginzrot's scholarship.^{3b}

The existence of a Roman pivoted front axle is due almost entirely to Ginzrot's drawings. These were

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1. Marjorie Nice Boyer (1960) p.128, H.Kreisel, Prunkwagen und Schlitten (Leipzig 1927) p.5, Albert Leighton (1977) p.344 Leighton Transport and Communication in Early Medieval Europe A.D. 500-1100 (London 1972) p.98
 2. 'Via Appia in the days when all roads led to Rome' the Smithsonian Report (Washington 1934), Leighton op cit (1977) p.348,
 3. Joseph Needham Science and Civilisation in China IV part 11 (Cambridge 1965) p.75
 36. Leighton (1977) p 342, (1972) p 71, Johann Christian Ginzrot Die Wagen und Fahrwerke der Griechen und Römer und anderer alten Völker (Munich 1817).

supported by a list of wagon components drawn from Roman authors, the main authority being Julius Pollux of Naucratis. Ginzrot's drawings, glossaria and his use of sources has been successfully discredited by Leighton,⁴ though indeed he stands condemned by words which come from his own mouth when he describes a figure which zeigt die Bauart eines solchen Wagens, wie ich mir ihn vorstelle, denn ich habe nirgends eine Abbildung, die hierzu passend ware, auf alten Monumenten gefunden.⁵ Ginzrot's front axle based as it is on mistranslation and imagination continues to be used in technological histories and reference works. In spite of the Smithsonian report, therefore, the three basic questions remain to be answered.

There is no basis for expecting continuity between the Roman period and the prehistoric in terms of a swivelling axle. Having removed the crutch of Celtic articulation, the classical evidence may now be judged entirely on its own merits. In reconsidering this evidence, several problems should be acknowledged. Firstly, there is no literary confirmation of the presence of articulation. Here of course the emphasis is generally upon what is potentially interesting to the reader and by this measure the battle chariot succeeds where the freight wagon fails. Secondly, there is no firm archaeological evidence. The claim for an Hungarian late Roman kingpin⁶ discovered in 1881, even if positive identification were possible, without the support of scientific excavation techniques or careful stratigraphical analysis, cannot be regarded as proof of any kind. Thirdly, since the documentary evidence is fragmentary, more reliance must be placed upon representative evidence. In this case, while the quality of original or its photographic reproduction may be poor, there is greater danger in expecting high standards of accuracy in the drawings of these originals. Though more readily

4. ibid pp.342-343 and ibid pp 118-121, Julius Pollux of Naucratis Onomasticon edited by Rudolphus Gualtherus Tigurinus (Basle 1541) National Library of Scotland Manuscript Gray 930.

5. Leighton (1977) p.342.

6. Hugo Motefindt 'Die Erfindung des Drehschemelsam vierrädrigen Wagen' Geschichtsblätter für Technik und Industrie VI (1919) pp.30-41.

available, these published drawings frequently exaggerate features to a point where it is sometimes difficult to recognise the same relief and cases do exist where the restoration or amalgamation of several fragments of different reliefs into one whole has taken place without due acknowledgement. Finally, the interpretations of many of the technological historians of last century, influenced as they were by Ginzrot, must be used with great caution because they have linked literary nomenclature to graphic representation without any evidence and because, in a way strangely reminiscent of the medieval historical consciousness, they happily transpose their concepts of wagon specifications to the Roman period. The representations of the vehicles may be considered under three headings, decided by utility; namely baggage wagons, triumph wagons and travelling wagons. It is the first of the preconditions - small front wheels or long axles which is most likely to be identified in this way.

The graphic representations show two kinds of baggage wagon; the ordinary square box-shaped wagon and what loosely might be termed the boat-shaped wagon. This latter, of course, shows immediate possibilities of articulation. Though both kinds appear elsewhere, they do occur together and in profusion on the column of Aurelius in Rome (110 A.D.) It would therefore seem useful to use this as a basis for the discussion. In one representation baggage wagons are being used to carry off victory spoils.⁷ One of the wagons with the curious boat-shaped chassis is drawn by an oxen pair.^[13-14] The wheels are solid, showing square axle ends, indicating that the wheels revolved with the axle which would, in the Roman period be technically archaic.⁸ What is interesting, however, is that the

7. P.Vigneron (1968) pl.37a.

8. H. Lorimer, 'The Country Cart in Ancient Greece' Journal of Hellenic Studies XXIII (1904) pp.132-51, Mrs. MA. Littauer and J.Crouwel 'The Origin and Diffusion of the Crossbar Wheel' Antiquity LI no. 202 (July 1977) pp.95-105, A.T. Lucas, 'Prehistoric Block Wheels from Doogarymore, Co.Roscommon and Timahoe East, Co.Kildare', J.R.A.S.I. CII (1972) Stuart Piggott (1968) pp.268-271.

front wheel is arguably smaller than the rear. This is also true of vehicles of similar morphology from the column [15] but drawn by horse pairs and with spoked wheels revolving on the axles and independent of them.⁹ However, in total, there are only three wagons out of many which do show a smaller front wheel, from the Aurelian column itself and from Trajan's column which depicts similar scenes or from the famous mosaic groups from Sicily and Ostia which show baggage wagons.¹⁰ Isolating these three Aurelian wagons, how far can they be taken as true evidence of articulation? In all three cases, the solid undercarriage is shown resting directly upon the axles which would effectively block lateral wheel movement. Had the undercarriage been constructed differently, the boat-shape would have given sufficient waisting to allow articulation.

Baggage wagons for transporting wine may also be treated as a distinct group. Here the barrels are often seated on a simple platform with no possibility of pivoting. However, the wine wagon from Pompei (c79 A.D.) has frequently been brought forward as proof of a pivoted front axle since the space between the rear and front truncated pyramids of the undercarriage has been interpreted as an opening to allow wheel ¹¹ movement. However, the front wheels would have been too high to avoid the chassis. Moreover, the general accuracy of the drawing is in question. As Leighton has pointed out, not only are the wheels not connected to each other and the body, but also the

9. Solomon Reinach, Repetoire de peintures grecques et romaines (Paris 1909) I p.327 fig.134 and I p.306 fig 48.

10. Lehmen-Hartleben Traianssäule (Berlin/Leipzig 1936) pl.21, Vigneron (1963) p.160a and b, Des Noettes L'Attelage fig.78 Singer et al 11 p.493 Toynbee Death and Burial in the Roman World (London 1971) George Jennison (1937)

11. A.C. Leighton (1972) p.78.

angle of the yoke would appear to depict movement on both planes: a particularly unlikely sophistication. A similar but squatter more practical version of the same type of vehicle from the Santander plate shows equal wheels ¹² the famous Igel wagon on the western pedestal [9] of the monument, though for freight and not simply a wine carrier, also has wheels of equal size at the front and rear. ¹³ At Langres a large barrel is mounted on a frame but from the representation it is impossible to tell if there is a bogie. ¹⁴ Similarly at Neumagen a special purpose vehicle with a large barrel laid lengthwise on the platform of a four wheeled wagon, cannot be used to determine the presence of articulation since the relief is effaced at the crucial place. ¹⁵ There is no sign of a pivoted front axle on the reliefs of freight or heavy duty farm wagons, whatever the type, for the Roman period. ¹⁶ The presence of a bogie on this type of vehicle would, it seems, depend on a number of factors, the most important being necessary rate of progress, terrain and availability of manpower to assist turning. The vast majority of heavy duty vehicles depicted on Roman reliefs are army baggage wagons which would, one imagines, follow relatively slow progress over terrain suitable for the army and with no lack of manpower to manoeuvre the wagons out of difficulties. ¹⁷

12. Bellido Esculturas Romanas de Espana Y Portugal (Madrid 1949) p. 345 No. 493.

13. Reinach (1909) p. 163.

14. Des Noettes L'Attelage fig. 35.

15. Leighton (1972) p. 80.

16. see also the hunting wagon from Orbe in Switzerland in Toynbee (1973) fig. 78.

17. Many soldiers are always depicted around the wagons from the Aurelian and Trajanic columns.

One place where one would imagine articulation be used if it were possible, would be on wagons for long distance passenger transport. Not only would the travellers want as much comfort as possible but they certainly would not relish being physically upset every time the wagon had to turn a tight corner. There are several possible representations of articulation. The most promising candidate is the 'closed carruca' from Pannonia [7] where the front wheel seems to be smaller than the rear.¹⁸ However, as with the others there is no mechanism to stop the wheels from crashing into the body sides and the body shape would be no aid to turning. When other similar reliefs are¹⁹ examined, for example the infant's sarcophagus [11] from Rome, the Langres [16] quadriga, the Klagenfurt [54] vehicle or the famous Vaison omnibus [9] it is clear that the greater percentage of these vehicles clearly have wheels of equal size. In connection with travelling wagons, one should also consider the model of a carruca dormitoria [6] published by De Azevedo.²⁰ Here the front wheel is small enough to pass beneath the wagon in a full lock. It is, however, difficult to find out upon what evidence this reconstruction is based. As far as I am aware, there is no material or representative evidence to support this reconstruction. Moreover, a wagonwright would not care to build a vehicle with an axle so close to the ground for obvious reasons. The Cornish wains of last century were fully locking but

18. Michelangelo Cagiano De Azevedo 'I Traḡsporti e Il Traffico' Civiltà Romana IV (1938) pp.10-14. Cḡnstructed for the exhibition of 1938.

19. Reinach (1909) III p.269, Esperandieu Reliefs IV p.282, Wilhelm Treue (1965) Pḡobé and Roubier (1961) pl.208 p.73

20. (1938) p. 13

the wheels were still large enough to allow the axle to clear the ground when the wagon went into ruts of up to two feet deep.²¹

The last category is triumph wagons. These were simply constructed but highly decorated platforms equipped with a seat or couch. A great many of these appear in Dionysian reliefs - a popular theme - and were copied by the artists of the Petrarch manuscripts of the sixteenth century. The arch of Constantine has a quadriga of this type on its eastern face, which appears to have a front wheel smaller than the rear. Similarly the sarcophagus from Rome depicting a Dionysian triumph seems to have a small front wheel. In both these cases, however, the forecarriage rests directly upon the axles, as is the common feature of other vehicles of this class.²² [14]

None of the Roman representations, has relief or mosaic from Britain to North Africa, show unequivocal proof of pivoting. Two or at most three wagons in each of these categories can be produced which arguably show one of the preconditions of pivoting. However, in no case are the wheels free to carry through the necessary movement. How far the wheels may be judged to be smaller in front is at no time the question at issue. The problem is in every case the style of the undercarriage. However, in coming to this decision I am painfully aware of the fact that other methods of aiding turning would not appear on a two-dimensional representation, for example waisting and long axles. In certain parts of England, especially Surrey and the West Country, no attempt is made to alter the shape of the vehicles but the lock of these straight-sided wagons is increased when the axle is lengthened and an appreciable gap created between body and wheels. Here, however, chains control

21. Thomas Hennell Change in the Farn (London 1934) p. 28.

22. Reinach (1936) 11 p. 255, p. 261, see also p. 255 Toynbee (1973) fig. 11.

the amount of rotation preventing the wheels from turning too far, the body being protected by a locking cleat in case of failure.²³ With this in mind it is now possible to reconsider documentary evidence of pivoting. Two texts are useful: the Theodosian Code and Diocletian's Edict on Maximum Prices. In the case of the latter fragments of a new text from the excavations at Aphrodisias helps fill the gaps of the defective Latin and partially defective Greek copies. This new information is especially useful for adding to section twenty six which is a list of wagon components and prices. Professor K.D. White suggests that one of these parts, columella, being the diminutive of columen, the axle of a mill, in the context of the document is a pivoted front axle.²⁴ He further suggests that the Romans used long axles hence the lack of graphic evidence and generalises that a pivot would be essential in Roman times because without it a wagon would not be able to move around town. This last idea is not altogether clear since it would be possible by judicious use of the town plan to cut many of the corners. However, the documentary evidence is clearly the only promising indication of Roman pivoting. One or two questions remain to be answered, however. Columella itself is used six times in Books XX and XXI of Cato's De Agri Cultura²⁵ to mean the pivot of a mill. However, in the Aphrodisias Edict it appears in a section devoted to wooden articles, the author

23. John Vince Discovering Carts and Wagons (Aylesbury 1970 and 1974)

24. Professor K.D.White personal communication to Professor Stuart Piggott, K.T.Erim and Joyce Reynolds The Aphrodisias Copy of Diocletian's Edict on Maximum Prices in Journal of Roman Studies LXIII (1973) pp 99-111.

25. W.D. Hopper and H.B.Ash, Cato and Varro: De Re Rustica (Camb. Mass. 1934)

clearly specifying when something is bound in iron. It has been suggested to me that a wooden pivot for a wagon is possible provided that it was of a close grained wood such as oak or ash. However, because of the irregularity of the strains, a wagon pivot should, wherever possible, be made of iron.²⁶ Hard woods have been used for the pins of potters' wheels until recently in India and China²⁷ and perhaps on the Wolds wagons of Eastern Yorkshire.²⁸ However, there is no mention of a wooden bolt in Hartley and Ingilby when they describe in detail the construction of the undercarriage of the Wolds wagons.²⁹ In fact they clearly imply that iron was used. Cato's columella of course was of iron. Neither the Latin nor the Greek texts can answer this question since the Greek has lines twenty to thirty in a fragmentary state only, while the Latin is completely defective. While the price would seem high for a wooden pivot, this comes exclusively from the Greek and since the line is completely missing, there is no way of knowing whether line twenty six in the Greek corresponded exactly to line twenty six in Aphrodisias.

The main question raised of course is how feasible longer axles would have been. A reasonable approximation in an ideal situation without any other kind of aid would be from five to eight inches on either side. However, since the mathematics depends upon road conditions, surface friction, speed angle of turn, how far the skid is controlled, the action of the back wheels as they follow the front, it seems impossible to recreate mathematically what actually happens when a wagon turns in this way. Moreover, while five inches seems quite reasonable,

26. Bertram Frank Curator of the Rydale Folk Museum, Hutton-le-Hole personal communication.

27. Childe in Singer et al pp. 57-216.

28. Ian M. Stead, personal communication.

29. Hartley and Ingleby (1972) pp.106-110.

the Theodosian Code in 364 and again in 368 A.D. ordered a complete standardisation of vehicles, not only proscribing a norm for portage weights and draught team size, but also regulating wagon beds. These rules were enforced on the carriage builders themselves.³⁰ In England, last century, the wheelwright George Sturt talks of standardisation of axle length (though they did vary from east to west) to within one inch to allow them to fit comfortably into ruts in the road surface.³¹

It is easy to imagine the same rule applying in the fourth century for the same reasons. Long axles, then, seem improbable. There is no excavated evidence to support them. Without them, the evidence from Aphrodisias is inconclusive.

Moving to the fourth century A.D., there is a Roman wagon, reconstructed from material excavated at Šiškovci in the Kyvstendil region of Bulgaria (ancient Thrace). The reconstructor Ivan Venedikov does not emphasise the presence of a pivoted front axle, but his wagon suspended transversely by straps fixed to four bronze sockets, by its very nature, forces a consideration of articulation.³² Again details of suspension are to be avoided but four points may be made in this context. Firstly, as with Klindt-Jensen, Venedikov's theory is remarkably plausible. However, Venedikov himself harboured doubts as to the soundness of his reconstruction and it was only in 1966-67 that German archaeologists accepted his theory.³³ Secondly, since 1967, the taxonomy of the bronze poles has been enlarged to include types which would not fit Venekikov's construction.

30. Pharr (1952) p. 147.

31. George Sturt The Wheelwright's Shop (Cambridge 1923).

32. (1960).

33. Lynn White Jnr. 'The Origins of the Coach' Proceedings of the American Philosophical Society CXIV (1970) pp 423-431, p.423.

Thirdly, of the nineteen wagons in his corpus, only five may be suspended but all share the same foreaxle construction. Thus the large bolt which features so predominantly in the photographs cannot be claimed to be a pivot.³⁴ Fourthly, not only is the whole reconstruction mechanically unsound³⁵ but any lateral swaying (which would after all be the unavoidable result considering the object of the construction) would bring the body into collision with the bronze poles. When the suspension is removed what is left is a fairly standard vehicle, of late Roman type, with four large equally sized wheels, the close spacing between the pairs indicating absence of articulation.

How then may the three original questions be answered. Remembering that previous authors had Ginzrot in mind, or the fact that prehistoric wagons pivoted or simply could not imagine a wagon without one, the evidence makes it difficult to accredit the Romans with the invention of a pivoted front axle. Ignoring flights of fancy indulged in by the reconstructors, since the idea of prehistoric pivoting will no longer hold water, continuity such as Gille believed in and Boyer and Leighton speculated about, is not possible. It is to the documentary evidence that historians and technologists should look for Roman articulation. At the moment since that evidence is not in existence, it is surely more sensible to look forward to a medieval pivoted front axle.

34. (1960) pl. 1 and 11.

35. A.C. Leighton (1972) p.122.

THE MEDIEVAL EVIDENCE.

'Illustrations do not with certainty prove evidence for the pivoted axle before the end and expense accounts not before the middle of the fourteenth century'.¹ This statement corrects the views of Des Noettes and other technologists who believed the first undoubted representation of a turning train appeared on a war machine in a German manuscript of 1480.² That this manuscript shows a pivot is beyond doubt, though vehicles with rigid axles continue in Europe until the seventeenth century and later.³ However, there is clear proof of a medieval invention of a pivoted front axle in the early fourteenth century and by implication even earlier.

'Gille in 1956 published a seal, plainly depicting a pivoted front axle dating from 1396 and he conjectured that this was the period of its invention'.⁴ This is Mrs. Boyer's representative evidence for the late fourteenth century. Her confidence in the seal of Francesco of Carrara is misplaced. No part of the representation may be said to depict an articulated foreaxle. Mirroring the Bronze Age rock carvings, it is a flat view of a wagon as seen from above and no definite pivoting mechanism is present.⁵

The most exciting claim for an early pivot comes from Lynn White.⁶ He points to a miniature [55] from the Trier Apocalypse (A.D.800) as being the first example of an early rigid horsecollar but points out in passing that the front wheel

1. Marjorie Nice Boyer (1960) p.135.

2. Singer et al 11 fig. 502.

3. Forrer (1932) p. 91 fig. 35.

4. (1960) p. 128.

5. Gille (1963) fig. 3 p.170.

6. Lynn White (1962) pp 66 footnote 4, fig 3; M.R. James, The Apocalypse in Art (London 1931) p 21; A. Goldschmidt, Die Deutsche Buchmalerei I Florence 1928) p 51; H. Swarenski, Monuments of Romanesque Art (London 1954) p 57; Trier City Library Ms 31 fol 58 r. The isolation of this illustration, over four centuries earlier than any other we have, is not an historical or social isolation. There is ample evidence for road development in Frankish times (see above p 201) in association with royal, religious and cult, and later imperial policies and developments, and capitulary discussion of Carolingian military movement is not irrelevant here. It is reasonable, therefore, in the light of present knowledge to retain the Trier evidence in this present discussion, isolated though it may at first sight appear.

is smaller than the rear. A great deal of controversy surrounds this representation. It is criticised for inaccuracy. By medieval standards, however, it is as good as any evidence yet put forward. It has small front wheels with lateral space for wheel movement. Clearly it is unwise to build a whole theory of medieval pivoting on one illustration, however.

Surveys of western illuminated manuscripts in the major public collections has produced fairly similar results with no great surprises. However, it does give a corpus of information upon which to base interpretation. Summarising therefore the findings, from the British Library and the Bodleian Library - since their catalogues are readily accessible but do not have a subject division and therefore prove to be the least suitable to the study of medieval transport - sixteen out of a total of one hundred and seventy seven vehicles, eighty of them wagons, from the British Library manuscripts and ten out of a total of one hundred and thirty vehicles, forty five of them wagons, from the Bodleian collection, have bogies. Of the whole British Library collection (with the exception of those at binding, Summer 1976) five farm wagons ⁷ seven passenger wagons with tilts, ⁸ two passenger box wagons ⁹ and two army baggage wagons ¹⁰ have pivoted front axles. They are all Flemish or

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7. British Library Egerton 1147 fol.16 (Flemish Late XVth.C)
Additional mss.13352 fol.3(Flemish XVthC.), Yates Thompson MS 3
(11) 30 (94) fol.2 (Florence 1502), Additional MS 24093 fol.20_b
(Flemish XVth C.)
 8. British Library Harley MS 5256 fol.22(French XVIth C.), Royal MS
17F1 (Flemish XVth C.) Royal MS 2AXVII fol.80(XVthC. Flemish),
Royal SM.16F111 fol.11(Flemish XVth C.) Burney MS 257 fol.59
(XVth C.Flemish), Royal MS 16GV.fol.176(French XVthC.) Harley MS
4374 fol.16,188(French XVth C.).
 9. British Library Additional MS 18350 (French XVthC.), Sloane MS
3983 fol.7b,12,18,25b (Flemish XVth C.).
 10. British Library Royal MS 15E1 (Flemish XVthC.) Harley MS 2333
fol.136,44,(French XVth C.).

French. All, save one are identified by small front wheels. British Library Sloane MS. 3983 is identified because of the visibility of the sway bar, an arched piece of wood which slid across the perch to facilitate turning. British Library Burney 257 is actually shown on the turn. Clearly from this evidence the fitting of a bogie is not dependent on whether the wagon has a central draught pole, or shafts, is drawn by oxen or horse-pair, or whether traces are used. British Library Sloane 3983 shows all of these variations, the wagons in each case being of identical undercarriage construction. The earliest bogie is Flemish from a fourteenth century manuscript. The predominance of Flemish and French wagons is indicative of the scale of production of these manuscripts and the choice of subject for illumination rather than an exclusivity in the fitting of pivots. Of the Bodleian collection, four are baggage wagons.¹¹ four are passenger box wagons, two passenger tilt wagons.¹² The earliest is French from a late thirteenth century manuscript.

Large numbers of manuscripts from the fourteenth century onwards continue to show unpivoted wagons. This is particularly true of groups of manuscripts depicting stories from the bible with a wagon theme, for example the Flemish group of Joseph stories, the French and English Elijahs, the "hexagonal" wagons of the French and Acre manuscripts. Yet there is a sufficient number of examples of bogies to show that wagons had

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11. Bodleian Library MS Bodley 264 fol.102,83v (Flemish XIVthC.), MS.Douce 135 fol.62v (XVth C. French), MS Canon Ital.196 fol.30 (Italian XVth C.).
 12. Bodleian Library MS Douce 48 foll8v (North French XIIIthC.), MS Douce 135 fol50, (French XVthC.), MS Canon Misc.280 fol.14v 32v,42,43, (Italian XVth C.) MS Canon Ital.85 fol.1 (Italian XVth C.), MS Bodley 971 (XIVth C.French), MS Rawl. 21 fol.46,47v (Flemish 1529).

such a fitment by the fourteenth century. There is no criteria for judging the miniatures objectively. Artistic convention, deliberate archaism, unawareness of technical difference between the cart and the wagon, all cause problems in interpretation. The basic problem is perhaps summed up in one manuscript, British Library Add.13350, where some folios have wagons which pivot, others do not.' Unfortunately for the history of the wagon, artists did not much concern themselves with realism until the fifteenth century and before that period the representations of the undercarriage of vehicles is almost lacking'.¹³ While arguments continue to surround the validity of the miniatures, it is textual evidence which must be sought to provide definite proof.

Medieval expense accounts have proved to be very helpful in the matter of fixing a date for the introduction of pivoting. The accounts of the Duchess of Burgundy for the year 1384-5 mentions torillons (pivots) and a great bolt of iron.¹⁴ Unfortunately there is nothing of this kind in the English documents. The wardrobe accounts do not provide an itemised breakdown of transport costs for the departments of the Household. The manorial documents have up to now provided no description of the components of the undercarriage. However, in 1294 and 1323 two swivel were bought with other equipment for carts and wagons and charged on the accounts of the Winchester manor of Cliffe¹⁵ in

13. Marjorie Nice Boyer (1960) p.129-30

14. *ibid.* p.131

15. Transcripts of some of the Winchester Manorial documents made by A. Drew, unpublished, in the hands of the Medieval Latin Dictionary committee. I am grateful to Mr. R.E. Latham for access to this material and for use of the slips of the dictionary while work is still in progress. Henceforth references will appear as Drew.

Kent. Together they cost one penny. The English Dictionary (Dialect)¹⁶ gives swivel as being 'that which allows to swing or turn around freely, something fixed in another body to turn round in it, a ring or link that turns round on a pin or neck. From the Anglo-Saxon Swifan, to turn round, to move quickly'. The swivel are not specified as being bought in a pair. They are not whippletrees. These are commonly billets, courbs, drauts, horstres, sweltrres, sweypetres and swyngletres, and they cost about one and a half pence to three pence. The price indicates that the swivel is of iron, smaller than a clout (about 2d) but larger than an iron lynch pin ($\frac{1}{4}$ d). This would seem to mean a fairly heavy bolt. It could be the hinge of a dung cart, where the whole body was lifted up to allow emptying. However, this has no sense of quick movement which the derivation of swivel would seem to imply. This is most probably the word for the kingpin of a pivoted front axle.

The only fourwheeled wagon to survive is the¹⁷ Oseberg wagon which has been given a date in the tenth century. The next extant vehicle is the coach built for the Elector of Saxony in 1584.¹⁸ Stripped of its ceremonial finery, the Oseberg [56] wagon like those on the reconstructed Oseberg tapestry, is purported to represent an everyday working vehicle. As reconstructed it has no pivoted front axle. There is no doubt that it has been badly constructed, the shafts for example are too narrow for a draught animal.¹⁹ However, there is no basis for reconstructing it with a pivot. 'The question of the existence of the pivoted front axle in the Middle Ages cannot unfortunately be settled by the one surviving vehicle'.²⁰ It can, fortunately, be solved by one surviving piece of material incorporating both textual and

16. Wright (1904) SV Vol.1V swivel, see also Skeat, An Etymological Dictionary of the English Language (1879-82), Bosworth and Toller, An Anglo-Saxon Dictionary (1893).

17. P.G.Foote and D.M.Wilson The Viking Achievement (London 1970) fig.36. See also fig.37 and pl.13.

18. George Thrupp The History of Coaches (London 1877) p.36.

19. Leighton (1972) p.32-3.

20. Marjorie Nice Boyer (1960) p.130.

representative evidence.

It can be said with safety that by the year 1335 the invention of vehicles with a pivoted front axle had been accepted. While forming an effective terminus post quam, the circumstances of its introduction, the other manuscript evidence and the linguistic evidence from English and French documents combine to allow conjecture that it was known before this time. Chapters XI and XII of Guido da Vigevano's Texauris Regis... provides the solution to the problem of manoeuvring a wooden fighting car from inside, in a way not far removed from the horseless carriages of last century and copied by all military technicians like Robert Valturo.²¹ Guido's drawings [57-58] are difficult but the text shows that the vehicle is propelled by the draught pole which has been swung round to form a tiller. A self-propelled vehicle could only be moved by a mechanism involving an articulated foreaxle. The question is of course, was it an essential condition or an obvious consequence? If Guido did not invent the bogie then it was in common use. Guido has been judged as being no genius but someone who put the familiar to good use. The casual undetailed descriptions of the means of propulsion seem to indicate that the problem of steering would never have occurred to him if he had not already been aware that in turning corners the front axle inclined at an angle.

Therefore the origin of the pivoted front axle lies between 900 A.D. and 1335. There is no sign of outside

21. A. Rupert Hall (1961) pp 17-21.

influence in its conception. Lynn White has put forward a Bible History of 1250 as a source of representation for wagons with bogies.²² However, none of the wagons pivot. Folio twenty one merely shows the draught pole beneath the undercarriage. On the contrary, such a detailed and careful manuscript on technical points, particularly harness, which shows wagons without articulation, would seem to point to a date later than 1250 for the invention of the pivoted front axle in western Europe.²³ However, it may safely be considered part of the wagonwright's repertoire of skills by the beginning of the fourteenth century.

There is one final consideration to be made on medieval pivoted axles. At the XVth International Congress for the History of Science and Technology, Professor Makkai put forward the idea that articulation was linked to the presence of a whippletree which indicated in his terms a liason between the crossbar and the front axle. This he sees in the Hungarian coaches of the fifteenth century and he denies the existence of a bogie before this time.²⁴ Leighton takes this one step further. With it (the whipple) power is applied tangentially making it possible to turn a fourwheeled wagon whether or not it has a pivoting front axle. A wagon can turn whether it has a pivoted front axle or not. It is a matter of the ease with which this can be done. A whippletree alone could not perform the function of a bogie. As has been seen, the introduction of a pivoted axle is far earlier than the late fifteenth century.

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22. Cockerell, James and Ffoulkes A Book of Old Testament Miniatures (1927) White (1962) p.66 See date of Douce MS 48, p.29 footnote 2.
23. L. Makkai L'Apport de L'Europe Orientale A L'Evolution des Moyens De Transport - Cheval - Etrier - Char paper read Edinburgh (August 1977 unpublished).
24. Leighton (1974) p.21.

There is no need to look for an eastern origin and as shall be seen later the whippetree was acquired to solve definite problems in harnessing. The fact that more efficient draught power facilitated turning is purely a coincidence.

How then does a medieval pivot affect our view of the inventive spirit of the middle ages.? This is a judgement which can only be made when other technical improvements in transport are set alongside the bogie. The use of vehicles is by and large dictated by terrain and availability of water transport. However, the increase in the use of vehicles in western Europe in the fourteenth century is clear.²⁵ As an example the only passenger vehicles in Bapaune in the thirteenth century were invalid cars. Later in the century there were so many chars in Paris that the king forbade their use by the Parisian bourgeoisie. This is, as one has come to expect, a far cry from the old fashioned view of medieval regression. Among the new ideas, that of a medieval pivoted axle no longer seems strange.

25. Marjorie Nice Boyer (1960) p.134-5.

CHAPTER TWO : SUSPENSION.

A suspension system, primarily of leaf and coil springs and hydraulic dampers, is designed to protect the body of a vehicle from road surface shocks. However, metal springs were not used until the late sixteenth century.¹ Thus the modern system with its cushioning springs has simply retained the old nomenclature. In the past the vehicle body was hung on straps, ropes or chains extending transversely or longitudinally from poles rising from the axletree beds. Two things should be noted in connection with the suspension. Firstly, as far as the pictorial record is concerned, it is as one would expect, related exclusively to four wheeled vehicles. Secondly, where it is successfully performing its function, life is much more comfortable for those in the body of the vehicle. Suspension therefore comes to be associated with long distance passenger carriages.

'Aux XVII e et XVIIIe siecles l'avant-train tournant avec roues passant sous la caisse, les ressorts de suspension, les bandages frettés à chaud sur les roues sont connus et appliqués principalement aux voitures de luxe...'² 'Travelling carriages with the body suspended on straps did not appear until the sixteenth century'.³ It is only in the later Middle Ages that suspended carriages come into widespread use'.⁴ 'The number of people travelling in carriages notably increased in the fifteenth century and this at the expense of riding on horseback., a fact which suggests that suspension was more and more used'.⁵ These are four conflicting statements which sum up the basic questions to be asked about suspension:

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1. Lynn White Jnr. (1970) Gay and Stein (1928) 1, p.336. E.E.Viollette-Duc p.62
 2. Des Noettes (1931) 1 p.127-3
 3. E.M.Jope in Singer et al, 11 p.547
 4. Albert Leighton (1977) p.346
 5. (1959) p. 364

the date at which suspension may be considered as an integral part of a vehicle: whether it is possible to isolate an area of origin: whether Mrs. Boyer's statement is accurate.

There is no definite evidence of suspension in prehistory. Plausibility is no substitute for positive evidence. Klindt-Jensen's hypothesis therefore must be laid aside until material has been found to support it.⁶

There is no evidence for Roman suspension. Lynn White Jr. and Albert Leighton have successfully shown that Venedikov's 'very stimulating proposal that suspended carriages first appeared in Roman vehicles of the third to the fourth century cannot be accepted'.⁷ Further, it might be useful to point out that suspension, as envisaged by Venedikov is present not only on five of the wagons from his excavation, but also on fifteen of the chariots.⁸ It is possible to maintain that suspension on an ancient chariot would be unnecessary, built as it was for speed or battle, and where the driver, normally the only seated member, would sit to the front to take advantage of the natural suppleness of the draught-pole. Before dismissing Roman suspension altogether, however, it would be worthwhile to bear in mind that plaustrum, used later to denote the constellation of the Great Bear or Charles' Wain which suggests that it must have been a fourwheeled wagon in Roman times, comes from the Indo-European root pleu meaning to sway or float.⁹ Interesting enough the Swedish Variarum Rerum Vocabula published in 1538 translates the Latin pilentum, derived from an unidentified Celtic source and used to denote

6. (1949-50).

7. (1970) p.431 (1972) pp.121-3.

8. (1960) pp. 244-9.

9. Stuart Piggott, Roman Vehicles:unpublished draft

the carriage of the Roman matrons, as a suspended wagon, a sparwagn hengiande wagn.¹⁰ However, as the evidence stands, it is more reasonable to agree with Leighton that 'even the Romans who were able to write shorthand while travelling in chariots seemed not to have conceived the idea of suspending carriages'.¹¹

Clearly suspension may be regarded as a medieval invention. It is the general opinion that suspension was introduced to western Europe as part of the Hungarian coach or kosci¹² in the sixteenth century. However, there is evidence of suspended vehicles in the tenth century from the documentary sources and in the eleventh century from the illuminations.

Documentary evidence suggests that the western Slavs were familiar with suspended vehicles in the tenth century. The Spanish Jew, Ibrahim ibn Jacuib described the brocade covered 'haudaj' suspended by chains which was the royal vehicle of the Bulgarians in c965 A.D.¹³ This is supported by the geographer Al Bekir who, quoting the tenth century writer Al Musadi, describes the King of Serbia's fourwheeled wagon with its body suspended by chains from four posts.¹⁴

The earliest evidence from western Europe is the vehicle shown on the miniatures of British Library Cotton Claudius BIV. Here the body of the vehicle resembles a hammock and is slung between two poles rising from the axletrees. It has been suggested that these miniatures are flat representations of fourwheeled wagons rather than two wheeled carts.

10. Gosta Berg (1935) p 172.

11. (1972) p 86.

12. Oskar Gromodka und Rudolf Müller, 'Über Wagen und Wagenbau' Technikgeschichte XXIII (1934) pp 70-78.

13. Georg Jacob Arabische Berichte von Gesandten an Germanische Fürstenthöfe (Berlin/Leipzig 1927) p 18.

14. Albert Leighton (1974) p 27.

The argument rests on the fact that some of the folios depict four people riding in the hammock and that this would be impossible in a cart of this nature. Whether a wagon or a cart, it is 'one of the earliest medieval attempts to mitigate the shocks of the road for a passenger by means of suspension.'¹⁵ The manuscript is assigned to a period from the ninth to the twelfth century. However, a date in the first half of the eleventh century is favoured.¹⁶ It is clear therefore, that suspension existed by the twelfth century in the west. What is less acceptable is Lynn White's hypothesis that this vehicle originated in the country of origin of the hammock, namely India, and that it was clearly the upper class vehicle of the Anglo Saxons. At the present moment there is no way that the Cotton vehicle can be regarded as anything other than an interesting curiosity. No similar representation appears in the main collections of Great Britain nor in the published facsimiles of important western manuscripts of this period which are readily available. There can be little doubt that such a vehicle existed. However, it is surely more possible to envisage it as an unusual and no doubt impressive 'imported model', a smaller version of the slavic vehicles of the tenth century.

Parallels to the Cotton vehicle have not been found. However, evidence for suspended vehicles in the fourteenth century is found in documentary and representational sources. The Weltchronik of Rudolph von Ems c1340 shows a wagon with a wicker body hanging from leather straps, while the Breslau manuscript of Froissart c1470 shows the funeral carriage of Richard II, the body hanging by chains. Such evidence is supported by Mrs. Boyer's work on the household records of Burgundy and Orleans. By the beginning of the fifteenth century

15. British Library Cotton Claudius BIV, see particularly fols. 71v and 72v, Leighton (1972) p 121ff, (1974) p 27, Lynn White (1970) p.431.

16. N.R.Ker, Catalogue of Manuscripts containing Anglo Saxon (Oxford 1957) p 178.

a chariot branlant, a shaking chariot, or a curre à chaennes 17
was the last word in high fashion for a great lady in France.
The queen of England on the other hand, had to make do with a
currus or a basterna.¹³

There is, therefore, definite evidence that a suspension system was employed in western Europe from the late fourteenth century, though the principle was probably known in the east from the tenth century. However, it would be fair to say that it is not common until the sixteenth century. Representations of carriages without straps or chains are far more numerous. As far as the French accounts are concerned, they frequently specify that these noble personages own only one small chariot branlant, that these are particularly luxurious and subject to frequent repair. Moreover, these vehicles in general were either built in Central Europe or 'according to Hungarian fashion'. Many were given as gifts. In 1457 King Ladislaus of Hungary presented the French queen with a 'chariot branlant fort sumptueux enriché'. From 1477-9 King Rene of Sicily employed German and Hungarian craftsmen. In 1479, Louis XI purchased a chariot built to Hungarian specifications. The Duke de Berri's chariot was built in Germany.¹⁹ It is easy, therefore to see the origin of the suspended vehicle in Hungary. Even at this early date the Hungarian carriage was superceding all other vehicles. In the next century the vehicle from Koscs became so popular that the term coach came to mean any carriage other than a working cart.

It may also be possible to see an eastern European origin in the illuminations. In France there is no evidence of suspension by leather straps, only by chains. According to the Arab geographers the Slavs were using chains

17. (1959) pp 359-366, Rheinau MS XV.

18. LQCG.

19. Marjorie Nice Boyer (1959) pp 364-6.

in the tenth century. However, by the fourteenth century, the Hungarian carriage had longitudinal suspension by leather straps, superseding that in use in France in which chains were stretched transversely beneath the chassis. This difference is clearly shown in the two manuscripts already discussed, the Weltchronik and the Froissart, the latter displaying more characteristics of the working wagon. One may interpret this evidence as indicating that the newer, more sophisticated developments had not yet reached France.

Finally to recall Mrs. Boyer's statement, how accurate is it to say that because there was a notable increase in the number of people travelling in carriages, advances in construction, primarily suspension, must be taking place. It cannot be denied that technological developments in wheeled vehicles were being applied in the later Middle Ages. However, Mrs. Boyer's thesis neglects one important facet of travelling in a vehicle. Albert Leighton mentions this but goes no further, when he insists that 'a society that regarded the saddle of a horse as a more honourable place than the seat of a wagon devoted little effort to ways of making wagon travel more comfortable such as the suspension of carriages'.²⁰ Until the later Middle Ages it was considered unmanly to ride in a vehicle. This was the prerogative of the sick, the aged, the criminal and of women. By the end of the fourteenth century, the stigma of sitting in a coach appears not to have been considered very great. Certainly nothing exists of the disgrace so clearly expressed in the 'Chevalier de la Charette' by Chretien de Troyes.²¹ Public opinion as to the propriety of travelling by coach should not be ignored when considering the increase in passengers using the roads in the fifteenth century.

20. (1972) p 121.

21. David J. Shirt, (1973) pp 279-303.

Suspension may thus be considered a product of medieval technology. Its adoption was one of the first fundamental changes in carriage design, and displays not only the skills of the medieval wagonwright, particularly in eastern and central Europe, but also the viability of transporting passengers overland and for long distances without demanding that they go beyond the bounds of human endurance.

CHAPTER THREE : MEDIEVAL SPARE PARTS AND RUNNING COSTS.

Having discussed the introduction of two of the most important and detectable technological developments in wheeled vehicles, it is now time to consider the kind of vehicle actually in constant use in the middle ages. Its component parts and the cost of purchasing, running and repairing such a vehicle. It might also be useful to decide who owned carts or wagons in medieval England and in what numbers.

The vehicle in most frequent use in England in the middle ages, be it a cart or wagon, was that used for agricultural work on 'the most fundamental institution of medieval society', the manor.¹ The greatest owner of vehicles was the king, not only in his role as a great manorial lord but also as the head of a large, itinerant household. The great estates also owned large fleets of working vehicles. Vehicles used for trade will be discussed in section four. This is not the place to consider market stimulation and economic trends as affected by the distribution of raw materials and manufactured goods.² Vehicles used for personal travel are peripheral.

The discussion of manorial transport is only possible because of the large number of surviving manorial accounts drawn up in the name of the bailiff or reeve, forming

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1. Edward P. Cheney, English Manorial Documents (Philadelphia 1896) p. 1.
 2. See for example K. Berrill 'International Trade and Economic Growth' Economic History Review XI (1960) pp 351-9.
M. Postan Medieval Trade and Finance (Cambridge 1973).

an 'unrivalled field for the picking up of unconsidered trifles which elude us in all the more likely sources of information'³ One of the unconsidered trifles is the itemised breakdown of manorial expenditure. Intended only for private record, composed largely to a standardised formula,⁴ these accounts are to a unique degree uninfluenced by outside events and reflect modifications in agrarian policy as well as accounting technique. Of the three classes of account produced; the mid term account; the end of term account drawn up for the reeve; the counter roll drawn up for and bearing the marks of, the auditors;⁵ it is the second with which we are concerned. Composed by the accountant or computans, it shows the lord the exact financial position existing between computans and lord, the former being held responsible for any losses or estate mismanagement. No doubt this hazard was outweighed by the prestige or like Chaucer's reeve, financial gain:⁶ Expenditure on carts and wagons may appear under three marginal headings: custus carucae, that is lumped together with purchases for the manor ploughs; custus carectis, custus carectis et plaustrorum and occasionally custus longae carectae; necessaria or minutiae, that is lists of small items which had to be bought during the year.

Certain points should first be made. Though representations were used to illuminate the general range of medieval vehicles in chapter one, section one, here the evidence

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3. Studies in Manorial History by Ada Levett H.M.Cam.H.Coate, and L.S. Sutherland (eds.) (Oxford 1933) p.48
 4. Manuscripts which have been considered as models are for example Cambridge University MSS Dd VII 6, Ee I I, PRO E163 24/34, Wards Liveries, Deeds and Evidence 197/5, British Library MS Add.41201. See also J.J.Drew, 'Manorial Accounts of St.Swithin's Priory' English Historical Review LXII(1947) pp 20-41, Legal and Manorial Formularies (Oxford 1933), ed. by J.P. Gilson.
 5. A counter Roll does not often exist but see the Pittington accounts, Bodleian Library, Bodley MS, B.Litt.d.50.
 6. The Canterbury Tales; The Reeves Tale.

is exclusively documentary and pertaining to those particular counties where a group of accounts still exists. Furthermore it may be possible to decide whether prices vary from county to county. Secondly, this chapter will deal exclusively with expenditure on the component parts of vehicles. The medieval lord had a heavy bill for harness, wheelwrighting and farriery on his estates. These costs are discussed in the relevant section. Thirdly, the prices given are in Sterling. Thus the libra is worth 180 old pence, the solidus 12, the denarius being the old penny (d) and ob the farthing. Personal names are given as they appear in the manuscripts or as they have been transcribed by editors. No attempt has been made to discover the villages named in the records but of course the counties have been carefully listed. Thirdly, where errors occur in medieval mathematics they remain, unless they are to be found in the addition. The accounts are not merely shopping lists but complicated renders of expenditure over a year. To check each roll carefully for arithmetical mistakes would not help to illuminate ancient transportation. This study is by no means exhaustive. Vast boxes of manorial documents are housed in every local repository. An exhaustive study of the rolls of one area would be a lifetime's work and is certainly not possible in a general survey of this kind. Fourthly, how far all or some of the prices were affected by economic conditions following the Black Death will be dealt with when all medieval prices including harnessing and wheelwrighting have been considered.

What were the numbers of carts and wagons used on the great estates, therefore? The instruments or inventories of the equipment, stock and grain yields remaining at the end of the year show that on average three carts or caretta is the norm for manors in Cambridgeshire, Kent, Hampshire, Oxfordshire, Berkshire, Gloucestershire and Buckinghamshire. Further to the north and east, however, in Lincolnshire and Northamptonshire, five or more carts are kept on each manor.

On a very few manors there is no mention of vehicles but, as in Radstowe, Northamptonshire, the stock count with its lists of carthorses indicates the presence of carts. Most manors have a variety of vehicles, though here the difficulty of sorting out nomenclature is complicated. The common type are carecta, biga and quadriga (which are more likely to be two and four horse carts than carts and wagons, although that assumes that the medieval computans was not as confused as we are by vehicle nomenclature), plaustrum, tumberell, longa carecta and plaustra. Normally a manor has both an iron shod and an unbound carecta.

The estates of Crowland Abbey have an unbroken sequence of inventories from the 1250's. 1258 is an exceptional year because twelve of the manors have instrumenta and this allows an interesting comparison. Most are in Northampton or Lincolnshire. They appear as follows; ⁷

Dowdike, Lincs.	1 biga ferrata, V sine, quadriga et rote.
Whaplode, Lincs.	1 caretta ferrata, 11j non ferrate et 1 plaustrum.
Wellingborough, Northants.	111j biga ferrate.
Addington, Northants.	1 caretta ferrata.
Elmington, Northants.	1 biga ferrata cum toto apparatu.
Morborne, Northants.	Vj bige ferrata.
Langtoft, Lincs.	V caretta ferrate.
Boston, Lincs.	1 biga ferrata et 1 quadriga.
Bowthorpe, Lincs.	no carts and no carthorses.
Radstowe, Northants.	no carts, 1j carthorses. ⁸

7. Frances M. Page, Wellingborough Manorial Accounts, 1258-1323 Northants. Record Society VIII (1936) (Crowland Abbey estates in the Hundred of Hamfordshoe), The Estates of Crowland Abbey (Cambridge 1934).

8. PRO, SC 6 949/3.

Three Crowland estates in Cambridgeshire also have inventories for 1258. They appear as follows;

Drayton, Cambs. 11j carette non ferrate.
Oakington, Cambs. 11j caretta unde quondam 1 ferrata.
Cottenham, Cambs. 11j carette unde quondam 1 ferrata.

There is no proof, however, that these vehicles were in good condition. The inventory for Croyland, for example, lists in its instrumenta for 1267-8, 1 broken cart, 1 weak cart bound in iron of a third-et alia ferrata debilia cum ferura tertie carecte cum attila trium carectarum.

Expenses for maintaining the carts in good repair were high but must be seen in context. At Oakingham in 1322, 6/10 was spent on the carts but the whole expenditure for the year was £24.10/7. Cottenham in 1322 shows 16/10 for vehicles as compared to £23.5/5.⁹ Worcester Priory found itself with a transport bill for 19/10 in 1351 as compared to the £1.15/8 for maintaining the ploughs and a total expenditure of £100.3/1½.¹⁰

Fitzherbert tells us a little about the composition of a medieval vehicle. 'This wayne is made of dyuers peces, that wyll haue a greate reparation... The bodye of the wayne of oke, the staues, the nether rathes, the ouer rathes, the crosse somer, the keys and the pikstaues... Also a carte made of asshe bycause it is lyghte and lyke stuffe to it as is to a wayne... and a carte-ladder behinde, whan he shall carye eyther corne or kyddes, or suche other. And in many countreys theyr waynes haue carteladders bothe behynde and before'.¹¹ The manorial accounts supplement this information which is after all given in 1534. Evidence from these rolls will now be considered.

9. Page, (1934)

10. S.G. Hamilton, The Compotus Rolls of Worcester Priory, Worcester Historical Society (1910); J. Wilson and C. Gordon, Early Compotus Rolls of the Priory of Worcester (Oxford 1908) Roll c293.

11. W.W. Skeat (ed), Fitzherbert, The Book of Husbandry 1534, English Dialect Society Series D Miscellaneous (London 1882).

in three groups; vehicles bought as a whole and vehicle bodies which were bought as separate items; spare parts for the vehicle, (considered in alphabetical order) items connected with vehicle expenditure which cannot be readily identified.

GROUP ONE:

BIGA.

RMLWL; a cart c 1194.

Winchester 1203 ¹²

In paramentis bigae fractae 10d.

Southampton 1269-70 ¹³

Una biga fracta emendanda et reparanda 10/1d.

Milton, Essex 1277 ¹⁴

In VIII clutis emptis cum clavis ad bigas 5d. In III axis ponendis in bigis 2¹/₂d.

Alton Barnes, Essex 1415 ¹⁵

Una biga empt. 7/-d.

Daventry, Northants 1434

Una biga empt. 23/10d.

CARETTA

RMLWL ; a cart c1150

Oakington, Cambs. 1267-8 ¹⁶

Una caretta ferrata et alia caretta debilis feratura.

Frakeham, Suffolk, 1277 ¹⁷

Due carette, una ferro ligata et alia sine ferro cum toto apparatu ad easdem

Southampton 1272-73 ¹⁸

Et aliis custibus carectarum 7/6d.

Kibberwrthe, Leics. 1277

Una caretta debis ferro ligata 2/-d.

12. Hubert Hall The Winchester Pipe Roll of 1203 (Winchester 1903)

13. M.W. Farr, Accounts and Surveys of the Wiltshire Lands of Adam de Stratton (Devizes 1959)

14. Drew

15. Thorold Rogers, A History of Agriculture and Prices IV (Oxford 1882) p417.

16. Page (1934).

17. J.R.L. Highfield, The Early Rolls of Merton College, Oxford Oxford Historical Society XVIII (1963) p93.

18. Farr (1959).

Cheddington, Bucks, 1277	Una carecta ferrata 16/-d.
Wytfeud, Wilts. 1277	Una carecta ferrata 5/-d.
Stone, Kent 1277	De 1j carectis ferratis 3/-d.
Bastead, Surrey 1287 ²⁰	Una carecta ferrata empt.10/-d.

CARETTA FIMALIS.

RWLWL:-

Cottenham, Cambs. 1267 ²¹	Una caretta ferrata et ferreum franga alterius, una non ferrata et alia ad fimum.
Oakington, Cambs.1267	Una caretta ferrata et alia caretta debilis feratura,1j debiles ad fimum
Aldenham, Hunts. 1298	Una carect. fer. lig.,una carect. pro autump., una carect ad fimos.
Dry Drayton, Cambs.1322	11j pars clatum emptis ad caretas fimaes 6d.
Newelond, Wores. 1423 ²²	Solutum Egidio Smyth pro diversis emendandis in carecta fimali ibidem 2/4d.

CARETTA CURTA/LONGA

RWLWL; a short/long cart
c 1311/1243

Blean, Kent 1294 ²³	Curtene, dua quarum,una cum rotis ferratis.
Bradewas,Wores. 1388	Una carecta cum rotis nudis
Worcester Priory 1389 ²⁴	Una carecta longa cum rotis nudis

CARMPOT.

RMLWL:-

Holcombe Regis, Devon 1335-6	In uno plaustro et uno carmpot bis axiand 4d.
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CARRUM (KARRUM)

RMLWL; a cart c 785

Moundsmere 1287	In 11j rot.ad j parvum carrum 2/-d.
Ropley,Hants.1399 ²⁵	In clat.empt.pro carbon car.20d.

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19. Highfield (1963) p95.
 20. Farr (1959)
 21. Page (1934)
 22. Hamilton roll c 425 (1910).
 23. Drew.
 24. Hamilton (1910)
 25. Drew.

CORPUS CARECTE.

RMLWL :-

Milton, Essex	1278	26	In uno corpore carecte ad easdem faciendo 6d.
Hokyton, Cambs.		27	In uno corpore noue carette 2/-d.
Petworth, Sussex		28	" " " " "
Speen, Berkshire	1345	29	In corpe un.carett de novo fac.2/-d.
Barton, Priors	1385		In duobus corporibus pro fimis de meremio domini faciend cum emendatione tumbrell.pro fimis 20d.
Ropley, Hants.	1418	30	In uno novo corpore carectino 8d.

CORPUS PLAUSTRI.

RMLWL :-

Petworth, Sussex	1347		In uno novo corpore plaustr.6d.	
"	"	1349	31	In uno corpore plaustr.fac. de meremio domini 15d.
Durham	1392	32	In factura unius waynbody 6d.	

CORTUM

RMLWL ; a short cart c 1286

Wellingborough, Northants	1286	33	In omnibus custis carectarum tam cortorum quam aliarum carectarum 11/2 $\frac{1}{2}$ d.
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DONGEPOT

RMLWL:-

Petworth, Sussex	1352	34	In reparand.curta fymorum 6d.
Whitchurch	1357		Una carettillo pro potto fimare de novo faciend 4d.

26. Drew

27. Page (1934)

28. L.F.Salzman, Ministers Accounts of the Manor of Petworth, Sussex
Record Society LV (Lewes 1955)

29. PRO.SC6 750/25

30. Drew

31. Salzman (1955)

32. Surtees Society (1898)p 392

33. Page (1934)

34. Salzman (1955)

Hinton, Ampner 1371

In uno pari rotarum pro le
dunkepot empto 3/-d.

" 1393 ³⁵

In uno corpore caretario et uno
dongiepot.

PLAUSTRUM

RMLWL; a wagon c 833

Akeringtone, Lancs. 1295

De uno veteri plaustro vendito 4d.

Ichtenhille, Lancs. 1295 ³⁶

In custu plaustorum cum uno plaustro
de novo facto 1/10d.

Holcombe, Regis, Devon 1334

In uno plaustro vestiend de novo 2d.
In egging dict. plaustr.

Greenham, Somerset 1345 ³⁷

In un. rot. plaustr. cum vellis nov.
Ryngard 5d.

PLAUSTRUM FIMALE

RMLWL:-

Worcester Priory 1389 ³⁸

Unum plastrum fimale cum una rota
nude et alia ligata.

PLAUSTRUM LONGUM

RMLWL ; 1439

Bradewas, Worcester 1388

Una carecta longa, dua plaustra
longa, unde uno totaliter debile
et sine rotis et aliud cum rotis
ferro ligato.

Worcester Priory 1389

Dua plaustra longa.

SPORTA

RMLWL; litter or basket c 1462

Hardewyke, Worcs. 1462 ³⁹

In una carecta ligata 22/-d. In una
sporta 16d.

TUMBERELL

RMLWL; tumbrel, a dung cart 1279

O.D.D.; ⁴⁰ a farm cart especially for manure, Yorks., Ches., Lincs.,
Warw., Worcs., Shrops.

35. Drew

36. P. Lyons Two Compoti of the Lancashire and Cheshire Manors of
Henry de Lacy, Earl of Lincoln, Chetham Society CXL (Manchester 1934)

37. Drew

38. ibid.

39. Hamilton (1910)

40. Drew, see fn. 42.

Pershore, Worcs.	1310	In clav.empt ad tumberell. fimorum emend. ld.
"	" 1319	Tumbrell, fac.ad tascham.
	1323 41	In factura uno tumbrell 3d.
Worcester Priory	1345 42	In bordis emptis pro tumberellis 6½d.
Hinton Ampner	1377	una carecta pro fimis cum duo tumbrell. et uno alia dougland.
Chilbolton	1393 43	In uno corpore carectario cum uno tumbrello ad idem empto 20d.

GROUP TWO

BARHUDUM

RMLWL; barehide, a cart cover	1172	
Beverley	1300 44	In una bahuda longa
?	1332 45	In una caretta cinta cum una longa barhuda sibi.

BEDDUM

RMLWL; bed, lower framework of a cart,	1276	
Wiltshire	1276 46	In reparacione duorum beddorum karrorum de novo et lignum scapulendum.. in novo ad carectam faciendo et axendo.
Monkton, Kent	1276	
"	" 1298 47	In courtebeddes novo faciendis in duo courtebeddes veteribus reparandis cum bord et clavis 4/-d.

-
41. Hamilton (1913)
 42. Wright Oxford Dialect Dictionary, Oxford 1904) Henceforth O.D.D. ; Drew.
 43. Drew
 44. PRO E101 98/11
 45. British Library Add.MS 38006 fol.1b; Wardrobe account of Robert de Tong, Treasurer of the Household of Eleanor, sister of Edward III on her journey to Nimwegen to be married to the Duke of Gueldres. 18th April-26th June, 1332.
 46. Farr (1959)
 47. Drew

BOLTUS

RMLWL; a bolt 1372

? 1372 ⁴⁸

In 11j quintalis ferri emptis pro
diversis ferramentis ad v carucas,
pro annulis ferreis, boltis, clippis.

? 1315 ⁴⁹

Pro un bolt. de fer p. la char 22d.

BORDA

RMLWL; a board 1167

Cliffe, Kent 1295 ⁵⁰

In XIj bord. emptis ad curtenas
emendendis 4d. In C de Hussem ad idem

BRODDUM.

RMLWL; a bradnail, 1276

O.D.D.; a short nail especially the round-headed nail made by
blacksmiths. ⁵¹

Milton, Essex 1274 ⁵²

In clutis cum brodd. ad idem 9d.

Cliffe, Kent 1294

In XIX de clutneyl cum brodd ad
idem 11½d. CCCbrod 4½d.

Bocking, Essex 1311.

In XXIV clutis ad carectas cum
brodd ad idem 22d.

CARETILLUM

RMLWL; a cartbody 1294

O.D.D.; cartil, cartel, a cartload.

Hereford 1289 ⁵³

j caretilli ad longam carectam

CLATA.

RMLWL; hurdle to increase the loading capacity of the cart 1330.

Ropley, Hants 1399 ⁵⁴

In clat. empt pro carbon car. 20d.

CLOUT

RMLWL; an iron patch to mend or protect wood, 1332

O.D.D. ; patch

Sturt, clete, a patch of iron for mending broken timber ⁵⁵

48. PRO SC6 900/5

49. " E 101 375/16

50. Drew

51. The ODD quotes the scots rhyme 'There's a nail and there's a brod
and there's a horse well shod.' c1870

52. Drew

53. J. Webb, Camden Society A roll of household expenses of Richard de Swinfield.

54. Drew

(London nd).

55. George Sturt (1923).

Milton, Essex 1277 56

In VIII clutis emptis cum clavis
ad bigas 5d.

Cobham, Oxon 1282 57

In XV clut.sine clavis empt 5d.

" " 1284 58

In XIj clut.empt cu.clavis 16d. In
C clav. p.clut.empt.2d.

Mersham, Surrey 1326 59

In XXIV clutis pro plaustris et
carectis 2/-d.

Pittington, Durham 1327 60

In XXX clutis emptis pro carribus et
pro carectis 2/6d. Pro clut. 1d.

GARTCLOUT.

RMLWL; as above

Speen 1352

In XIj cartcloutes emp.cu.clavis 2/6d.

" 1355 61

In VIIj cartcloutis emp.14d. In clav
ad idem 2d.

CLITTUM

RMLWL; as for clout

Cottenham, Cambs. 1322 62

In XIIIj clittis cum CC clavis 17d.

Oakington, Cambs. 1322

In XXIII clittis emptis 16d.

CLOUTNAILS

RMLWL; as for clout

Bernehorne, Sussex 1282

C cloutnails 2½d.

Petworth, Sussex 1347

CC clutnails 3d.

" " 1350 63

CL cloutnails 4½d.

COURBA

RMLWL; a curved piece of wood.

Adisham, Kent 1286

In courbis et jugis boum ferrandis 8d

Loose, Kent 1329

In 11j jugis boum et j corb ringlando 6d.

GANTERIUM.

RMLWL ; cart shaft 1311

Bocking, Sussex 1311 64

In ferro pro ganterius elongand 6d.

56. Drew

57. Bodleian Library DD Queens College Deeds and Evidence Box XLIII
Roll 252

58. ibid. Roll 253

59. Drew

60. Bodleian MS B.Litt d.50

61. PRO SC6 750/24/25.

62. Page (1934)

63. Salzman (1955)

64. Drew

GROPES

RMLWL; iron clamp. 1273
Crawley, Hants. 1305
Worcester Priory 1376 ⁶⁵
Hokyton, Cambs. 1320 ⁶⁶

In vetera caretta gropanda 4d.
In gropsis pro caretta de Netherton
3/-d.
In j pari gropsis cum clavis 11d.

GRIPNEYEL.

R/LWL; -
Bocking, Essex 1311

Pro clouts, grippneyl 4d.

HURTELUM

RMLWL; extension to increase load, 1305.
Silkstead 1303 ⁶⁷

lj hurteles pro caretta emptis 2d.

LIMON

RMLWL; a cart shaft 1200
Silkstead 1276 ⁶⁷
Oldington 1280 ⁶⁸
Moundsmere, Kent 1287
Bythorn, Hants. 1324 ⁶⁹

In lj limonibus emptis 6d.
In j par limon ad caretta 10d.
In limion eiusdem caretta...3d.
j par lymon 6d.

SCALA

RMLWL ; cartrail 1245
Overton 1280 ⁷⁰
Wellingborough, Northants 1322 ⁷¹

In j scala contra autumnum 2d.
In pigwithies et virgis emptis
pro bacles et pungen ad scalas 2½d.

-
65. Hamilton (1910)
66. Page (1934)
67. Drew
68. PRO SC 1070/5
69. Drew
70. PRO SC 6 375/19
71. Page (1934)

SCHAMELLUM

RMLWL; tumbrell or ducking stool 1278

Alton Priors 1373 j corpore cum shamel

SPIKING.

RMLWL; nail or spike 1261

Cuddington 1299⁷² In C spiking 3d.

Worcester Priory 1345⁷³ Spiking nail 9d.
CC spyking 13d.

STOCKUS

RMLWL; wooden upright of a cart 1276

Stone, Kent 1277 De j stocco 15/-d.

TEMO

RMLWL; draught pole 1200

Cliffe, Kent 1282⁷⁴ In 11j temonibus emptis 10½d.

Cobham, Oxon. 1345⁷⁵ In j temonem 3d.

TRABS

RMLWL; beam 1241

Alexander Neckham, 1190;⁷⁶ 'robur quod usualiter trabem vel temonem dicemus' .

Cliffe, Kent 1282⁷⁷ In 111j trabes 12d.

TRADBEND

RMLWL; part of a cart 1323

Moundsmere, Hants 1284 In vet, caret.ferrat.emend.cum
1j tradbend et 1j lurlegg fac.de
ferro domini 2d.

" " 1289 In j nova tradbend empt ad emend.
j caret. ferrat 2d.

THILLUM

RMLWL; a cart shaft 1324

Silkstead, 1375⁷⁸ In stipendio fabri faciento circulas
ferreas et ligantis thillyn dicte
carecte fracte 6d.

72. Drew

73. Hamilton (1910)

74. Drew

75. Bodleian MS DD Queens College Box LX111 roll 253

76. Wright A Volume of Vocabulari s Alexander Neckham de Utens-

77. Drew

ilibus 1190

78. Drew

Petworth, Sussex 1347⁷⁹

j par thillis 18d.

GROUP THREE.

BASTER

Baston Priors 1299

j baster empt 3½d.

BEND PEDAL

Chibolton 1307⁸⁰

In tercia carecta pro blado in
autumpno cariendo emendanda cum
11j bend pedal. ad idem faciendis 22d.

FOTBEND

Wonston 1386⁸¹

In emendatione veteris carecte
cum fotbend 12d.

CARTSAKIS

Oakington, Cambs. 1361

Et in 1j gong.de cartsakis 3d.

CARTEKYPO

Wellingborough, Hants 1373

In uno cartekypo 2d.

CARTESCRILES.

O.D.D. scrile ; brushwood

Wellingborough, Hants 1323

In ij paribus cartescriles 2d.

CLEPELES

O.D.D. ; iron hook

Cuddington 1299⁸³

In ij cleppeles ad carect 3d.

"

In 11j cleppeles ad biga 4d.

CLUSPES

Worcester Priory 1346

In cluspes 9d.

LACLOTTES

Hinton Ampner 1423⁸⁴

Lacloottes empt pro vet.carect

RERECORD

Worcester Priory 1313⁸⁵

In uno rerecord ad longam caretam 12d

79. Salzman (1955)

80. Drew

81. Drew

82. Page (1934)

83. Drew

84. Drew / (1934)

85. Page, Hamilton (1910)

There are certain points which may now be made. Firstly carts and wagons could be bought in two ways, complete or in pieces to be put together on the manor.⁸⁶ Wheels of course were commonly bought separately, except in the case of a brand new cart. Chassis bought separately cost around sixpence in the 1270s, rose to around eight pence by the beginning of the fifteenth century but could cost as much as three shillings. Carts purchased as complete were bought in two ways, bound or unbound. Unlike the prehistoric vehicle, the medieval cart had a great deal of ironwork not just straked wheels. The cart could be bought complete or the ironwork purchased separately. A shod cart cost anything up to thirty shillings but not less than about eight. They are by far the most common of the two kinds. In a list of carts purveyed for Edward's campaign (from Northamptonshire), only one of thirty five was unshod.⁸⁷ On the Merton College manors in Suffolk, to choose an example at random, the ratio of shod to unshod carts is seven to two in 1277.⁸⁸ A cart, furthermore, could be made from timber from the manor - the lord's timber - and from old iron from the manor which was actually preferred because it was stronger. Secondly, there is no evidence from prices that the carecta longa, the plaustrum longum or for that matter the plaustrum itself had four or two wheels. It is likely, however, from the Moundsmere entry for 1287, that the carrum had four wheels. Thirdly, there is evidence for a complete overhauling of vehicles on the manor before harvest time contra autumpno.

The main conclusion to arise from a glance at group two is that the medieval cart was a very patched up affair. The greatest expenditure is that on iron patches and nails.

86. Thorold Rogers IV p 417-419.

87. PRO E 101 98/39

88. Highfield (1963) p 90 ff.

The clout is more usually used for the wheels but it can mean any kind of wooden or iron plate used for mending. The exact meaning of courba remains unknown. Drew suggested that it was perhaps a wagon bed. However, this is unlikely since it occurs exclusively with harness and in particular with yokes and ox bows. Finally in group two, although shafts and draught poles would seem more closely allied to the harness, they are nonetheless an integral part of the vehicle construction, giving it as distinctive a form as the shape of the body itself. Shafts were certainly detachable. Thomas Parker of Starston in Norfolk in 1312 was sent to prison when he committed fratricide, by hitting his brother with a cart shaft. His claim of self defence was unsuccessful.⁸⁹ Shafts were, like the prehistoric draught poles tipped with iron.⁹⁰ A piece of iron went around the shafts of the cart and around a projecting piece of cart body to prevent tipping. This is the snubbers.⁹¹

It might be interesting at this point to consider prices given in compensation by the lawcourts for cases involving death by cart or wagon. It must be remembered, however, that these are legal values which it is possible to maintain, bear little relation to actual prices.

In 1249 the Berkshire Eyre awarded up to 4/6d. in a case of death. In 1249, the Wiltshire Eyre awarded over 30/-d. for plaustra with three oxen or more, 5 to 14/-d. for carts with two horses and no more than 3/-d. for carts alone.⁹² The Shropshire Eyre in 1256 awarded as deodans 10/-d. and 27/6d. for carri cum bobus 14/-d. for a carecte cum duobus equis and 5/-d. as the precium carecte.⁹³

89. B.Hanawalt, Crime in East Anglia in the Fourteenth Century, Norfolk Record Society XLIV; the Norfolk Gaol Delivery Rolls 1307-16 (1976)

90. Sir Cyril Fox (1931) pp 185-199

91. O.D.D.

92. C.A.F.Meekings (1961)

93. Bodleian NS B.Litt.d.617-8

The Eyre of Kent in 1313 awarded as much as 33/4d.⁹⁴ while the Durham Register in 1363 records Ii caract.ferro ligato precio 26/8d. Ii plaustra debilia precio 6/8d. and IIIi or equis trahentibus 2/11d.⁹⁵ Clearly it was not only dangerous to be a pedestrian or a reckless driver, it was expensive to own a cart if found at law.

Apart from major expenses, the cart owner often had several petty expenses. Cleaning the ditches and making roadside hedges, for example, cost the Earl of Lincoln at least £17 in every year, and this was only for his northern estate.⁹⁶ Tolls had to be paid to drive in the meadows, to enter woods and to cross stubble fields.⁹⁷ Finally a small but essential item was lubrication. Leighton maintains that 'the Romans were probably more familiar with lubrication than the early medieval peoples'. Here he is thinking of Pliny's reference to pigfat which was used as axlegrease and a disputed mosaic from Lyons where a figure is seen about to throw water on the circus track. Clearly what the figure is doing has little to do with lubrication and a great deal to do with laying the dust between races. The emphasis which has recently been placed on the account of the Prussian king's journey where peasants lined the route with buckets of water to cool the wheels is almost certainly misdirected at least as far as can be shown by the English records.⁹⁸ Oil, and grease, unct and sapo are found in almost every manorial account. Though amounts were never specified, 1½d. to 13/6d. was spent in the thirteenth century on keeping the axles well oiled. In Sussex in 1282 grease was 3d. a pound but this kind of information is unusual. The source of the lubricants are unknown, but on the Merton College estates in the 1290's they were just as well acquainted with pigfat as Pliny had been.¹⁰⁰

94. Selden Society XXIV (1909)

95. Bodleian MS B.Litt.d.50

96. Lyons (1934)

97. Bodleian MS Top Oxon c207, Farr (1959)

98. Leighton (1974) p 123, Gromodka und Muller (1934) p 73.

99. Salzman (1955)

100. Highfield (1963) Pliny N.H. XXVIII, XXXVII, 141.

Since the purchase of some form of lubrication is a major part of any account, it is not possible to accept Leighton's premise that the oiling of vehicle components was unusual in the Middle Ages.

Though these costs might seem adequate in themselves, the greatest of the expenses was the wage bill. The King's household was of course extremely large but in it the carters enjoyed a position of comfortable mediocrity above the general servants and beneath the upper levels of household society, the milites, clerici, servientes hospicii regis and the scutiferi regis. The carters were all directly responsible to a gardein des charettes named in 1279 as John de Gillingham. They were entitled to their wages of about 3/-d. per year, a yearly clothing allowance of a tunic and supertunic (distinctions in rank being shown not by the quantity but quality of the garments) and 2 pairs of shoes.¹⁰¹ This clothing was not livery. The experiment of Henry III in this direction does not seem to have been repeated.¹⁰² The king also was obliged to give the carters small grants for retirement, sickness and burial. In return they were expected to mend the carts, do extra stable work and as far as the manorial carters were concerned, to work in the fields.¹⁰³ Carters' wages differed little from the king's household to the manors. They were among the most numerous regular servants, or famuli, on the estates. Grain allowances were more common than gifts of clothes and shoes. The basic difference was that carting services, remnants of the pre-Conquest labour services, were hardly ever commuted and that complicated though the study of customary labour is, tenants preferred to continue to perform carrying services and harvest work.

101. PRO E 351/17, E 381/11, M. Hill The King's Messengers (London 1960)

102. H. Johnson, 'A Year in the Life of Henry III' Church Quarterly Review XCV no. CXIV p 323

103. Edinburgh University Library MS Phot. 1225, the Lathes Journal of John de Boys serviens ad carucas ae caretas, (Norwich 1428).

Thus the manorial accounts demonstrate the kinds of vehicles in regular use in medieval England, how they were bought, their component parts, or at least as many as can be identified, and the kinds of expenses the medieval consumer might be expected to meet. He would also have to buy harness, wheels and draught animals. He would have to pay for the repair of the carts and the care of the horses or oxen. Owning a vehicle in the thirteenth century therefore, would appear to be an expensive business. However, it should not be exaggerated. Vehicles were owned in large numbers by medieval landowners. Moreover, when the tenants performed their carting services they provided their own vehicles. Old notions of the absence of land transport in the Middle Ages are really no longer viable when all the evidence has been considered.

SECTION 2 : B : WHEELWRIGHTING TECHNIQUES.

The strength of the wheel is the single most important element in any vehicle. All innovations are, therefore, introduced to make it stronger, lighter and swifter. Section C will try to outline improvements in wheelweighting techniques by discussing the three basic wheel types - block, crossbar and spoked - in terms of their chronology, constructional differences and relationship to one another, to function and to axle type. It will also examine the constituent parts of a wheel, in particular the hub, spokes, felloes and tyres, to try to reach some conclusion as to their development and costs in the medieval period.

CHAPTER ONE: BLOCK WHEELS

A block, disc or solid wheel, unlike its hypothetical ancestor, the roller, was constructed not of a circular section of trunk lopped off a tree of the requisite size, but constructed of one or three planks, cut longitudinally to take advantage of the strength of the grain. In the case of the tripartite disc, these were held together by external visible bars, internal dowels or inserted sleeves.¹ A pair of openings is a standard feature on the surviving wheels from western Europe, though their function is unknown. Lucas' suggestion that the holes allowed the passage of a locking pole is, at the moment, the most attractive hypothesis.

Wheels, actual survivals and models, are the most frequently available evidence for ancient vehicles. Representations of block wheels exist in the Near East by the fourth millenium B.C.. At a nominal date of 2,650-2,600 B.C., there are vehicle burials in which both wagons and carts with

1. V.G.Childe, (1951) pp 136-7 A.T. Lucas 'A Block Wheel Car from Co. Tipperary, JRSAL LXXXI pp 135-44, 'A Block Wheel Car from Slievenamon, Co. Tipperary' JRSAL LXXXIII p 100, S. Piggott 'A Tripartite Disk Wheel from Blair Drummond, Perthshire' P.S.A.S. XC p 238-41 M.A. Littauer and J. Crowel 'The Origin and diffusion of the crossbar wheel' Antiquity LI (1977) pp 95-105.

tripartite disc wheels are present. In the 2nd millenium B.C. in Transcaucasia, Georgia, and the Kalmyk steppe, tripartite disc wheeled vehicles were buried,² while block wheels dating from the second millenium to as late as the first century B.C. from Europe have been found.³ Block wheels, furthermore, were in use last century in Anatolia, South Russia, China, India, Ireland, Sardinia, Scotland, Sweden, Spain, Portugal, Thessaly and Wales.⁴

'The disc wheel undoubtedly shared the fate of so many culture elements by being displaced at a comparatively late date by innovations from the south. In this case it was the spoked wheel'.⁵ This was Gosta Berg's answer to the problem of why the block wheel fell out of use. However, it has long been known that the disc wheel survived until recent times in a few areas. The problem thus became the disappearance of block wheels from the Roman period to the seventeenth century. The answer is, of course, that the hiatus does not exist. Documentary evidence which implies and representational evidence which confirms, block wheels in the medieval period may be put forward suggesting continuity from prehistoric times.

Primitive vehicles with block wheels have the wheels fixed on a revolving axle. A wheel revolving with the axle and not on the axle is usually wedged into place and mortised. On an independently revolving wheel, the introduction of a nave to keep it in place, reduced the friction and noise that went with the revolving axle. This is primarily

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2. V.G. Childe (1951) pp 186-7 S. Piggott (1963) pp 263-70
 3. H. Motefindt, 'Die Entstehung des Wagens und des Wagenrades' Mannus X pp 1-63, J.D. Van der Waals 'Neolithic Disk Wheels in the Netherlands' Palaeohistoria X pp 103-46 (1964) Bona (1960) pp 83-11.
 4. Suffern and Hemp Primitive Carts Antiquity 111 (1929) pp 340ff, Littauer and Crowel (1977) pp 95-105.
 5. Berg (1935) p 115.

the case because the nave being relatively closed can be oiled.⁶
A few passages from Roman literary sources, therefore indicate disc wheeled vehicles. Both Ovid and Vergil talk of stridentia plaustra and Varro says 'Quos ad vecturas item instituendam ut inania primum ducant plaustra et si possis per^{aut} vicum oppidum crebar crepitus ac varietas rerum consuetudine celerrima ad utilitatem adducit'. Vergil furthermore uses the word tympanum to describe wheels -

'Navigiis pinos, domibus cedrumque cupressosque
Hinc radios trivere rotis, hinc tympana plaustris'

- which would imply solid discs. Moreover Pliny says that one of the few things which terrifies a lion is the noise of wheels turning, even on an empty chariot - 'rotarum orbes circumacti currusque ... magis terrent' .⁷

Representational evidence confirms the use of block wheels in Roman times. A sarcophagus from Rome shows a wine cart drawn by a bullock. This vehicle along with carts from the arch of Septimius Severus and Aurelius' column, and theca. 79 A.D. representation of the farm vehicle from Pompeii, continues to show disc wheels made of nailed planks (five on one wheel, six on the other).⁸ It might be useful to note that in all cases where block wheeled carts are represented they are drawn by oxen. This is indicative of the level of sophistication of solid wheeled vehicles.

It is generally believed that there are no representations of solid wheels in the medieval period.

6. Littauer and Crowel (1977) pp 95-105

7. Ovid Tristia III : X, Vergil Georgics II : 443-444, Varro, Rerum Rusticarum I : XX Vergil ibid II : 443-6, Pliny, H.N. VIII : XLX

8. Solomon Reinach, (1909) III p.293 ibid p.263, Vigneron (1968) II pl 57a and 57b, Singer et al II fig.583

This is no longer acceptable. The fifteenth century Hours of King Manuel of Portugal shows disc wheel hay carts still at work.⁹ The Dutch Hours of Catherine of Cleves, c1440 [59] illustrates a baby carriage with solid wheels.¹⁰ British Library Add.24945, fol. 192, a fifteenth century Italian manuscript shows a block wheeled engine [60]. Bodleian manuscript Bodley 264, fol.82r (Flemish, fourteenth century) has a marginal joisting horse on disc wheels, while British Library Egerton 1894, fol. 2v, a fourteenth century French manuscript shows a shepherd's hut on wheels, the wheels being solid.[61] Moreover the earliest known medieval representation of solid wheels yet encountered is folio 17v of Bodleian Bodley 614, an early twelfth century illuminated manuscript. Thus illuminated manuscripts clearly show the survival of solid wheels for a variety of purposes throughout the medieval period and in a number of countries in western Europe.

With the exception of the wagon from Oseberg in Vestfold,¹¹ there is no excavated evidence of wheels which can definitely be assigned to the medieval period. The information from the illuminated manuscripts can be supplemented by a number of references in manorial accounts which imply block wheels. Among the costs of bound and unbound or nude wheels, are found several pairs of what the documents call plain or simple wheels, which are a good deal cheaper than the others. The Alton Barnes bailiff in 1402 bought a pair of these rota planat for a dung cart for 8/-d. He bought another pair in 1403, 1412, 1413 for up to 7/1d. He also bought a pair at Takely for 6/-d.¹² These are fairly expensive - normally a pair of wheels

9. Ferdinand Galhano, O Carro de Bois em Portugal, Lisbon 1973, pls. 120, 121. I should like to thank Professor Piggott for access to this publication. I believe it is not generally available in this country.

10. The Hours of Catherine of Cleves. Facsimile ed. J. Plummer (USA 1966) pl. 92 I am grateful to Mrs. P. Campbell, Dept. of Fine Art, Edinburgh, for bringing this miniature to my attention.

11. Foote and Wilson (1970) pp 258-262

12. Thorold Rogers 1 pp 417-421

would cost from 3/-d. to 13/-d. However, rot. plan. recorded in the 1392 Ropley account (Hampshire) and in the 1404 account were bought for 3/4d. per pair. Simple wheels are also very inexpensive. The 1294 account for Milton, Essex, says 'In l nova carecta empta cum l pari rotarum simplicium 4/2' while the account for Clifton, Kent in 1295 records 'In l pari rotarum simplicium empto ad carect. 16d.'¹³ There are furthermore, numerous entries of wheels which are simply called rota but are noticeably less expensive. Drew noted that wheel prices occurring in the early Winchester Rolls included many at 2½d to 5d. Thus the materials and the labour costs were never more than a carpenter's wages for one day. It seems incredible that any wheelwright could, in this short time, cut out the curved felloes with the necessary precision, cleave the spokes, chip out the hubs, mortise the spokes into the hub and felloes and fit these various pieces together. However, this would be more in keeping with the construction of a simple disc. Finally, though rare, there are references to creaking wheels in medieval records.¹⁴ Thus it is no longer possible to deny the existence of solid wheels in the middle ages.

Finally, before leaving the most primitive wheel form, it might be useful to discuss axle type. To quote Mrs. Littauer 'it may be taken as axiomatic that a round axle end indicates a wheel revolving on the axle and a rectangular axle end, a wheel that revolves with the axle.'¹⁵ The former gives better speed and more efficient turning because it reduces the skid on the outside wheels. It needs, furthermore, a nave or hub, the central block of the wheel, (cylindrical and chipped out or turned from seasoned elm), which revolves on the axle arm and into which spokes are set. A further piece.

13. Drew

14. The Wardrobe Accounts of Henry, Earl of Derby 1390-93 - 180/16, 189/30.

15. Littauer and Crowel (1977) p 97.

is cut from the elm nave to insert the linch pin. Thus an axle tenoned to the wheels is more primitive and would logically precede a fixed axle in a typological series. The first point to be made about axles, therefore, is that while this order is adhered to in the Near East and Europe,¹⁶ in Ireland the order appears to be reversed. Lucas'¹⁷ study has shown that the fixed axle is characteristic of the prehistoric period and a revolving one in use in recent centuries. However, it is possible that both types existed simultaneously, and although there is little evidence, it is not implausible that the revolving axle was in continuous use in Ireland from earliest times. The second point is that it has been stated categorically that the presence of linch pins presupposes a fixed axle. While this is clearly the case on ancient illustrations, it may be useful to point out that ox carts still in use in Iran and Turkey today have revolving axles and linch pins.

Axles change little from the Iron Age in both gauge and construction.¹⁸ As far as medieval wheels are concerned, it is price with which we must be concerned. In the manorial documents, bearing in mind that this is a random selection, they are represented thus;

AXIS.

RMLML ; an axle 1231

Croyland 1276¹⁹

Pro axatione caretarum de Morburn
et longe carette et ferura quorundam
equorum 6d.

Worcester 1276²⁰

In longa careta axanda per v vices
cum quinque axis ad idem emptis 2/2d.

16. ibid

17. Lucas JRSAL LXXXI111

18. S.Piggott, Ancient Europe (Edinburgh 1965) 'A Wheel of Iron Age Type from Co.Durham' P.S.A.S. (1949) p.191

19. Page (1934)

20. Hamilton (1910)

Milton, Essex 1280	In 11j axis 4 $\frac{1}{2}$ d
" " 1283	In 111j axis emptis et imponendis 10d.
Cliffe, Kent 1294	In axibus ad carectas emptis 9d.
Milton, Essex 1316	In 111j axis emptis 6d. In eisdem imponendis 4d.
Hokyton, Cambs. 1320 ²¹	In 11j axibus emptis 6d. In axatione caretarum 6d.
Wellingborough, Northants 1322	In 11j carectis axandis 6d.
Worcester 1423 ²²	In axellis longe carecte ididem ad iij vices 2/-d.
Monkton, Kent 1299 ²³	In rotis boxandis 6d.

AXLE CLOUTS

RMLWL ; iron plate to protect the axle

Worcester Priory 1291 ²⁴	Pro axibus clutis clavis et hernesio emptis ad caretarium busce 29/10d.
Westerham, Kent 1324	In 1j paribus rotarum 5d. In clutis emptis ad easdem.
Aldenham, Herts. 1376	In 3 clutis ferreis emptis pro axibus dictarum rotarum 3d.

CIRCULUS

RMLWL ; 1324 hoop, for cartwheel

Radstowe, Northants 1264	In 1j circulis ad modiola emend ad carectas non ferratas emt. 2d.
" " 1265 ²⁵	In circulis ferreis circa modiola supponandis, 2 $\frac{1}{2}$ d.

FRETTA

RMLWL ; fret, hoop fitted to the hub of a wheel c 1302

Cokhan, Berks 1287 ²⁶	In caret. frettis emend 11/-d.
Hampstead 1274 ²⁷	j carta axand et frettand 6d.
Cliffe, Kent 1295	In frettyng rotarum 4d.
Monkton, Kent 1298	In XVj frett 8d.
Moundsmere, Hants 1298 ²⁸	In 111j frettis ad carect 1d.

21. Drew

22. Hamilton (1910)

23. Drew

24. James M. Wilson and Cosmo Gordon, Early computus Rolls of the Priory of Worcester, Worcester Historical Society (Oxford 1908)

25. Drew

26. PRO SC6 747/15

27. PRO SC6 743/17

28. Drew

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Vernham Dean, Hants 1361 Ij frettes 3d.
 Wellingborough, Northants
 1361 j pari frettes 2d.
 Oakington, Cambs. 1361 ³⁰ in frettes emptis 3d.

HURTER

RMLWL ; hurtardus, iron plate to protect the axle, 1222.
 Durham Abbey 1330 ³¹ XVj carteclouts, Ij lypennis
 Ij haxanailles, Ij hurtour 23d.

LINCA

RMLWL ; linchpin 1296
 Pershore, Wilts. 1345 ³² In Ij par lynces empt.4d.
 Ropley, Hants 1382 In Ij hurter et lincez ferr ad carect 10d

MODIUS

RMLWL ; hub 1267
 Hubs are never bought separately. Entries relate to hoops or
 bands bound round the hubs to prevent them from splitting.

NAVIS.

RMLWL : -
 Pershore, Wilts. 1306 Ij naves apponend de novo in Ij rotis 8d

STRACUS.

RMLWL ; iron plate on the outer rim of a wheel 1267
 Bernehome, Sussex 1282 In strak.imponend et reparend 15d.
 Hokyton, Cambs. 1320 In LX straknail 15d.
 Mordon, Oxon 1332 ³³ In L straknal p.vet. cart.firmand ep.12d.

29. Drew
 30. Page (1934)
 31. Surtees Society (1898).
 32. Drew
 33. Page (1934)

Thus medieval wheels were heavily protected. Axle boxes were fitted for about 6d., costing about $1\frac{1}{2}$ to 2d. throughout the period. They were protected from wear by clouts (1d.) and hurters (3d.). They were also protected on the outer rim by iron plates. Hubs are never found separately but there is one instance of a nave - if indeed this is how the word may be interpreted since it does not appear in the RMLWL as such. Hubs were bound by hoops, circulis ($2\frac{1}{2}$ d.) and fretts ($\frac{1}{2}$ d to 4d.) to prevent splitting under the pressures of wheel movement. By the 1380s lynch pins were made of iron. Thus medieval wheels would be a considerable weight, would have a large number of iron fittings and with the tire added, would plainly constitute an extremely expensive item.

CHAPTER TWO : CROSSBAR WHEELS.

A crossbar wheel is constructed of a thick stave which holds the nave and crosses the diameter of the wheel and bars on either side, crossing the central piece at right angles and mortised into the felloes. Normally two sets of crossbars are present to prevent wheel collapse. It has been described as a pans pipe - the syrinx of ancient Greek chariotry. Its weak point is that when it is submitted to irregular pressure it tends to come apart in all directions whereas a spoked wheel will come off entire. Its greatest strength is that it is relatively simple to make.

Because of the way it breaks up, there are no material survivors of these wheels except for one example from Mercurago in Italy,¹ which has been considered to be an intermediate form between the disc wheel and the fully developed crossbar. Miss Lorimer was the first to isolate the crossbar as a distinct type, to derive it from Mercurago and to show it in common use in fourth century Greece.² Though Childe rejected her thesis,³ Mrs. Littauer's recent paper has made it possible to 'reinstate Miss Lorimer's technological, if not her geographical conclusions and at the same time accord the crossbar wheel a more venerable position in the history of draught than before'. She traces all surviving representations of the crossbar in the Near East and southern Europe from the second millenium to the third century B.C.⁴ The crossbar wheel then appears to vanish from representational art. Recent survivals in Portugal,⁵ Spain⁶ and England⁷ indicate that there

1. S.Piggott (1963) pp 268-270, pp 302-308

2. H.Lorimer (1903) pp 135-44

3. V.G.Childe (1951) p.187-193

4. Littauer and Crouwel (1977) pp 95-105

5. Galhano (1973)

6. Richard W. Bulliett, (1975) p 193

7. W.H.Pyne, Microcosm (London 1806) I am grateful to Professor Piggott for access to this work.

may be continuity. As Mrs. Littauer has pointed out 'The humble vehicle to which the cross bar wheel must have been relegated as the spoked wheel was taken over by the finer and faster ones was not of interest to Near Eastern art'.⁸ The same may be said for other periods. However, there is a medieval representation from the Hours of Manuel of Portugal which shows crossbars in use on farm carts.

Furthermore Mrs. Littauer suggests that the crossbar was introduced to Mexico from Spain during the Conquest since there is no earlier evidence of wheels on the American continent. She further suggests that since there is no further documentation of it from northern Europe (after the Bronze Age) and since, when it is found in Britain, it is only in the late eighteenth century, it may have been brought back by soldiers returning from the Peninsular War.⁹ This is a very interesting idea, the more so since the Duke of Wellington is reputed to have complained about the noise of the Spanish bullock carts which were so bad that the 'scratching of a knife on a pewter plate is like the sweet sound of a flute beside them'.¹⁰ However, this could easily apply just as well to a block wheeled cart. Moreover it is at least remotely possible that manorial records in England indicate the survival of crossbar wheels in the medieval period. These may be the rot. scapuland. which appear in the rolls of manors in Kent, Essex and Hampshire. They appear thus ;

8. Littauer and Crowel (1977) p 101

9. ibid p 103

10. Grace Stretton 'Some Aspects of Medieval Travel' TRHS VIII (1924) pp 77-98, 'The Travelling Household in the Middle Ages' Journal of the British Archaeological Association XL (1935) pp 75-103, p 88 ff.

ROTA SCAPULAND

RMLWL ; - scapello to scapple or dress timber or stone.

Moundsmere, Hants 1297¹¹

In j par de bridde et j par grossarum rotarum scapuland 6d. In spokis pro eisden 3/3d.

" " 1298

In j par de bridde et j par grossarum rotarum scapuland cum spokis ad eandem de merem domini scapuland et fac 22d.

Therefore, rot.scapuland. have spokes but are larger and cheaper than normal spoked wheels. There is no positive evidence, but it is interesting to speculate that these are crossbar wheels.

In conclusion, while there exists enough evidence to suggest the origin and diffusion of the crossbar wheel in prehistory, there is at the moment, no source which can be used to trace its subsequent history. However, it would be fair to say that recent examples and the one representation of crossbars which we have¹² (though it is of course dangerous to base a case on one piece of evidence) indicates that it survived throughout the medieval period in western Europe and into last century without interruption.

11. Drew

12. Galhano (1973) pl 120, pl.121.

CHAPTER THREE : SPOKED WHEELS

A spoked wheel is constructed by fitting radials into the nave and felloes. First the circumference of the nave is marked into equal parts, depending on the number of spokes. The mortises are wedge shaped, the sides being radial to the axis of the hub, of equal size and set alternately slightly to the front and back. The spokes themselves are driven into these mortises, their outer ends shouldered and fitted into the felloes. The advantage of the spoked wheel is that it is strong and light. ¹

The spoked wheel appeared first on light, swift chariots on the Near East, in the second millennium. The war chariot was used in Egypt and Mycenae by about the sixteenth century B.C. However, it is also known in Europe, in South Russia, in the second millennium B.C., the Danube Basin by 1,000 B.C. and northern Europe by the ninth century B.C. ² There is little point in listing examples of large numbers of representations and actual finds of spoked wheels which are catalogued elsewhere in books which are readily available. ³ However, several points might usefully be made. Firstly, the idea of a Kassite origin for spoked wheels has not yet been superseded. ⁴ Secondly the number of spokes vary in ancient wheels from thirty four at Pazyryk in Siberia to the four spokes of Mycenaean Crete, but number is not indicative of technical competence. The six spoked wheel appeared as early as the four and this latter continued until at least as late as the ninth century A.D. ⁵ Thirdly, apart from variation in the number of spokes, there are only two major changes in spoked wheeled vehicles, which may be seen as technological

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1. George Sturt (1923) Thomas Hennell The Countryman at Work (London 1947)
 2. Childe (1951) pp 187-193
 3. See Piggott (1965) bibliography
 4. *ibid.* p 92
 5. Singer et al 11 fig. 507

developments namely the introduction of a single piece felloe and of fitting an iron tire hot. These innovations will be discussed later. It is enough to say here that both these improvements did not survive into the middle ages and that the medieval spoked wheel differed little from its prehistoric predecessors.

Little can be said therefore of the spoked wheel in the middle ages except that it was tired with strakes, that a six or eight spoked wheel is the most constant feature of every vehicle representation from the eleventh century onwards and that, while Chaucer tells us that 'Twelf spokes hath a cartwheel comunly', which suggests that the modern system of having two spokes per felloe was coming into use, miniatures from western Europe continue to show vehicles with one spoke per felloe. It might be noted in passing that the Oseberg vehicle was reconstructed with twelve spokes and a six piece felloe.⁶ Such reconstructions have always looked to modern carriages and the validity of these results must be in doubt.

Finally, the prices of medieval wheels, the ways in which they could be bought and variations in those with tires and those without, will be dealt with at the end of the discussion of felloes and tires.

6. Foote and Wilson (1970) p 258

CHAPTER FOUR : FELLOES

The felloes are the pieces of bent wood which go to make up the rim of a wheel. The manufacture of felloes in the past is very hard to discuss, because survival, except under certain ideal conditions, is very rare. Made entirely of wood and unbound, felloes rarely survive and are seldom clearly depicted on representations. They are, however, crucial to the running of the wheels and their stability.

Kossack in 1971 discussed the surviving felloes from the prehistoric period, and argued, using technical details, for an origin in the Near East.¹ More important, however, he discussed the introduction of a wheel with a single piece bent felloe and a nail-less tire in the La Tène period (7th century) in central and northern Europe. Here the felloe was bent by steaming, by moist heat of some kind or by the mechanical means on unseasoned wood, that is green wood. What is important here is that the normal multi-piece felloe continues to exist alongside the technically more sophisticated single piece felloe and in fact supersedes it. There is no evidence, documentary or representational, for the survival of the single piece felloe in the middle ages, and it was never re-introduced.

1. G. Kossack, 'The Construction of the Felloe in Iron Age Spoked Wheels', Brown, Boardman and Paul (ed.) The European Community in later Pre-history Studies in Honour of C.F.C. Hawkes (London 1971) pp 143-163

CHAPTER FIVE : TIRES.

W.G. Hoskins, ¹ writing for the Countryman in 1950 claimed that the practice of putting tires on wheels did not originate until the thirteenth century. However, the idea of covering the running surface of the wheel is known possibly from the third millenium B.C.in the Near East and the idea of nail-studded tires is clearly common by the eighth century B.C. Wheels from early Iron Age contexts in central Europe show that the nails securing the tires though countersunk into them, still constituted the actual running surface. ²

The major technological achievement in tiring was the introduction of a nail-less iron hoop tire, fitted hot which, when it contracted would lock tightly all the wooden parts of the wheel, giving it greater strength. This type of tire is found from the fifth century B.C. in northern and central Europe. ³ However, nailed-on tires do survive into the medieval period while hoop tires had to be re-invented in the modern period.

Evidence of wheel type, construction and costs appear frequently in the account rolls of the thirteenth and fourteenth century England. They are grouped with the expenditure on carts and wagons and with harness form a very major part of it. Such evidence appears thus;

BRYDDES.

RMLWL:-

Moundsmere, Hants 1297 ⁴

In j par de bridde et j par grossarum rotarum cum spokis ad eandem de merem domini 22d.

" " 1298

In j par de bridd et j par grossarum rotarum cum spokis pro eisdem 2d.

1. W.G.Hoskins Carts and Wagons, The Countryman XL1 (1950)p 339

2. Curtis, (1975)

3. Kossack (1971)I.M.Stead La Tène Burials of Eastern Yorkshire(Yark 1965) S. Piggott (1965)

4. Drew

Moundsmere, Hants 1300

In j par de bridd et j par
gross.rot. de merem domini fac.
2/-d.

Hannington 1330

In j pari de brydd empto 3/1d.

Wooton 1332

In j pari de brydd empto 4/-d.

Silkstead 1332

In j pari rotarum de brydd 3/4d.

Hannington 1368

In j pari de briddes empto ad
ligandum 8/-d.

Horn church, Wilts 1404 ⁵

In j pari de bryddes empto 10/10d.

" " 1406

In j pari de bryddes empto 7/-d.

Alton Barnes, Wilts. 1409

In j pari de briddes 8/-d.

Hornchurch 1409

In j pari bryddes 7/-d.

Start, Wilts. 1410 ⁶

In j pari de bryddes 8/6d.

CANTUS

RML.WL:- Canthus (cantus) rim of wheel, felloe c 1200

Houghton 1282

In Ij cantis et Ij radiis in
vetere rota imponendis lld.

Wooton 1329 ⁷

In Ij quarton cantuum pro dictis
rotis emptis 10d.

Beaurepaire, Durham 1360 ⁸

In colpacione XXVI pass.cantorum,
XXXV pass. radiatorum ad rotas
plaustrorum et carectarum
colpacione IX^{XX} (9 score) iugum
et axium XL gangis ploustiltis,
IX moldbredclutis 2/8d. In
tribus pass. cantorum, IIj pass.
radiatorum otto axibus XIj.iugis
XXV arcibus colpandis et missis
apud Beaurep. 19d.

5. Thorold Rogers IV p 417

6. ibid pp 417-425

7. Drew

8. Bodleian MS. B.Litt. d.50

DOUELLA

- RMLWL ; stave, dowel connecting the felloes of wheel 1300.
Holcombe Regis 1369⁹ In XXXIV doull,empt 16d.
" " 1371 In rep.rot.plaustr. viz le strakes
et doules 6d.
Heckley, Hants 1295¹⁰ In ferr.empt p.doules fac.ad
ferramentu. altius plaustr.
renovend.et reparend 11d.

FELLEA/VELGA

- RMLWL ; felloe (of a wheel)1281.
Harrington,Southampton 1299¹¹ In Vj circulis ferr.p.11j felyes
rot. fratt.cumlig 6d. In velyes
inde scapuland 19d.
Persnore, Worcs. 1310¹² In Ij velg et 111j spok.appon.
super vet. carect 9d.
Pyrford, Worcs. 1370 In j par rotarum novarum fac
cum feleghes remanent in manerio
anno preced.,una cum axacione.
Persnore, Worcs. 1370 In 1j velyes apponend super
carect 4d.
Pittington, Durham 1327¹³ In duobustrotis carrum emendandis
cum Ij felies 3d.

GROPA

- RMLWL ; iron clamps for mending a wheel 1273
Drew ; felloe clamps.
Persnore, Worcs. 1350¹⁴ In X1j groppis cum groppnail ad
idem empt. 2/4d.
Milton, Essex 1274 In ferro ad gripp, faciend 6d.

9. Drew

10. Bodleian MS. DD Queens College, Box XL1, Roll 181

11. Bodleian MS DD Queens College Box XL111, Roll 267

12. Drew

13. Bodleian MS. B. Litt d 50

14. Drew

LIGATURA

RMLWL ; binding, bond 720, 1202.

Heckley, Hants 1299¹⁵

In ligatur, eazdem (carta) cu.
ppo.vet.ferr.groppis, clav.et
elongand str.13d.

Moundsmere 1324¹⁶

In stip.fabri pro j vet.rot.
cum vet. ligatura ligand et
etiam pro VIIj. minute bend
ferr.fac.ad ligand predictas
rotas subter veter strakis in
locis ubi necesse fuerit 5d.

Ferramentum is also found alone obviously related to ligatura.

Chartham, Kent 1270

In ferr.empt ad idem (carect)10/1d.

" " 1295

In j novo ferro empto ad idem 7 $\frac{1}{4}$ d.

Monkton, Kent 1298

In j novo ferramento cum clavis
et gripes 7/-d.

" " 1299

In j ferramento ad idem cum omni
attilo 7/-d. In positione eiusdem
ferramenti 6d.

Silkstead, 1369¹⁷

In j pari rotarum empto ad
ligandum cum una nova ligatura
gropp.grossis clavis et toto
alio apparatu empt.40/-d.

RADIUS.

RMLWL ; furrow, ray 1240

Drew ; a spoke

Chilbolton 1346

In j pari rotarum in radiis impon-
endis

Houghton 1232

In lj cantus et lj radiis in
vetere rota imponendis 11d.

ROTA.

RMLWL ; a wheel c1297 Primarily an unbound wheel

A.

Chartham, Kent 1270

In lj paribus rotarum ad curtenam
2/11d.

Milton, Essex 1278

In lj paribus rotarum ad c arectis
3/6d.

15. Bodleian MS.DD Queens college, Box XL1, Roll 183

16. Drew

17. Drew

Milton, Essex 1280	In j nova carecta cum rotis empta 3/6d.
" " 1294	In j pari rotarum empto ad ferrandum 3/-d.
Monkton, Kent 1299	In j pari rotarum ad ferrandum 2/2d.
Morden, Surrey 1332 ¹⁸	J pr.rot.cart.ad ferrand. 3d.
<u>B.</u>	
Sutton, Sussex 1352	In j pari rotarum ad merem domini fac. 20d.
Petworth, Sussex 1352 ¹⁹	In j pari rotarum ad merem domini pro plaustr.fac. 18d.
Vernham Deans, Hants. 1361 ²⁰	In j pari rotarum feliant ad merem domini 18d.

ROTA FERRATA

RMLWL ; an iron bound wheel c1230.

A.

Chartham, Kent 1270	In j pari rotarum ferr.ad carect. 2/10d.
Milton, Essex 1274	In j pare rotarum novarum empto ad carectam 14/-d.
Worcester Priory 1293 ²¹	Pro j rotis caretarum emptis 2/6d. Pro ferro et clavis et ligaturis cum stipendio fabri ad easdem rotis ligandas 20/-d.
Monkton, Kent 1298 ²²	In lj paribus rotarum ad ferrandum 5/-d.
Wolverhampton c1280 ²³	Et in uno pari rotarum empto ad caretum 2/1d. Et in ligatura cum ferro empto ad idem 18/-d.
Oakington, Cambs. 1314	In custibus caretam cum j pari rotarum 18/5d.
Hokyton, Cambs. 1320 ²⁴	In j peei ferri ad feretandum rotarum cum opere 7d.
Stert, 1412 ²⁵	Ij par rotarum ligand 60/-d.

18. Bodleian MS Top Surrey d.4

19. Salzman (1955)

20. Drew

21. Hamilton (1910)

22. Drew

23. Legal and Manorial Formularies p 32

24. Page (1934)

25. Thorold Rogers IV pp 417-421

B.
Milton, Essex 1274 ²⁶
In j pari rotarum in eodem
ferrando de vetereri ferro
domini 8d.
Cokham, Berks 1279 ²⁷
" " 2/3d.

ROTA GROSS.

Moundsmere, Hants. 1300
In j par. bridd et i par gross. rot.
de merem domini fac 2/-d.
" " 1303 ²⁸
In Ij veter. par grossarum rotarum
velgand de merem rotar. 13d.

ROTA NUDA

RMLWL ; untired wheel 1297

A.

Merstham, Surrey 1326 ²⁹
In Ij paribus rotarum nudarum pro
carectis 3/4d.

B.

Speen, 1356 ³⁰
In j p. rot. nudas de meremio dmi.
fac. except. spokeo emp. p.a.o. 2/6d.

ROTAE AD CARECTAS FIMALES.

Drew ; wheels bought especially for the dung cart.
Hokyton, Cambs. 1320 ³¹
Ij pari ^{hus} rotarum ad carectas fimales
2/-d.
Ropley, Hants 1392 ³²
In j par. rot. plan. empt. pro fimum
extrahend 3/4d.
" " 1404
Alton Barnes 1402 ³³
In j pari rot. plan. pro carecte
fimale 3/-d.

ROTA PARVULUM.

RMLWL ; -

Durham Priory 1454 ³⁴
Ij rote parvule pro j charyete
ferro ligate

ROTA PLANA see above

ROTA SCAPULAND see page 128.

ROTA SIMPLEX see page 121.

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- | | |
|--------------------|-----------------------------|
| 26. Drew | 31. Page (1934) |
| 27. PRO SC6 1131/2 | 32. Drew |
| 28. Drew | 33. Thorold Rogers IV P417. |
| 29. <u>ibid.</u> | 34. Surtees Society (1898) |
| 30. PRO SC6 750/26 | |

SPOKA

RMLWL ; a spoke 1279

Moundsmere, Hants 1299

In j pari bridd et j pari
grossarum rotarum cum spokis
pro eisdem 2d. In spokis pro
eisdem empt 1ld.

Pershore, Wores. 1310

Moundsmere 1300 ³⁵

In 1j velg. et 111j spok...9d.

In j quarteen de spokis emptis
ad dictas rotas 8d.

STRACA.

RMLWL ; iron plate on outer rim of wheel 1267

Chilbolton 1267

In ferro empto ad dictas
strakas perficiendas et clavis
ad idem faciendis 4 $\frac{1}{2}$ d.

Littleton 1272

In ferramento imponendo et 1j
strach imponendis 6d.

Moundsmere, Hants 1284

In XLV lbs ferr. empt pro j nova
strak inde fac. 7d.

" " 1285

In 11j nov. tradbend de j veteri
straka de Elsefeld fac et in
eadem rota cum eisdem emend 2d.

Moundsmere, Hants 1287

In stip. fabri pro j strak
elongand et pro novis tradbend
cum XIj gross clav. de ferr.
domini 3d.

" "

In VIIj strakis 4d.

Ropley, Hants. 1416

XXVj lachettes ferr, empt cum
clavis pro les strakes perus
rotarum carecte affirm una cum
stip. fab. 3/-d.

SLODDIES.

RMLWL : -

O.D.D.: -

Guyton, Oxon 1437 ³⁶

j par. sloddes 13/4d.

Hickling 1520

j par flode 8/5d.

35. Drew

36. Thorold Rogers 1V pp 419

There are several points which can be made about the evidence of account rolls as to the nature and construction of medieval wheels.

The word brydde^{36a} is unknown both to the RMLWL and to the E.D.D. Clearly it is used in place of rota but apart from the fact that it is spoked, there are no indications as to the features which distinguish it from other rota. Unless made with manor timber, it cost normally about 8/d., the average cost of an iron bound wheel at the same date. It does not seem to be bought iron bound but the Harrington entry for 1368 indicates the brydde was to be bound later, the iron work being bought separately, since there is no mention of it in the account. It was clearly a finely worked, rather expensive untired wheel. Whether it changed its name when bound is a matter for speculation.

The classical latin term canthus, meaning felloe, is rarely used by the thirteenth century. The common word in the accounts is velga or felea or a related form and the average price whether for a canthus, felea or velga is about 2d. The appearance of dowels which joined each felloe indicates that the medieval wheel had a composite felloe, constructed very much in the manner of the wheels from the British Library Cotton Tiberius B V vehicle (11th century)³⁷ from England, for example, folio 3. It also compares closely to the curtain felloes of the Han heavy duty vehicles from the first century B.C.³⁸ Furthermore, the Harrington 1299 entry links the term scapuland specifically with a felloe. Thus while it was argued in chapter two that rot. scapuland may possibly represent crossbar wheels, it is also possible that it is descriptive of the 'pared', flower-shaped wheel often depicted in western European illuminated manuscripts, for example, the De Berry Hours, British Museum Royal G VIII³⁹ folio 297, Royal 1E IX folio 87 Add.15268 folio 58 and in the sixteenth century woodcuts such as those reproduced in

36a. Thorold Rogers IX p417-8.

37. Singer et al 11 fig.495

38. G.D. Lu, R.A. Salaman, J.Needham 'The Wheelwrights Art in Ancient China 11;' 'Scenes in the Workshop' Physis 1,111(1959)

39. Les Grandes Heures de Jean Duc de Berry (London 1971)

notably figure 150, cut in 1502.

Strakes were iron plates, cut to fit the rim of the wheel. Fixed from the centre of one wooden felloe to the centre of its neighbour, a set of strakes replaced the hooped tire in the middle ages. Each strake covered the junction of two felloes, were fitted hot and placed alternately so that the pressure was applied equally to each side, forcing the constituent parts of the wheel to tighten. Strakes had about ten nails, five on each side, but these were not punched in any regular pattern. Sturt describes a strake nail as being as 'long as a sardine with a big thick head'.⁴¹ Stow in 1533 while describing a wheel said that 'divers great nails of iron were there found such as are used in the wheels of shod carts, being each of them as big as a man's finger and a quarter of a yard long, the heads are two inches'. These are the kind of nails depicted in the miniatures of the Luttrell Psalter, British Museum Add 42130. Oddly enough Drew claimed that the Luttrell nails were triangular. Clearly, however, they are rectangular-headed nails which is quite normal. British Museum Add 15277, illuminated in 1400 in Italy, shows these strakenails very clearly. Obviously it was these which caused shod carts to be banned from a number of medieval towns, for example, Beverley,⁴² Bristol and Bury St. Edmunds⁴³ because they were churning up the streets. When entries in the accounts furthermore refer to carts in toto apparatu or cum toto atillo, the exact composition of parts is unknown. An entry for Worcester Priory for 1376⁴⁴ shows the number of fittings which could be bought for one vehicle. 'Item fabro de Hallowe pro grosso clavorum grossorum et cropnayl cum ligacione j paris rotarum carecte 9/-d. In grossis clavis emptis pro dictis rotis ligandis cum strakes... 12/6d. In grospio...3/-d. In 11j clutis...20d. Thorold Rogers⁴⁵

40. Deidrich (Geneva 1908)

41. Sturt (1923) Stow, Survey of London (1598) Morley (ed) p 184, Crofts (1967) pp 135;05.

42. Selden Society (1888)

43. Crofts (1967) p 18

44. Hamilton (1910)

45. IV p 417-427

gives a further indication of this for the fifteenth century. Ligatura, however, would not seem to mean ironwork in general. It would seem to be rather, the complete set of strakes and nails which went to make up the surrogate tyre. This seems the best interpretation of consecutive entries in the account for the manor of Chilbolton, 1267, which reads 'In nova ligatura ad dictas rotas ligandas cum toto atillo. In ferro empto ad dictas strakas perficiendas et clavis ad idem faciendis 4^{sd}.⁴⁶ This would also account for the fact that although strakes for repairing wheels are frequently recorded, new strakes are hardly ever bought. Finally, strakes are mentioned in the rolls as being elongand. The practice of selling overshort strakes appears to have been common as an inquisition was set up in London in 1300 to set a fixed, standard size for both strakes and gropes.

Wheels are nearly always bought in pairs and separately from the vehicle for which they were intended. This is probably indicative of the fact that two craftsmen were involved, the carpenter and the smith. It is interesting that, as far as the English manorial records are concerned, it is the former who sees to the vehicle chassis, the latter to all the ironwork including the wheels. Though the word wryght is known from early glossaries,⁴⁷ wheelwrighting as a distinct occupation would seem to be relatively late. Only in 1345 is there a mention of a wheelwright. This comes from Worcester Priory accounts which has an entry in stipendio i rotarii.⁴⁸ The RMLWL has a date for the appearance of the word rotarius in 1167, but it is possible to maintain that the title wheelwright was used rarely in the medieval period. Miss Sanders⁴⁸ saw the prehistoric wheelwright as being sedentary and working in close contact with the smith. As far as the manor clerks were concerned, until the

46. Drew

47. T. Wright A Volume of Vocabularies (Liverpool 1857).

48. Hamilton (1910)

fourteenth century, they were virtually indistinguishable.

There is little point in duplicating the vast tables of prices and decennial averages of wheel expenses of Thorold Rogers.⁵⁰ It may perhaps be more useful to indicate a few general points which arise from the evidence of the records rather than produce a catalogue of facts which can be found elsewhere. Firstly, wheels could clearly be bought in two ways, unbound or bound. If they were bought unbound to be bound later, they were generally more expensive and, therefore, probably of better quality than wheels which were intended to be left unbound. Bound wheels cost on average 18/-d. to £1 while naked wheels cost around 7/6d. There are cheaper wheels costing around 1/-d. to 2/-d. Though prices do rise at the end of the middle ages, it is not a very major rise and would easily be accommodated into the expenditure on vehicles. Secondly, these prices may be further subdivided into those made with manorial timber and iron and those made without. In the case of the latter of course, the cost of the materials were included in the cost of the finished product and this could make a difference of, as far as timber was concerned, 2/6d. and as far as the iron was concerned, about 18/-d. Sturt⁵¹ indicates that even in the last century old iron was preferred because it was stronger, so this is not merely a tactic of the manorial reeve to save money. Thirdly, a large number of wheels were bought or repaired contra autump. before the heavy demands of harvest time. Fourthly, wheels for the dung cart are often cheaper than other forms. Apart from rota simplex and planat., other unknown types are listed which may be simply dialect wheel names such as sloddes or flodes from Northern England or the schozear from Oxfordshire⁵² but these have so far not been listed in any of the easily accessible dialect dictionaries. A difference in name, however, surely

50. Thorold Rogers 11 p 521ff.

51. Sturt (1923)

52. N.Hohne The Manor and Manorial Records, reprint (USA 1971)

p 52.

indicates a difference in form or function. Fifthly, in contrast to the rota gross, which possibly indicates a heavy duty wheel, the rota parvulum from Durham, though this is the only example yet encountered, perhaps might be interpreted as a light, or even a possible spindle wheel. If it were a spindle wheel, this entry would provide evidence of this form fifty years before the introduction of the Flemish spindle wagon into southern Britain. ⁵³ Finally, Thorold Rogers ⁵⁴ shows that there were certain towns, such as Lullington, where wheels could be bought more cheaply than anywhere else. Thorold Rogers also shows from subsequent accounts that when a reeve bought wheels 'on the cheap', he could expect frequent repairs. Thus even the medieval consumer could expect quality only if he was prepared to pay for it.

Finally types of wood used for component parts are not mentioned in the records. While the close concordance of the prehistoric period with the nineteenth century in choice of woods (ash and elm for felloes; oak for the spokes; elm, oak or ash for the hubs; alder for wheel planks; ash, birch, yew for dowels) ⁵⁵ would seem to indicate continuity, there is no evidence to fill this gap, except for one sixteenth century reference quoted by the O.E.D. that French white ash was preferred for felloes, ^{and the} reference from Durham account rolls for ashwood for felloes, axletrees and 'naffs' or hubs. ⁵⁶ Though subject to availability, the special qualities of certain wood types remain unchanging. Oak for example is preferred amongst all the English hardwoods for spokes, which because it can be cleft instead of sawn and a sawn spoke, which would be crossgrained, would snap. ⁵⁷

53. Jenkins (1961) pp 8-11

54. Thorold Rogers ll p 521 ff

55. Professor Piggott's information for which I am grateful

56. North Yorkshire Local History Society Survey: Private communication, local secretary Robin Hoods Bay, N. Yorkshire, July, 1976. Durham Rolls Surtees Society (1898) 13th - 16th century

57. Sturt (1923)

While there is no medieval evidence to support the conclusion that the same woods continued to be chosen for their specific qualities, it is logical to assume that they were.

CHAPTER SIX : DISHING.

George Sturt in The Wheelwrights Shop described a dished wheel as a 'Japanese umbrella turned inside out, a flattish limpet'. A dished wheel is constructed by tapering the spokes and altering the knock at the spoke hole. It was done so that not only could a broader body or load be taken without increasing the width of track but also because it made the spoked wheel strong enough to stand up to the constant downward and central pressures of normal movement.¹ On wheels without a dish the iron nave bands gave some protection but the dished wheel was mechanically more sound. The question is of course whether a Chinese origin for dishing and its transmission to western Europe in the sixteenth century is acceptable.

Professor Needham's work on Chinese technology is well known. His study has proved beyond doubt that the dished wheel was in use in China by the second century B.C. if not earlier.² What historians have found less acceptable is his thesis that this knowledge was transmitted to the west in the sixteenth century. Their arguments are based on the fact that dishing as a process could easily have happened by accident. When tiring hot, unless the hub is held down, the pressure of the tire, as it contracts, will push the spokes into the hub with such force that it will rise above the level of the wheel, turning it into a shallow cone. Needham's critics have found it strange that something which could be so easily caused by carelessness, or miscalculation should have to be transmitted from the east. However, those favouring the 'accident theory' have overlooked the fact that such pressures are only possible with the fitting of a hooped tire and that the medieval smiths were fitting strakes where the pressures are far less. Thus accidental invention of the dished tire would have had to have waited until the modern period. However, dished wheels are clearly shown after 1500. One woodcut in particular by Joss Amman, 1568, shows the wheelwright making a dished wheel and drilling out hubs.³

1. Sturt (1923) Wymer English Country Crafts (London 1946)

2. Needham and Lu (1959)

3. Singer et al 11 fig. 505.

Since dishing therefore had to be done properly, it is less probable that the practice was an independent innovation.

How far an eastern origin is acceptable depends on the fact that there were no records of a dished wheel in western Europe before the sixteenth century. It is possible that miniatures from the Berry Hours show dished wheels especially since the illuminators, the Limbourg^s, were experimenting with the new techniques of perspective and shadow.⁴ It is also possible that British Library Royal 19 C VIII, folio 39, a fifteenth century Flemish manuscript, shows dishing. These are uncertain, however, and would only serve to push back Needham's date a little. There were two periods of Chinese contact with the west - the late twelfth and the fourteenth century. No miniature has so far been found to demonstrate dishing at either of these two periods. However,

since China appears to be the only area which had a firm knowledge of dishing many centuries before 1500 A.D., since Europe appeared to be ignorant of the technique until 1500 and since cultural contact with China in the middle ages and the transmission of other technological developments can be clearly demonstrated,⁵ there seems little point in questioning Needham's thesis without definite proof to the contrary.

4. Les Grandes Heures (1971)

5. Needham Science and Civilisation in China (Cambridge 1965) IV.

SCRIPT

SECTION THREE : IMPORTANT DEVELOPMENTS IN SUBJECTS
RELATED TO VEHICLE CONSTRUCTION.

SCRIPT

SCRIPT

SECTION : A :

BREEDING AND DRAUGHT.

Any vehicle is only as efficient as its working parts. However, unless there is also a strong, efficient draught beast, suitably harnessed, that vehicle, however perfect, is not going to go anywhere. Therefore, section C will try to outline the main achievements in draught and traction, comparing the prehistoric, Roman and medieval periods in terms of practical knowledge and ability in this particular sphere. It will also try to suggest that, in contrast to vehicle construction where historians were prepared to ignore the achievements of the medieval craftsmen, studies in the history of early traction, particularly those of Des Noettes, became so dominated by the highly emotive topic of human slavery that later technologists refused to accept the premise that a society based on slavery would be capable of experimenting with ways to improve animal draught.

SECTION A : BREEDING AND DRAUGHT.

The evolution of the successful draught animal is dependent on the recognition of three techniques; domestication, castration and selective breeding. This section will consider the achievement of efficient draught and whether the distinction which has been made between the prehistoric and medieval periods in terms of bovid and equid traction is valid.

CHAPTER ONE : PREHISTORIC DRAUGHT.

It is possible to maintain that two of the three preconditions necessary for successful draught had been achieved by the prehistoric period, namely domestication and castration.

The domestication of cattle was achieved by the fifth millenium in eastern Europe. The domestication of equids was achieved by the third millenium B.C. in the near East and southern Russia. However, it is the onager,¹ the small Asiatic wild ass which is the first equid to be depicted as a draught animal.² The horse is exclusively associated with the spoked wheeled vehicle.

Castration is an essential preliminary to successful draught. There are two purposes for castrating the male animal, firstly to control it - vital in the case of bovid traction - and secondly as a preliminary to selective breeding of certain selected individual animals in a herd. It is only the former with which we are concerned for the early period. Selective breeding was not fully achieved until the Roman period. Good osteological evidence for oxen castration in the fifth millenium B.C. in the Linear Pottery culture of central Europe.³ Equid castration is a much later development but was clearly a sophisticated process by the first century B.C. Unlike equid draught bovid draught would have been impossible without castration. In the case of an ox it is not blood which is important but emasculation.

Certainly there is no positive evidence for selective breeding in prehistory. However, it has been thought likely that 'in Central Asia, where horsekeeping is rooted most deeply side by side with a high standard of horsekeeping, the rudimentary forms of horsebreeding got developed as early as the Iron Age.⁴ This is speculation, however.

1. Piggott - private communication

2. see The Royal Standard of Ur, Curtis (1975)

3. S. Piggott (1963) pp 266-318

4. S. Bókönyi, 'Mecklenburg Collection, part 1 Data on Iron Age Horses of Central and Eastern Europe' American School of Prehistoric Research Bulletin XXV (Camb. Mass. 1963)

The primary question is how far the prehistoric and medieval periods may be distinguished by a characteristic draught form. It has been suggested that the central draught pole and oxen draught is indicative of prehistory, while shafts and equid traction characterises the middle ages. Certainly shafts are not seen in prehistoric Europe. However, shafts are just as common in the late Roman period and oxen traction continues to be just as popular for pulling heavy vehicles in the medieval period. Both bovids and equids are represented in the prehistoric period. The distinction therefore is not clear. A far better association but one which is valid for all periods is that of the horse with the spoked wheel.

CHAPTER TWO : ROMAN DRAUGHT

The most important achievement was the introduction of selective breeding. Though stimulated in Roman times by the desire to produce the ultimate circus animal, it was nevertheless to have an important effect on later stock. The main difference between ancient and modern ideas is of course that to us a Clydesdale is a Clydesdale irrespective of where it was bred, but to the ancients a Thessalian horse was born and bred in Thessaly.

The Romans have always had a rather bad reputation for allowing random breeding. Although allowing brood mares to mate with wild stock is a practice approved of by some societies as a means of toughening the strain, in the case of the Romans it was probably a literary myth - mares put in foal by the wind - rather than a reality. In contrast, Columella describes the care with which matings were supervised on the stud farms or equariae. According to Columella, there were three classes of equid; noble stock or generosa materies; breeding mules (prices for their offspring were so high that they were equated with the noble stock);

common stock, the vulgarii.⁵ However, there is no indication as to the extent to which horses were employed in transport. Probably the stocky ponies of the north, those described by Caesar, those found in Celtic graves for example at Arras in Yorkshire⁶ or Llyn Cerrig Bach in Anglesey⁷ or at the Newstead Roman cavalry fort in Scotland,⁸ were favoured for draught, That the heavier horse was available for draught by the second century A.D. is indicated by the representation from Châlon-sur-Saône.⁹ How widely this was used for traction, if indeed it was used at all, is unknown.

More important for Roman draught was the extensive breeding of mules. Originating in Asia Minor, the offspring of an ass and a mare, it is called by Hall a 'cultural invention', unlikely to have been created without the meddling assistance of man.¹⁰ According to Varro, three regions bred the best mules, Apulia, Peloponnesus and Reate.¹¹ The mule was favoured because of its resistance to heat and disease, its longevity, its ability to digest coarser food, its steadiness and intelligence. Claudian's poem sums up all the qualities which the Romans liked in the mule, which caused them to use them for all vehicle transport on the road.

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5. Columella, De Re Rustica, 3 vols H.B.Ash, E.S. Forster E.Heffner (eds) (Camb.Mass.1955) book VI
 6. Ian Stead (1965)
 7. Fox (1931) pp 185-199
 8. J.K. Anderson, Ancient Greek Horsemanship (Berkeley/Los Angeles 1961)
 9. Max Hilzheimer, The Evolution of the Domestic Horse, Antiquity IX (1935) pp 133-140
 10. A Leighton, 'The Mule as a Cultural Invention', Technology and Culture VIII (1967) pp 45-52.
 11. Varro, De Re Rustica, W.D.Hooper and H.B. Ash (Camb.Mass. 1934)

'Adspice morigeras Thodani torrentes alumnas
 Imperio nexas i perio vagas
 Dissona quam varios flectant ad murmura cursus
 Et certas adeant voce regenti vias
 Vanvis quaeque sibi nullis discurrat habenis
 Et pateat duro libera dolla iugo
 Ceu constricta tamen servit patiensque laborem
 Barbaricos docili concipit aure sonos.
 Absentis longinqua valent praecepta magistri
 Frenorum vicem lingua virilis agit.
 Haec procul angustat sparsas, spargitque coactas
 Haec sistit rapidas, haec properare facit
 Laeva jubet? laevo deducunt limite gressum.
 Multa strepitum? dexteriora petunt
 Nec vinctis famulae, nec libertate feroces
 Exutate laqueis sub ditto tamen
 Consansuque pares, et fulvis pellibus hirtae
 Esseda concordēs multisonora trahunt
 Miraris, si voce feras pavaverit Orpheus,
 Quum propas pecudes Gallica verba regant' . 12

Mules are the common traction animal on all the representations of private vehicles of the Roman period in Italy and Gaul. Martial, for example, complains of not being able to find a gap in the endless droves of mules pulling wagons loaded with marble blocks -

'vixque datur longas mulorum runperemandras
 quaeque trahi multo marmora fune vides' . 13

According to Suetonius, Nero never travelled with less than a thousand carriages drawn by mules with silvered hipposandles.

'Nunquam minus mille carrucis fecisse iter traditur soleis mularum argentis' . 14 Mules were of course liable for

12. Claudian De Mulabus Gallicis Epigram 1.

13. Martial, Epigrams V : 22,7,8.

14. Suetonius, Nero 30,3.

requisition by the state for military transport. A text from the Abinnaeus archive dating to 342 A.D. lists names of civilian owners of beasts liable to requisition.¹⁵ Mules were clearly the favoured draught animal of the Roman period.

Donkeys on the other hand, were despised.

Apuleius calls them 'extremae sortis quadripes...dolendus atque miserandus'.¹⁶ Ponies—Manni were, however, quite acceptable for draught. Ovid, for example talks of draught ponies. 'Parvaque qua primum rapientibus esseda mannis ipsa per admissas concute iora jubas'.¹⁷

Oxen were used for all heavy haulage. Varro indicates that they could be bought already trained or to be trained, and Columella recommends that the untrained ox should be yoked between two older oxen to be trained.¹⁸ One of the distinct advantages of using oxen apart from cheapness was the fact that they were easier to train than horses, being by nature quiet, gentle and plodding. In Sussex in the nineteenth century, when an old pair retired, a young pair was trained by being placed at the centre of the team with an experienced pair before and behind, the master ox of the team being placed on the off side.¹⁹

Finally, there would appear to have been a noticeable reduction in the number of geldings cut or beaten in the Roman period. However, the Romans were well acquainted with the techniques of castration particularly those of Mago the Carthaginian. Columella bases his ideas on castration and farriery

15. Bell, Martin, Turner Van Berchem The Abinnaeus Archive (Oxford 1972) p 150

16. Toynbee (1973) p. 385.

17. Ovid, Amores 11, XVI

18. Columella De Re Rustica

19. The Countryman Spring 1971 pp 133-4

on Mags. It is possible that the Romans preferred not to geld for two reasons. Firstly stallions have more fully developed neck muscles and entire stallions may have had less trouble with inefficient harnessing. Secondly, it may simply have been a matter of pride that a horse used for the games should be difficult to control, full of spirit as well as retaining the physical characteristics of its sex.

Thus by the end of the Roman period, the technique of breeding equids is fully developed. Mules are used almost exclusively for vehicle transport, the ox for the hauling of heavy wagons over long distances or for farm work.¹

CHAPTER THREE : MEDIEVAL DRAUGHT

'In the early middle ages the Roman organisational genius was lost and because of rarity, expense and prestige, horses were seldom encountered pulling wagons. The real technological revolution of the eleventh century was to put horses to work'.² Until the eleventh century horses were seldom represented at work. The Gerona Tapestry and later the Bayeux Tapestry are the first sources to show an equid doing normal agrarian tasks. Moreover, early written sources indicate that while selective breeding continued it is unlikely that this was for draught. The Carolingian capitularies for example show that Charlemagne maintained a special herd and that the foals were separated until the time came for them to be mated with a selected sire or dam.³ Moreover in the thirteenth century in Europe, the aim was to breed battle and saddle horses and not carthorses or affers.

1. A. Burford, 'Heavy Transport in Classical Antiquity' Economic History Review XIII (1960-61) pp 1-18

2. Leighton (1974) p20.

3. Monumenta Germaniae Historica, legum sectio II, I, Capitularia Regum Francorum, Capitularis de villis, XIII, XIV, XV.

However, while it is possible to agree with Leighton on the fact that horses were seldom used before c1050 for regular draught work, it is perhaps less acceptable to maintain that their introduction revolutionised existing modes of transport. While we must agree that the horse gradually took over from the ox, it must not be forgotten that the didactic treatises on estate management disapproved of the horse as being too expensive to feed.⁴ To insist on a revolution underestimates the widespread use of the ox for transport in Classical Antiquity. The supremacy of the horse was much more gradual than a revolution.

It is not possible to show breeding centres in the middle ages because the local desmesne studs and weekly sales in the area market are characteristic of the breeding of the period. These existed as early as the tenth century and continued throughout the period.⁵ Carthorses could cost anything from £1 to as much as £6 in the thirteenth century. While reeves were encouraged as a matter of course to buy draught mares to increase the stock, the accounts and osteological evidence often confirmed by the stock lists of manorial accounts, that certain manors were breeding horses on a scale larger than would be necessary for their own needs. However, these local studs are small compared to the great cattle breeding estates of northern England, the vaccaries of Lancashire and Cheshire, in particular those belonging to Henry de Lacy, Earl of Lincoln.⁶ Although they were primarily for breeding cows, they did also produce large numbers of bullocks which no doubt were later used for draught. A few of these manors belonging to de Lacy also bred horses on a larger scale than normal, but the real numbers were in the cattle vaccaries.

Thus breeding for draught was not a highly specialised centrally controlled process in medieval England.

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4. Dorothea Oschinsky, Walter of Henley and other treatises on estate management and accounting (Oxford 1971)
 5. D. Whitelock Anglo Saxon Wills (Cambridge 1930) XI, British Library Stowe Charter 36 William Fitzstephen, Chronicle of London Rolls. Series, The Greyfriars Chronicle of London Camden Society LIII (London 1952)
 6. Lyons (1934)

However, local stockbreeding had developed enough to meet the needs of the desmesne and the surrounding area quite adequately. The only improvements were to come in the modern period with the introduction of the shire horse.

SECTION 3 : B : HARNESSING TECHNIQUES.

Any discussion of the technological changes in wheeled vehicles would be incomplete without a similar consideration of improvements in the mechanics of harnessing, that special system of link work and levers by means of which, the motive force of an animal may be applied to traction.¹ Three demands are made on a harnessing system; efficient forward movement; control; breeching and stopping. This section will try to consider the chronology of the introduction of a rational harnessing system, the validity of the thesis which sees its origin in the east and the general range of harness in the middle ages. It will also examine Des Noettes' conclusion that the introduction of efficient harness did for the eleventh and twelfth centuries what the steam engine did for the nineteenth, the plausible solution to the problem of what he saw as the sudden upswing of European vitality after the year 1000.²

CHAPTER ONE : ANCIENT HARNESSING.

The common form of attachment in prehistoric and classical times for both bovid and equid draught was the yoke. A yoke is a wooden bar designed to fit across the necks of two animals, to which it is attached by a number of leather thongs, or a U-shaped wooden bow. There are a variety of different forms of yoke, Modern regional variation is

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1. Needham and Lu (1960) p 122
 2. Des Noettes L'Attelage Vol.1

is infinite and this may also have been the case in the past. There are, however, two main classes of yoke; the bow, withers or neck yoke and the head or horn yoke. The first is characterised by vertical holes in the beam through which passes the bows encircling the animals' necks. The second is distinguished by the horizontal perforations, swellings and indentations for the thongs by which it is bound to the horns. The most noticeable difference, while in use, is the position of the head and neck, the latter being extended.

Yokes often survive, especially in water-logged sites. The yokes from Petersfehn, Oldenburg and Vinelz, Switzerland have been given Neolithic dates by Clark.⁴ Although depicted in ploughing scenes from Bronze Age petroglyphs,⁵ the earliest reliable information comes from Iron Age sites such as Hradenin in Czechoslovakia.⁶ The western seventh century B.C. La Tene yokes in their form and curvilinear character contrast with contemporary angular yokes from northern Europe. A yoke now in the National Museum of Antiquities in Edinburgh, found at Dungannon in Northern Ireland, has been compared with these western European types and it has been suggested that such construction suggests a chariot and horse rather than farm cart and oxen. However, though many have used shape as a defining factor in this way, it is impossible to distinguish an equine from a bovid yoke. Though primarily functional pieces of equipment, shape would seem to be guided as much by aesthetic as practical considerations.⁷

The horn yoke has an almost continuous history from prehistory to the present day. It survives in those areas mentioned by the Classical authors, namely the Alpine districts of Switzerland, Germany and North Italy, Scandinavia, the Pyrenees, Sardinia, Algeria, Yugoslavia, Poland, Czechoslovakia.⁸

3. Alexander Fenton, *Draught Oxen in Britain*, *Nardopisny Vestnik Ceskoslovensky* 111-1V (1969). I should like to thank the author for a copy of his paper.

4. Clark, (1952) p 169, p 310

5. Haudricourt and Delamarre (1955)

6. S. Piggott (1949)¹⁷

7. S. Piggott (1949) 5.

8. Fenton (1969)

Hornschlitten or traineau a cornes have a long history in these areas. Pliny, for example, described the horn yoke of the Alpine cows - 'Plurimum lactis Alpinis quibus minimum corporis plurimum laboris capite non cervice iunctis'.⁹ Gallo-Roman reliefs show head yoking.¹⁰ However, the Roman farmer, following the lead of Columella, thought such attachment inefficient and barbarous. 'Nam illud quod in quisdam provinciis usurpatur ut cornibus inligetur iugum fere repudiatum est ab omnibus qui praecepta rusticis conscripserunt neque immanito plus enim queunt pecudes collo et pecto re conari quam cornibus atque hoc modo tota mole corporis totoque pondere mitantur; at illo retractis et resupinis captibus excruciantur'.¹¹ This belief continued into the middle ages, no doubt due to the influence of the Roman agronomists. Palladius, for example, On Husbandrie says -

The medes censed tyme is now to make,
 And beestes from nowe forth from hem to crie,
 The feeldes faate and drie, on hem to wake
 And breke hem up, but at the wending slake
 The yoke, thyne oxen neckes forto cole;
 But drawing by the horne is noo goode scole'.¹²

However, it would be a mistake to take this criticism as meaning that neck yoking superseded the horn yoke as a technical improvement. It would be just as much of an error to accept Lynn White's statement that 'late Antiquity saw an advance with the invention of the horns-yoke, the earliest specimen of which comes from Ireland but is not exactly dateable'.¹³ It would surely be more reasonable to see the horn yoke as a logical extension of what must be the earliest form of harnessing, namely direct attachment to the horns. Moreover, while there are very early yokes for head attachment

9. Pliny, VI:LXX: 179

10. Esperandieu, (907-38) IV pl.3245, II, p 282, V pl.4032.

11. De Re Rustica, II:II:22-4

12. II:II, from a MS of c1420 from Colchester Castle, English Text Society (London 1873-79) ed. Barton Lodge.

13. (1962) p 59 footnote 6.

from north and west Britain, ¹⁴ head yoking of cows was common at an earlier date in Egypt and Assyria. ¹⁵ However, there exists no firm evidence as to the greater antiquity of either form of yoke. It is indeed strange that Lynn White should believe that the horn yoke would be a technological improvement of later Antiquity, given all the disapproval that the Roman agricultural writers shower on it. Here, he is transposing modern technical judgements to the classical period. Strange though Columella, Cato, Varro and Pliny would have found it, head yoking in some instances is in fact favoured form of traction. Modern Savoyards, for example, use both the withers and head yoke, but specifically chose the latter for draught in hilly areas, where in ~~ere~~ descent the centre of gravity of the wagon load would be too high for a neck yoke. ¹⁶ It does not follow, therefore, either now or in the past, that the neck yoke is better because it allows a stronger pull. This is simply another case where innovation takes second place to practical considerations and environmental experience.

The withers yoke, of course, is the common form of attachment for both bovids and equids in Classical times. There are two problems to consider. Firstly how far we may accept the statement 'that Antiquity harnessed horses in a singularly inefficient way' ¹⁷ secondly, if this is the case, why they took no steps to improve their draught.

It is of course the failure of the Romans to adapt the withers yoke to the harnessing of equids which has caused so much derogatory comment from historians of technology. The best description of classical yoking procedure

14. S. Piggott (1949)

15. Des Noettes *L'Attelage* fig.451. 1 pp 52, 42, 86.

16. Fenton (1969)

17. Lynn White (1962) p 59.

comes from Homer. He says -

'They (the Trojans) took away from its peg the
mule yoke made of boxwood
With its massive knob, well fitted with
guiding rings and brough forth
The yoke lashings (together with the yoke itself)
of nine cubits
And snugged it well into place upon the smoothed
polished wagon pole
At the foot of the beam, then slipped the ring
over the peg and lashed it
With three turns on either side to the knob and
afterwards
Fastened it all in order and secured it under
a hooked guard. '

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In contrast to the thirteen and one half feet for the yoke straps of Homer, Cato favours eighteen feet as well as sixty feet of leather cordage for the cart, twenty six feet for the reins and fifteen feet for the line or traces - '...Funem in loreum in plostrum PLX, lora retinacula longa PXXVI, subiung ia in plostrum PXII, funiculum PXV. ' 19

There can be little doubt that efficient harnessing achieved a rapid more practical form of land transport. The question is, however, how and when the ability to attach an equid to a vehicle in such a way that it may make full use of its strength - a rational harnessing system - was achieved.

The problem of efficiently harnessing an equid was created by anatomical differences.²⁰ An equid does not have the bony projection of thoracic vertebrae which form the ox's raised crest against which a yoke is placed. The pull of the ox comes from the neck immediately in front of the withers, while that of an equid is sustained most naturally from the shoulders. Thus it is not merely a case of ill fitment when the yoke is transferred to the horse but of incorrect design failing to locate the point of traction.

18. The Iliad XXIV, 269-275, Richard Lattimore (trans) (Chicago 1951)
19. De Re Rustica, LXIII,
20. Needham and Lu (1960)

It is possible to contend the orthodox view, namely that it was ignorance of the anatomical differences which made ancient harness inefficient. On the contrary, ancient technicians were very well aware of the obvious difference between the neck of an ox and that of a horse. So well aware that they tried to compensate for it by the use of a throat and girth harness. In other words, to the bow yoke was added two flexible straps which ran from the yoke around the neck and the girth of the horse. The neck strap operated to keep the yoke forward, while the girth held it back.

The greatest criticism of this system was that although the point of traction became the equid's chest or neck, the pulling force is still transmitted to the vehicle through the yoke, resulting in upward pressure on the throat band. Resting, therefore 'audessus du garrot'²¹ the strap compressed sternocephalic muscle and trachea. The horse could thus not put his full body weight into his tractive effort for fear of suffocating himself. Furthermore, pressure on the vagus nerve and blood vessel walls caused vascular disturbance and venous congestion of the head.²² To relieve pressure on his windpipe the horse would instinctively rise onto his hind legs. One may consider, therefore how far ancient representations of the chariot horse in this position was due less to spirit and more to unbearable discomfort.

The throat/girth harness was a single, clearly recognisable type, which remained unchanged from its initial appearance until the present. It was in use in the Near East from the third millenium B.C. in Egypt from 1500 B C , the common form in Greece and represented on Roman monuments. It occurs on Etruscan, Persian and early Byzantine reliefs and in western Europe, where its oldest appearance would seem to be on

21. Des Noettes L'Attelage I

22. E.M.Jope, Singer et al II

a fourteenth century Florentine sculpture. It is still used today in parts of the Middle East.²³ Although in the case of medieval representations, deliberate archaism cannot be ruled out (given the nature of the medieval artistic consciousness, however, this is extremely unlikely), it is puzzling to see such an obviously dangerous system surviving at a point in time when better harnessing forms were available. The answer must be that the choking effect of the ancient harness may have been exaggerated. Practical experiments in which Sumerian battle cars were built from reproductions and tested in the field, harnessed to donkeys, would seem to confirm this attitude, However, care should be taken in accepting these kinds of results without reservation, since such experiments cannot reproduce the actual conditions under which these vehicles normally operated. They can help only to supplement the evidence.

The function of yoke saddles should not be overlooked in this context. The simple transference of the yoke even with a throat and girth strap, would have been impossible not only because the bony withers of the horse is particularly susceptible to chafing but also because the instinctive raising and lowering head movements of a horse in motion, would alternately loosen and tighten the straps of the throat and girth harness, which should be kept taut if they are to exert equal tension on the yoke and keep it in place. Mrs. Littauer has discussed the function of a number of Y-shaped wooden objects²⁴ used by the ancients in harnessing. These have been identified from prehistoric Egypt, Syria and the Orient. [64] Yoke saddles intact and on position on the yoke were found in barrow 5 at Pazyryk in the Altai and have been given a fifth century B.C. date. They are also found at an early date in China.²⁵ Whether or not they have an eastern origin, which seems likely, Mrs. Littauer is

23. Des Noettes *L'Attelage*, figs. 17, 24, 25, 33, 58, 68, 72, 64, 65, 89, 116, 117, 145, 157, R. Bulliet (1975) fig. 86

24. M.A. Littauer 'The Function of Yoke Saddles in Ancient Harnessing' *Antiquity* XLII (1968)

25. Needham and Lu (1960)

convinced that they were not only narrowing devices to fit the yoke to the smaller equid neck, but in position, forward of the withers, would divert much of the pressure from the region of the throat to the upper shoulder. This utilisation of the shoulders is the conception behind the design of the first unquestionably efficient form of equine draught, the breast-strap harness. Some Y-shaped bronzes from Ireland have been identified by Dr. Catherine Johns as yoke saddles.²⁶ However, these are too slender and small to have been used in this way. Attachment at the top of the Y to the yoke would have been difficult, there are no signs of wear on the relatively soft bronze and unlike the examples considered by Littauer, some of Dr. Johns' yoke saddles have loops or rings at the ends of the slender shafts.^[65] Richard Haworth considered a number of these bronzes but remains uncertain as to their function.²⁷ Although this cannot be ascertained with any certainty, so close is their association with bridle bits - there is a correlation between the length across the end of the upturned Y and bit size and often also in decoration - that it would be more logical to consider this as being indicative of their function rather than to consider them as yoke saddles to which they morphologically bear little resemblance.

Moreover, the draw rein apparent on all of the Egyptian and Assyrian reliefs, to keep the head rigid and down by bit pressure, would not be possible if the harness strangled.

Lastly there has been wide discussion of standard rates of efficiency of ancient harnessing types. It has been estimated that a team of equids in ancient harness could pull around 492 kilogrammes as opposed to a similar team in modern

26. 'Spur-shaped Bronzes of the Irish Early Iron Age' British Museum Quarterly XXXV (1971) pp 57-61

27. 'The Horse Harness of the Irish Early Iron Age' Ulster Journal of Archaeology XXXIV (1971) pp 27-49

harness which could pull 1930 to 2430 kilogrammes.²⁸ The former is the highest limit set by the Theodosian code.²⁹ It has, thus, been concluded that 'the net effectiveness of ancient draught animals in harness was not more than one third of the modern expectation,'³⁰ an opinion which it is emphasised is under, rather than overstated. Irrespective of the manner in which it is expressed, it is surely questionable to assess rates of efficiency for ancient transport upon what is considered the best modern standards. These conclusions were drawn from nineteenth century tables of average work expectancy, for nineteenth century draught work, in the conditions under which it operated. Since the throat and girth harness is unlikely to have been able to pull a modern vehicle even when empty, it is surely absurd to use this as a basis from which to judge its performance in the past. It is moreover, futile to attempt to define a standard rate of efficiency from the surviving sources. As Burford³¹ has pointed out, ancient authors were not concerned with recording such matters and the Theodosian code in 433 A.D. is the only source to record limits for weight and capacity. Any judgements pronounced upon the efficiency of ancient transport, if they are based on a comparison with modern draught are unduly critical and must be considered unfair. However, the dismissal of heavy haulage in classical antiquity because of the failure to achieve efficient equine harnessing, is far more important than a simple oversight, on Des Noettes behalf, of the practical and efficient use of oxen draught and a failure to recognise that the Romans actually practised tandem harnessing.³² It is the far more important refusal of Des Noettes to accept that a society which had slaves could or would feel it necessary to make improvements in animal draught. This idea has become generally accepted. However,

28. R. Forbes, Studies in Ancient Technology 11 (Leiden 1955) Singer et al, 11.

29. Pharr (1952)

30. A.P. Usher, A History of Mechanical Inventions (Camb. Mass. 1954)

31. A. Burford (1960) pp 1-18

|Lynn White (1962) pp 156-7

32. Vigneron, (1963) p.125ff, Des Noettes L'Attelage fig.46

Burford's study of heavy transport has shown not only the wide use of oxen draught but also the conspicuous absence of man power. The idea of classical society as uninventive and slave-ridden has caused the neglect of the role of classical technicians in the experimentation towards better harnessing techniques and opened the way for an acceptance of the theory that the modern harness was imported from the east.³³ This will be discussed later. However, it must be said at this point that slow development in harnessing equids may be seen throughout the Roman period. It is wrong to examine the past for indications of overpowering change. Practical and environmental considerations are always prominent. Transport in classical antiquity was not the minor issue which Des Noëtés presents. As M.I. Finley has pointed out, the idol of maximum productivity is but a very recent elevation.³⁴

CHAPTER TWO : THE INTRODUCTION OF A RATIONAL HARNESSING SYSTEM.

The breast strap is the first efficient form of equine harness. In this system the equid's shoulders are surrounded by a trace, suspended from a strap from the withers, and attached to the shafts by long traces. If the strap is too high it will cut the gullet just like the throat and girth harness. Too low and it will interfere with shoulder movement. It is simply an advanced form of throat and girth harness but the traces along the sides allow the horse to pull with its chest, on a horizontal plane.¹ Since there is no upward pressure as there was with the yoke, the neck strap did not ride up and choke the animal. It is the form of harness still used in the nineteenth century for light draught work.²

33. Needham and Lu (1960)

34. M.I. Finley 'Technology in the Ancient World' Economic History Review (1959-60) XII p 120-5, The Ancient Economy (Berkeley and Los Angeles 1973), 'Technical Innovation and Economic Progress in the Ancient World', Economic History Review XVIII (1965) pp 29-45

1. Bulliet (1975) pp 176-215

2. John Philipson, Harness as it has been, as it is and as it should be. With remarks on traction and the use of the Cape Cart by Nimshivich. (London 1832)

The most efficient equine harness is the collar. This is a rigid cushioned frame - the cushion and the frame being either separate or combined - which substitutes for the spinous cervical and thoracic vertebrae of the ox. Pressing directly on the sternum muscles, the line of traction is immediately linked to the skeletal frame and the area of traction located far away from the respiratory system. The shafts or traces are attached to the collar at shoulder level and the animal pulls from this area, the spot mechanically and anatomically most suited for tractive effort. The collar is generally stuffed with rye straw and lined with leather or felt. To the collar is attached the hames, which is a piece of metal, fitting the shape of the oval collar exactly between the fore and after-wales. If it does not fit exactly into this central ridge, the collar will press unduly and may gall the horse.³ The collar is generally regarded as being superior to the breast strap especially for heavy loads. However, in the last century there was some question, particularly among the mounted regiments, as to which system was better on the grounds of efficiency and humanity.⁴

' C'est au debut du Xe siecle, sur les peintures du manuscrit latin 8085 de la Nationale, probablement d'origine française, que l'attelage moderne apparait pour la premiere fois' .⁵ 'While Lefebvre des Noettes pointed to three Frankish miniatures of the early tenth century as the first indication of the new horse-collar, there is a picture of it earlier in the Trier Apocalypse [55] which was illuminated in the heart of the Frankish realm about the year 800' .⁶ 'The padded horse collar...did not come into being until the Middle Ages'...⁷ and ineffective modern harness was in use in Roman Imperial Times'^{8b}. 'Au point de vue géographique, il semble que les steppes qui séparent la Chine des forêts Sibériennes aient été le centre de ces perfectionnements de l'attelage' .⁸ 'We might thus be

3. Michael Brander, The Horseman's Vade Mecum (London 1971)

4. Philipson (1882)

5. Des Noettes L'Attelage p.123

6. Lynn White (1962) p 61

7. Lionel Casson, Travel in the Ancient World (London 1974) p 181

8. Haudricourt and Delamarre (1955)

8b. Bulliett (1975) p198

confident that the modern harness was the product of a slow development in the Occident, were it not for reports of philological evidence...implying a diffusion from Central Asia'.⁹

'Is it possible that modern harnessing technique...actually reached Europe from the south as a final gift of Roman ingenuity instead of from the east several centuries later?'¹⁰

Clearly, therefore there are two fundamental questions to be considered, the date and area of origin of rational harnessing.

It is generally accepted that the breast strap originated in China and was transmitted to Europe at the time of the transmigration of the Steppe peoples in the sixth century. Needham has put forward evidence for this method in China by the second century A.D. but also points to an intermediate form from northern China in the fourth century B.C.¹¹ Bulliet, however, has produced evidence from Roman North Africa which indicates that the breast strap as a harness for a camel, the common draught animal, was already of considerable antiquity. Several stone reliefs have been studied which suggest that existing theories - which cannot account for this evidence, since no significant central Asian or oriental influence in third century A.D. Roman Tripolitania can be traced - are incomplete, if not in essence, incorrect. These reliefs depicted camels harnessed in precisely the way that they are harnessed in Tunisia today, namely by breast strap.¹²

The horse collar, it is generally believed was introduced into Europe some time after the ninth century and was universally adopted by the twelfth. Lynn White, however, has put forward a miniature of c800 A.D. as being the oldest representation of the collar in Europe.¹³ Though the illumination is not particularly accurate, there are no other straps and the

9. Lynn White (1962) p 60-61

10. Bulliet (1975) p 198, p.199

11. Needham and Lu (1960)

12. Bulliet (1975) pp 194-197

13. (1962) p 61

horses' necks are extended in a normal manner. Such a depiction stands in contrast to ancient representations of throat and girth harness, for example the model from the Oxus¹⁴ or the Tutankhamun frescoes,¹⁵ and may be regarded in all fairness as a typical medieval representation in the vein of British Library Royal 1 C VII folio 154v (12th century), Bodleian Laud Misc. 752 folio 134v (12th century), Corpus Christi 3 folio 161v (1139), the Winchester Bible in the Victoria and Albert Museum folio 120v¹⁶ or for that matter figures 140 - 144 in Des Noettes.

The Cambridge Economic History¹⁷

has put forward textual evidence for an eleventh century collar but this has since been successfully discredited by Lynn White.¹⁸ Needham however, produced evidence from the province of Northern Wei for the sixth century and the ninth century which shows shafts and two forms of collar harness, one having two components - collar and yoke, one having three components - shafts, a curved piece of wood like the yoke or a carriage crossbar connecting the shafts and the padded collar.¹⁹ It is the latter system which Needham sees being transported to Europe. Needham's thesis was confirmed by Haudricourt who presented strong philological evidence based upon the oriental origin of the word hames. Tracing this back through twenty languages, he isolated its origin as a pack saddle of a [66] Bactrian camel.²⁰ The essence of the invention of the horse collar therefore, was the inversion of the horseshoe shaped, felt-padded, wooden baggage rack of the nomads. This invention, which according to Needham could not possibly have been made in Europe because of its relationships to the camel and to that distinctively Mongolian product, felt - was borrowed by the Slavs before the diaspora of

14. Wilhelm Treue⁽¹⁹⁶⁵⁾ 67.

15. ibid p 99

16. T.S.R. Boase English Art 1100-1260 (Oxford 1953) pp 175-6

17. Parain, in Cambridge Economic History 1 quoting from N.E. Lee Travel and Transport through the Ages, (Cambridge 1956)

18. Lynn White (1962) p.61

19. Needham and Lu (1960) (1965) IV, 11.

20. Haudricourt, 'Contribution a la Geographie Ethnologique 1 (1948)
de la Voiture?

Revue de Geographie Humaine et d'Ethnologie 1 (1948)

the sixth century A.D. and was introduced to the west by the ninth century.

There is conclusive evidence that the collar was known and used in the east by the early centuries A.D. Lynn White's scepticism that there was no unambiguous evidence for a Chinese collar earlier than 851 A.D.²¹ has since been refuted by the evidence produced by Needham and Lu from Yukang in Shansi province, contemporary with and confirming the 'implicit evidence' of pre-ninth century A.D. collars from the frescoes of the thousand Buddha caves, Tunhuang in Kansu.²² However, the question still remains as to whether transmission from the east is the only answer to the appearance of modern harness in the west. Whereas last century, it was considered correct to emphasise the creatively transmissive role of the Huns, it has become popular in recent years to stress a 'new and intriguing link between the Roman and Chinese civilisations'.²³ When this attitude is coupled to the viewpoint of Des Noettes, the result is that Roman portrayals of modern or transitional harnessing forms are harshly judged in the interests of maintaining a central Asian origin. Needham, for example, demands higher standards of accuracy from Roman and medieval illustrations than he does for his own Chinese evidence. If we are to believe in many of his inferences, we must be prepared to accept the credibility of some of the western representations.

It is therefore possible to maintain that in the Roman period in western Europe, there was at least experimentation with different forms of equid harnessing and that some of these experiments had achieved in some measure, efficient harnessing. Firstly, the intermediate Chinese evidence suggests that the invention of the shafted chariot was the limiting factor and that traction from the sternal region was not achieved until

21. Lynn White (1962) p 61.

22. Needham and Lu (1965) IV, 11.

23. The Sunday Times, March 6, 1977 p 13

shafts became available.²⁴ This may be extended to include any vehicle which is attached along the sides, by traces for example, rather than from above. Shafts are present in North Africa by the third century A.D.²⁵ Shafts from Roman contexts in western Europe are also known. A Roman mosaic from Ostia shows a mule harnessed between shafts.²⁶ This second century representation would appear to show a collar sitting high on the neck though it must be agreed that the presence of a girth strap makes it possible that this is a throat band rather than a proper collar. Two extant representations of second century reaping machines show single animals harnessed between shafts, though detail of the harness has not survived.²⁷ A Gallo-Roman representation from Trier, dating to the fourth century shows a shafted chariot attached to what must be taken as a rigid collar.²⁸ A shafted chariot is depicted on the third century A.D. sarcophagus of Cornelius Statius. Here also a rigid collar may be present.²⁹ Traces are represented on a few of the Roman bas reliefs for example at Ostia and there is evidence for traction by traces in early Iron Age Britain.³⁰ Moreover there are representations of collar-like objects from the pagan lapidarium at Arles, and on Trajan's column.³¹ Shafts are depicted on reliefs from Metz and Arlon but here girth straps are also present. From Arlon, there is another shafted dung cart but the harness is not clearly visible. A remarkable harnessing assemblage is also represented at Arlon Langres, while the Vaison 'omnibus' shows a variety of straps including a back pad or harness saddle and breeching or a crupper.³² These few examples serve to show that the Romans were certainly experimenting with new techniques with considerable success. There is, moreover, not only evidence for fully developed breast strap harnessing for camels

24. Needham (1963) IV, II.

25. Bulliet (1975) p.176-215

26. Casson (1974) p.161, Needham (1965) IV, II fig 534 footnote g p 317-8

27. Lynn White (1962) p 60, K.D.White (1967)(1970)(1975).

28. Bulliet (1975) fig.99, Needham IV II fig.553 Esperandieu V no.4034

29. Needham (1965) IV II fig 73, Joep in Singer et al fig.544, Toynebee (1973)

30. G.Calza and G.Becatti, *Ostia* (Rome 1957)(4thed.) Fox (1946)

31. P'obé and Roubier (1961) p 180, Vigneron (1963) II pl.62b

32. Reinach (1909) II p 95, Esperandieu V 4030, 4033, IV p 282

P'obé and Roubier (1961) pl 203.

and horses from Roman North Africa, there is also a representation on a Roman lamp, dated between the first and third centuries A.D., of a single horse cart harnessed between shafts which are attached to a horse collar.³³ Needham has criticised a number of these Roman collars on the grounds that they are depicted as being placed too high on the horse's neck.³⁴ Though such a position would normally indicate the occlusive throat strap, Needham has ignored the fact that the animal's neck in every case is extended normally as it would be pulling a collar. The absence of girths in many of these cases is significant. Though many of the reliefs have the collars poorly situated so do accepted representations of modern harness from medieval manuscripts. Surely it is time to rehabilitate the Roman representations and accept them as depictions of collar harness? If the Roman reliefs are rejected, how can the collars from the Bayeux and Gerona Tapestries, or from many of the western European manuscripts of the tenth to the twelfth centuries remain acceptable?³⁵ Evidence points to modern harnessing in Europe by the fourth century A.D.

We might thus be confident that the modern harness was the product of a slow development in the Occident were it not for reports of philological evidence...that English 'hames' and German Kommut are of Turkic origin implying a diffusion from central Asia.³⁶ Philological work completed by Bulliet on harnessing terminology, however, suggests a Roman and Tunisian origin for modern harnessing and that transmission was aided by the Muslim conquests.³⁷ Leaving aside for the moment

33. Bulliet (1975) fig. 98, Brogan 'The Camel in Roman Tripolitania' Papers of British School at Rome XXII (1954) pp 126-31, P. Romanelli 'La Vita Agricola Tripolitana: attraverso le rappresentazioni figurate' Africa Italiana III (1930) pp 53-75 J. Ward-Perkins 'Gas es suq-el-Ori A Desert settlement in Central Tripolitania' Archaeology III (1950) pp 23-30.

34. in particular the vehicles from Ostia, Trier, and Avignon.

35. F. Stenton, The Bayeux Tapestry (London 1957) C. Zervas, L'Art de la Catalogue (Paris 1937) pl 4.

36. Lynn White (1962) pp 61-2.

37. Bulliet (1975) pp 202-207.

the actual linguistic evidence, the foundation of Haudricourt's thesis is that the collar developed from an inversion of the pack saddle of the Bactrian camel, a horseshoe shaped pad with two long horizontal sticks, one on each side, attached to each other by thongs crossing the space in front of and behind the humps. Haudricourt's thesis is that turned vertically, the pad became the cushion and the two sticks the frame to which the shafts are attached. However, evidence for this form of saddle in central Asia from the fourth century is not common. The saddles for this period have no pads and wide curving boards or reed bundles take the place of the sticks.³⁸ This is the kind of saddle also seen later for example on the camels of the column built by Theodosian in Constantinople in 336 A.D.³⁹ The important point is that these boards are connected between the humps rather than at the ends and therefore, a considerable amount of redesigning would have had to have taken place before they could be upturned and placed around the neck of a horse. As Bulliet has pointed out, the rigid poles envisaged by Haudricourt do exist but these are on present day camel saddles and the evidence suggests the alternative possibility that 'given the evident change in saddle design between T'ang times and the present, the invention of the horse collar influenced the design of camel saddles and that this produced the anomalies in vocabulary noted in Haudricourt.'⁴⁰

Thus the dates previously put forward for the introduction and the area of origin for modern harnessing are no longer acceptable. Previous theories neglected Roman evidence because of attitudes linked to the emotive issue of slavery or because the evidence as it stood indicated that the Chinese material was at least a century older than anything found in Europe. The Roman evidence, however, must now be considered as showing at least quite remarkable sophistication and that if the

38. Bulliet (1975) p 210-3

39. Reinach (1909) I p.103

40. Bulliet (1975) p 213

modern collar had not been developed, which it almost certainly had, significant advances in tractive devices were being made in the fourth and fifth centuries. It is thus easier to see continuity between the medieval and Roman periods both in the methods of traction and the general style in which they are depicted chronologically and linguistically, a southern or European origin is as logical as an eastern one.

Before leaving ancient collars it might be useful at this stage to point out that the curved pieces in elaborate openwork with coral inlay, described by Jacobsthal as hames mountings (from an Iron Age site in Saint-Germain) are now regarded as yoke sheaths.⁴¹ 67-68.

Finally, the origin of the whippetree must be considered as an essential and useful part of the modern harnessing system. It has been considered as a 'transmigrated yoke', a device to aid turning, a means by which the reins were kept apart, a bar which in tandem harnessing allows the animals in front to pull the vehicle and not simply the horses coming behind and a jointed piece of wood whose function is to cushion the shock caused by the rapid movement of horses as opposed to the more deliberate movements of the ox.⁴² Thus the true nature of the whippetree is still unknown, It is, however, certainly connected with the redundancy of the yoke, at least in origin since it only appears after the adoption of the collar.

Irrespective of its function, the real question is its date of introduction.

' At least one of the innovations included in the complex of techniques that made horse-drawn transport feasible is unique to the middle ages. This is the whippetree, a wooden bar

41. Paul Jacobsthal, Early Celtic Art (Oxford 1944) p 185 no.171 pl.107, 108.

42. Marjorie Nice Boyer (1960)
Personal communication Mr. Macdon ld, Saddlery Dept.,
St. Cuthbert's, Edinburgh, Needham (1965) IV 11.

whose ends are hooked to the horse's traces and whose centre is connected to the front of the vehicle' .⁴³ I know of no whippetree earlier than those on the bronze doors of Novgorod Cathedral made at Magdeburg in Saxony in 1152-4' .⁴⁴

Historians are agreed that the whipple was a medieval invention. However, there have been claims from archaeologists for Iron Age swingles, from surviving rods and rings to which the traces are attached.⁴⁵ Claims for an early whipple would seem to be unlikely since no representations exist for the Roman period and the decorated ring terminals could just as easily have been fixed to the front of the chariot as to a whipple bar. The first representations of both whipple bars and individual whipples attached to vehicles are medieval. Novgorod cathedral is not the earliest, however, since a scene from the Bayeux Tapestry c 1070 shows a whippetree being used on a harrow⁴⁶. Whipplebars and individual trees appear to be contemporary and though one would imagine that the trees would give more freedom of movement, the presence of one of the other in representations is not indicative of technical competence, since they appear for the first time almost simultaneously. Nor can a centre of origin be isolated neither from the illuminations nor from the multiplicity of names which indicate widespread dissemination in western Europe. After 1070, it appears frequently in European manuscripts and is as distinguishing a feature of horse harness as the yoke is of the harnessed ox.

43. Leighton (1972) p 114-6.

44. Lynn White (1962) p 66 footnote 5.

45. Jacobsthal (1944) 1944 p 120 Germania XIV (1934) pl.104

46. Stenton (1957)

CHAPTER THREE : MEDIEVAL HARNESS.

Thomas Hennell in 1934 described a ploughman of East Quantoxhead, Somerset, as having two or three songs which he sang continually over and over again and when he stopped singing the oxen stood still in their tracks.¹ Horses, however, were almost certainly a very different proposition, and for the medieval scribe at any rate, harness was indispensable, if not in reality then at least as a word which was useful to have in their vocabulary. Harneys could mean almost anything except food and drink. It could mean armour. The Derby accounts order 'Vill longe koferes withe the armes and a sprewse kofere of harnes and a pype fol of harowes loked and an hogeshed lokes wethe myn howenhernes'.² It could mean the personal belongings of the wardrobe - 'Unum saccum cum lecto et hernes... cariatum in carectis garderobe - '³ or of an individual - 'Pro locōne diversorum harnestorum domini'.⁴ It could also mean goldsmiths' work - 'a collar garnished with harness of latten for the lord's greyhound'.⁵ or even clothes - green woollen stuff 'pro diversis harnesiis domini...faciendis'.⁶ Harneys or hustylment may mean a utensil.⁷ Finally, it can mean the equipment of a horse - 'pro harnesic j carecte';⁸ 'Inlj coreis ad harnes longe careta';⁹ 'Carte harnas, vix. colers, panell...'¹⁰

Harness in its final sense appears frequently in medieval illuminated manuscripts. By the tenth century completely modern harness with traction from the sternal region is depicted.

1. (1934) p 26
2. Camden Society 46/18, Stretton (1924), Derby Accounts 46/18.
3. *ibid.* p 98.
4. Camden Society 187/13
5. A Wardrobe Account of 16-17 Richard II, Archaeologia LXII pp. 497-514.
6. Derby Accounts 241/24
7. Promptorium Parvulorum, Camden Society (1843)
8. Derby Accounts 175/5
9. Hamilton (1910) roll c 482
10. Durham Account Rolls Surtees Society (1893) p. 607

The farm wagon with a central pole, oxen draught and yoke, however, continues into the middle ages and is as popular as equid draught for agrarian use. When travelling carriages are represented, however, these are drawn exclusively by equids. Furthermore, it may be said that the problem of effective horse harness has never been solved. Even in the last century, controversy over harness was prevalent and straps, often with contradictory functions, proliferated. Such difficulties may be seen in medieval depictions by the presence of a postilion rider with multiple teams. Moreover while the collar is the most frequently represented equine harness, after the eleventh century, the breast strap continues to be depicted. British Museum Royal 20D1 for example shows breast strap in one folio and collars in another with no apparent reason behind the change. Breast strap, however, tends to occur more frequently in biblical histories where presumably the illuminator may have been trying to be deliberately archaic. Generally, however, it is the collar which is present with equids. Collars are shown with hames as separate pieces. Often there are no hames. This is particularly the case with manuscripts illuminated in England. Hames depicted on Flemish manuscripts are almost exclusively square topped while those of the French manuscripts come to a curved point. This variation is not a matter of chronology and therefore by implication technical competence, but rather of regional or national variation. Blinkers are common in European miniatures by the fifteenth century, especially on carriage horses. The covering of the eyes of a working equid has been known since Roman times but the date of the introduction of blinkers is unknown. Oxen did not need blinkers, but when they worked in tempting surroundings they were nets over muzzles, for if one had bent its neck to graze the neck of its yoked partner would have been hurt. Swingles or whippetrees are frequently depicted. They appear on vehicles drawn by equids or mixed teams but hardly ever with oxen teams alone. By the fourteenth century, vehicles are rarely depicted without whipples. Representations show both the whipple bar and the jointed individual trees but by the fifteenth century both are

common. Each pair has their individual trees, the free swingle trees nearest the vehicle being attached to the fixed swingle bar. Saddles or central girth straps and cloths are shown from c1070.¹² Saddles become the most popular, however, and with the use of postilion from the fourteenth century it is generally a normal riding saddle which is used for the lead horse. The general range of harness in common use in the middle ages is most clearly depicted in manuscript c1250¹³ which is extremely detailed in technical matters. In particular it illustrates clearly leather trace coverings, collar and horn harness.

The general range of harness available in the medieval period, particularly the fourteenth and fifteenth centuries most clearly shown by entries in the manorial accounts. These also indicate costs materials and craftsmanship involved in the making of harness in the middle ages.

This material on yokes is based for the most part on the surviving compotus rolls for the manors belonging to the cathedral priory of Winchester. These are mainly in Hampshire and Wiltshire.¹⁴

Prior to 1325 there is no mention of yokes in these records. Evidently they were homemade. This is of course still the case as late as the sixteenth century. If we are to believe Tusser. 'Yokes, forks and such other let baillie spie out, and gather the same as he walketh about. And after at leasure let this be his hier, to beath them and trim them at home by the fire. (1583)

From that date they appear in about one roll in three, on an average about five being bought at a time and with the price varying from 1d. to 2d. each. There are three categories of entry:-

- (a) Yokes ready made and their cost,
- (b) Charges for making the yokes, the wood being supplied by the manor.
- (c) Blacksmith's charges for fitting the iron-work.

12. Stenton (1957)

13. S.C.Cockerell, M.R.James and C.J.Pfoulkes (1927)

14. Drew.

YOKES READY MADE AND THEIR COSTS.

(a) Cornwall	Burnere	1d = 1400	
Essex	Milton	1½d = 1277	2d = 1296
Gloucs.	Tidenham	1d = 1292	
Hants.	Chilbolton	1d = 1318	
	"	2d =	
	Houghton	10d = 1280	(for 8)
	Littlejohn	1d = 1248	
	Silkstead	7d = 1325	(for 12)
	"	1d = 1331	
	"	2d = 1379	
	Wonston	¾d = 1267	
Herts.	Aldenham	2d = 1372	
Hunts.	Elton	3d = 1351	
Kent	Cliffe	4½d = 1294	(for 5)
	"	1½d = 1345	
	"	1½d = 1347	
	Hollingbourne	3d = 1369	
	Lyddon	3d = 1340	
	Westerham	1d = 1268	
	West Farleigh	2d = 1286	
Norfolk	Briston	1d = 1301	
Wilts.	Durrington	2½d = 1292	
	Stockton	¾d = 1267	
	"	1d = 1280	
	"	5½d = 1305	(for 4)
Worcs.	Oldinton	1d = 1328	
Wilts.	Alton Priors	12d = 1267	(for 9)
	Patney	1d = 1267	
	"	1d = 1271	

The ox bows arcus, were sometimes bought with the yokes. However, on many manors there is no mention of these at all. On some desmesnes it is laid down that these should be made by the ox herds., for example at Silkstead. The custumal of Chilbolton. Camerarii of 1261 says of the oxherd, 'inveniet funes et arcus ad carucas domini quamdiu necesse fuerit'. Oxbow

stones are still to be found. Hartley and Ingilby describe the bows being made where hazel sticks, held in position by pegs placed in the holes in their cases were bent round the carved stones to make the bows for the ox yokes.² When set they were fastened to the yoke by a rope of twisted withies.

By the late fourteenth century they were bought ready made or with timber from the manor. For the former the entries appear thus:

Elton, Hunts 1391 ³	In arcibus boum et bukks emptis 10d.
Adisham, Kent 1286	In courbis et jugis boum ferrandis 8d.
Enford, Wilts. 1248	In jugis et arcia boum emptis per annus 7d.
Lyden, Hants. 1340	In Ij chippis, Ij baginis, Ij sidrestes, Ij scheldrestes, Iv bilettis, Ij shidhames et Ij arcibus boum empt 11d.
Lullington, Sussex 1390	In thistris arcibus et aliis minutis pro caruc. et plaustris 2/9d.

When timber was supplied by the manor itself the prices appear thus:-

Combe, Hants	½d = 1308
Crawley, Hants	1d+ = 1410
Michelmersh, Hants	½d = 1267
" "	½d = 1299
Moundsmere	½d = 1329
"	1d = 1402
Ropley	1d = 1384
"	1d. = 1415
Vernham Dane	1d = 1374
Wootton	3d = 1316 (for 15)
Aldenham, Herts	1d = 1351
Pryford, Surrey	½d = 1293

A typical entry would read like the one from Wootton, Hants.,

'In stipendio carpentarii facientis 15 jugo boum ... 3d.' (1316)

Carpenters pay being then on average 2½d to 3d per day, the inference is that the making of each yoke took less than an hour.

2. Rydale Folk Museum, Hutton-le-Hole, Farndale, Yorkshire

3. Drew

Sometimes the whole yoke was made by farm servants;

'In jugis et lanis nichil quia per familias'
(Holecombe, Regis, Devon, 1333) Sometimes the manor is charged by the carpenter for the drilling of holes (to take the oxbow?).

'In 4 jugis boum perforandis et reparandis..1d'
(Wroughton, Wilts. 1303)

The use of neb yokes is apparently on the inventory of the cellarer's account of the 1477 roll from Battle Abbey, Sussex, but Drew merely gives a translation of the latin and no costing.

(c) Charges made by the blacksmith;

This last class is by and large the most interesting of the three. In the fifteenth century yokes were fitted staples, rings and hooks, etc., to which chains were attached. We have mention of these on a number of manors in the late fourteenth century. Indeed if it is safe to translate the verbs *circulare* and *ringulare* as to fit rings and Drew apparently was of the opinion that this was a safe translation, then they were being used in Kent as early as the 1280's. In any case it is noteworthy that in eight out of ten manors where ironwork is mentioned before 1350, were in Kent.

Ruckinge, Kent 1281	'In 2 jugis boum ferrandis et ryngulandis..8d 'In 2 jugis boum circulandis ..6d
Adisham, Kent 1284	Adisham, Kent, 1284 'In 2 jugis boum ferrandis 8d.
West Farleith, Kent, 1286	'In eisdem (3 jugis boum) circulandis cum ferro..6d.
Little Chart, Kent, 1328	'In 4 jugis boum ferro rynglandis..8d.
Loose, Kent 1329	'In 3 jugis boum et i curb' ferro rigglando..6d
Ebony, Kent, 1330	'In 1 jugo faciendo et ringulando ..4d
Barkshore, Kent 1336	'In 1 jugo boum empto et ferro rynglando ..6d
Lydden, Kent, 1342	'In 1 jugo boum ferrando..5d
Westwood, Wilts. 1316	'Pro jugis ferrandis...7 $\frac{1}{2}$ d

Worcester Priory 1346	'In stapulis emptis pro jugis boum..3d (Almoner's Roll)
Hinton Ampner, Hants. 1377	'In juga boum cum anulis, crokys et stapulis ferreis (Inventory)
Whitchurch, Hants. 1390	'20 boltis, 10 hokys, 4 cappis et 20 anulis ferreis ad 10 jugaboum (Inventory)
Wootton, St. Lawrence, Hants. 1398	'In 20 cappis 10 anulis 10 stapulis et 6 croke ferreis de novo faciendis ad 10 juga boum...8s.6d.
Crondal, Hants. 1418	'In 7 jugis boum cum stapulis et hokyos ferreis' (Inventory)
Yalding, Kent 1350	'In 2 jugis novis ferratis emptis ..8d.

Collars were bought ready made on every manor, ⁴ though the purchase of hames is recorded separately. This would tally with the custom in southern England in the nineteenth century where wooden hames were often made and spares were easily carried, repairs or replacements carried out in a matter of minutes. Iron hames were used 'chiefly for horses for road work and often as a point of decoration. In some counties, Gloucestershire, Oxfordshire and Wiltshire, collars were preferred to yokes. The oxhame like the horse hame was made of wood' but had a 'drawbar' a trace attachment higher up, because of the different pull. Because of the horns, the collar was U-shaped, put on upside down, fastened with a strap and then twisted round until the buckle and strap were on top, and the thickest part of the flocking rested on the chest. Prices for collars rise from 6d to 8d. before 1350 and from 8d. to 13d. after that date. Entries also record repairs and materials.

4. The Countryman Spring 1971 p 138

COLERUM.

RMLWL ; a collar

Milton, Essex 1278 ⁵

"

"

Chartham, Kent 1270

Cliffe, Kent 1294

"

Monkton, Kent 1298

Mo undsmere, Hants. 1299

Radstowe, Northants 1264 ⁶

Wolverhampton c 1290 ⁷

Petworth, Sussex c 1327 ⁸

"

"

Easton 1325 ¹¹

1357 ¹⁰

In j bass et coler emptis 13d.

In j collar 5d.

In j collari et j pari de bass
ad sellam 16d.

In 11j colers 15d.

In hamis, curb et wippeltr.
emptis 4d.

In j carthame, Imj novo collar ad
idem 4d.

In Ij coler et j bas 15d.

In j par de base. et Ij colar empt 7d

In j par baconum de novo empt et
veteribus emend cum 1V colariis
equorum emend 13½d.

In Ij coleris emptis cum hamis 8d.

Ringes 8d. hames 3/-d colar 11d.,
flokkes 8/1d. filo 6d.

In j coler empt 6d.

In j coler empt 8d.

In j pari ocr. pro collaris inde
faciendis cum filo ad idem empt 4d.

HAMA

RMLWL ; hame 1282

Agney, Kent 1285

Cliffe, Kent 1282

Moundsmere, Hants. 1287

Cliffe, Kent 1292

" 1295

" 1297

In Vj hames emptis 6d.

In VIIj hames emptis 12d.

In Ij annulis ferr de ferr
domini fac ad pendend, in Ij hames
et in limion ejusdem caret cum Ij
platis ferro fac et imponend 3d.

In hamis, curbis et wippeltr. empt 4d.

In oxeboghes et stotthames emptis 8d.

In restis, schamel axibus jugis
hames et oxseboghes emptis ad carucas 9d.

5. Drew

6. PRO SC6 949/3

7. Legal and Manorial Formularies (1933)

8. PRO E101 35/15

9. PRO SC6 950/23

10. PRO 750/25

11. Drew

Wroughton, Wilts. 1311

In cappis auriculis hamis et
happ ferreis pro lann carucatum
faciendis de proprio ferro 11½d.

SELLA

RMLWL ; saddle 1282

Littleton 1248

Silkstead, 267 ¹²

Milton, Essex 1280

" 1294

" 1296

" 1299

" 1302

Westmill, Herts. 1283

Chilbolton 1307

North/
Wellingborough, Hants 1322 ¹³

Vernham Dean, Hants. 1335 ¹⁴

Fendesham, Worcs. 1362

Whitchurch, 1373

" 1377

Silkstead, 1382

Speen 1257 ¹⁵

j sella cum baciis ad carect 12d.

In Ij paribus bazz. cooperiendis
et implendis 6d.

In j sella cum basse 8½d.

" " 6d.

" " 1½d.

In 11j sellis ad carecta sine bassis
9d.

In j pari base ad sellam carecte.

j sella empta cum bass et in Ej
sell carectar empt sine bargis 12d

In V collariis et i pari bac et j
pari de bac de proprie coreo
faciendis cum canavat et flokis
ad idem emptis 18d.

In emendacione IV veterum sellarum
et in octo libris burle emptis pro
eisdem et pro emendacione Vj
colariorum et in tribus paribus
papis carectarum 22d.

In j barga ad sell carect empt 4½d

In j pannelo pro cella carect empt
9d.

In arbora cum j bas empts ad
cellam 12d.

In j arbore (struck through and
ligno interlineated) pro sella
carectaria empta 4d.

In j pannelo pro sella carectaris 8d.

In j ligno p.uno cartsadel 4d.

12. Drew

13. Page (1936).

14. Drew

15. PRO SC 6 750/25

HARNESS MATERIALS

RMLWL ; corim album - white tawed leather 1148
corium tannatum - tanned leather.
burra, burellus - coarse wool 1172
canavacium - rough cloth, canvas cl300
floccus - refuse wool cl200
villosus - rough cloth 747

Drew ; wadmol - thick woollen cloth.

Worcester 1286	16	In albo coreo empto 14d.
"	1293	In albo coreo ad harnesium 2/d.
Monkton, Kent	1295	In harnesio carectario reparando contra autumnum cum flokk, canavacio et albo coreo emptis ad idem 3/-d
Michelmersh	1316	In stipendio unius facentis Vl j collaria et lj paria bas nov. et emendantis lj collaria et lj bas et cooperientis unam sellam carectariam 2/2d. In corio tannato 20d. In V virgis emptis 15d. In XlX lib burr emptis 14d.
Pershore, Worcs.	1346	I flokkes empt ad vet harnesium empt 2/4d.
Wooton	1393	In V virgis de wadmol emptis pro coleriis cooperiendis 20d.
Whitchurch,	1395	In V veteribus colariis reparandis cum j ulna de canavasio et vlII ad idem emptis 12d.

WHIPPLETRES.

BILET

RMLWL ; swingle bar of plough 1300

Lyden, Kent	1311	In curbis et biletis 4d.
"	1340	In lj chippis, lj vaginis lj sidrestes, lj scheldrestes, lV biletis lj shidhames et lj arcubus boum empt 11d

CURBA/COURBA

RMLWL ; a curved piece of wood 1282

- Lyden, Kent 1272 In j curbis emptis et ringlandis
10d.
- Cliffe, Kent 1282 In j curb, lj shamel emptis 5d.
- Adisham, Kent 1286 In courbis et iugis boum ferr-
andis 8d.
- " 1343 In courbis et iugis boum ferrandis
12d.
- Agney, Kent 1333 In lj curbis empt. In lj bilettis
emptis 1d.
- Loose, Kent 1329 In j courbe ringulande et
scapuland cum ferro 4d. In j
iugis boum et j curb ferr
ringlando 6d.
- Russedon-in-Sheppey, Kent 1363 In lj novis courbis pro 1V
stottis ad carucas 4d.

DRAUT.

Wright E.D.D. ; a rough whippetree

- Lyden 1325 In 1lj paribus de drautesempt 3d.

HORSTRE

Drew ; whipple

- Lyden, Hants 1368 In lj horstres 4d.
- " 1369 In j horstre 2d.

SWEILTRES

Drew ; whipples

- Lyden, Hants 1325 In sweiltres emptis 2d.

SWEYPETRES

Drew ; whipples

- Wellingborough, Northants. 1323 In lj sweypetres 1d.

TRACES AND STRAPS

CORDA.

RMLWL ; rope 1183

- Milton, Essex 1277 In j corde de cano duplici 3½d
- " 1299 In lj cordis ad carectis et j
paris de canabo.
- Cliffe, Kent 1294 In lj cord de weft ad equos
pasturandos 2d.
- Radstowe, Northants, 1267 In 1Vlj cordis de basto ad affros
ligand in pastura 8½d

Milton, Essex 1299

In 1j cordis et 1j capistris
de proprio pilo faciendis 2d.

DRAUTES.

Drew ; traces

Oakington, Cambs. 1362

In j petro canobi facti in
harudrautes et trays 3d.

Holcombe Regis, Devon 1372

In reparacione le drath pro
bobus trahendis 12d.

HARCIA.

RMLWL ; harness

Hales 1297

Consuetus est capiendi virgas
in harcis vincinorum et inde
facere coribellas

Brightwell, Berks 1203

In hartis et aliis necessariis ad
carucas 2/8d.

PENTRELLUS

RMLWL ; -

Hamilton ; a breast girth.

Worcester 1333 ¹⁷

In j pentrello empto pro sella
servientis et j freno pro eodem
ac repapacione freni precentoris 2/-d

ROPA

RMLWL ; rope 1292

Durrington, Wilts. 1292 ¹⁸

In virgis emptis pro ropis et lannis
2½d

Ropley Hants. 1403

1j popos ferreis pro bobus in
eisden (caruce) trahentibus

Holcombe, Regis, Devon

In stipendio fabri pro erpeyre
ropis, trackis et aliis necessariis

Lyden, Kent 1276

In 1j stotrop et Vj capistris
emptis 7d.

Adisham, Kent 1343

In VIIj paribus de stotropes cum
portouvres (?) et capsitis ad
idem emptis 16d.

STERCWITHES

RMLWL ; -

Drew ; traces

Worstead, Norfolk, 1351

In st'cwithis 2d.

17. Hamilton (1910)

18. Drew

TRACTUS

RMLWL ; trace 1388	
Weston, Herts 1278	In 11j colariis et 11j paribus tractum ad stottos 2/9d.
Milton, Essex 1280	In 1j paribus tractum 6d.
" 1316	" 10d.
Chartham, Kent 1294	In 1j cordis et 1j trays 16d.
Ropley, Hants 1402	In 1j paribus tractum empt cum Pypys pro eisdem 15d.
Worcester 1294 ¹⁹	In pipis ad trayturam longe caree emptis 7d.
" 1371	In albo coreo pro tractibus emendis 8d.

TUG.

RMLWL ; tuggum, a tug 1250, togwithum, a tugwithe, (for fastening swingle tree) 1360	
Elton, Hunts. 1298 ²⁰	In LXXX togwythen et LXXX thysters emptis ante festum omn. sanct. 6d.
? 1250	In carucis emendandis...in jugis et tuggis ad idem emptis 9d.

VIRGA

RMLWL ; a withy for harness 1294	
Dry Drayton	In virgis emptis 2/1d.
Sydden, Kent 1311	In cordis et virgis ad harnesium 9d
Russenden-in-Sheppey, Kent c1300	In Vj fessis virgularum emptis pro instrumentis carucarum faciendis 6d.

WARROKES

RMLWL ; warroccum packing stick, 1247, wedge for tightening lashings of scaffold poles 1325.	
Hamilton; girths ²¹	
Worcester 1376	In 1j warrokis pro sella summagiala 4d.

19. Hamilton (1910)

20. Drew

21. Hamilton (1910)

WAUTYGHES

RMLWL ; -

Salzman ; surcingle or girth ²²

Petworth Sussex 1349

Pro Vl j gatys et watyghes
pro carecte 5d.

Several indications are therefore given by the manorial account on the harness in constant use on the manor. Firstly unlike collars which are always bought complete (except for the hames) saddles for carts may be bought complete but more commonly are bought in parts. The wooden foundation is described as lignum or sella lignea until c1350 when it becomes arbor. That there may be a distinction between the two is indicated by the 1377 entry for Whitchurch. Bacium is the saddle pad which is always bought in pairs up to c1300 and thereafter is bought singly. These two facts together would seem to indicate a modification in cartsaddle type in the early fourteenth century. Saddles today may be stuffed with a panel of wool, with a leather covering, or made of felt covered with leather. Though Alexander Neckham in 1180 says that a horse collar should be covered with felt, no mention is made in the records of felt saddles. The most common harness materials are burrel, canvas, coarse cloth and refuse wool. Medieval cart harness would seem to have resembled the slightly cheaper modern saddle. Material is also bought separately to rehabilitate old saddles on the manor. Secondly, horse collars were probably bought in one piece because it was one of the principal leather crafts. In the late thirteenth century in Paris, makers of horse collars managed to retain both night working and peddling within their gild (against the normal guild regulations) by agreeing to have their collars inspected for bad stuffing. Night work was characteristic of the leather trade. Saddlers, however, did not work at night because their wares were expensive and demand for the fine leather parts of saddles and for the saddles themselves was brisk. Thirdly pannellus is also used in the rolls to mean

22. Salzman (1955)

23. Bronislaw Geremek, Le salariat dans l'artisanat parisien aux
Mille au XVe siècles (Paris 1968)

saddle pad. However, it never appears in the same roll as the word bacius, though they do occur in similar contexts and with similar price ranges. Fourthly there are five types of hide of which four are raw and the fifth is tawed. This is the albeum correum of the accounts and it is used exclusively for cart harness. Tanned leather, treated with chemicals and greases wears longer and is generally thicker than the finer rawhides. The thicker the leather, the more fat content and therefore it wears better and is more flexible. Fifthly swingles, traces and bands form a large group in the medieval accounts. Fitzherbert discusses the positioning of several of these parts. 'They must haue hombers or collers, holmes withed about their neckes, tresses to drawe by, and a swingletre to holde the tresses abrode, and a togetwith to be bytwene the swyngletre and the harowe.'²⁴ The word draut which is supposed by Drew to have been the origin of the modern term draught reflects the importance of the function of the traces. They are generally bought by the fathom, about nine fathoms per vehicle.²⁵ They were made of two materials, hemp or twisted willow. The oxherds in Chilbolton²⁶ were apparently expected to make their own traces and Chilbolton lies on the river Test where withy beds are common. However, the auditors instructions at Dry Drayton in 1323 is of special interest as interlined above 'In virgis emptis' the auditors had written 'de cetera face seminare canabum', showing that here hemp was considered more suitable than withies. Only one mention is made of rope made of finer material, namely cord de camo which suggests silk. Ropa would seem to be the word used to describe metal traces though clearly it is only in the fifteenth century that these appear consistently in the accounts. Piping, encircling the traces consistently occurs in the records only in the fifteenth century. This may indicate that they were linked to the introduction of chain traces, although it has always been understood that these tubes were placed strategically to prevent wear - as illustrated

24. Skeat Fitzherbert; The Book of Husbandry 1534 English Dialect Society D miscellaneous (1832)

25. Salzman (1955)

26. Drew

by the manuscript of 1260 ²⁷ and would therefore seem more logically to have been of more use with hemp traces. Sixthly, there is no indication of the use of horsehair for ropes as set down in the instructions of Walter of Henley. ²⁸ However, since this task has always been done by hand with pullings from the horses' and oxen's tails ²⁹ there would be little need to record such rope. Finally, metal components such as terrets, so common in the prehistoric record are entirely absent from these documents. Turrets or bit rings do occur as does various small metal parts for the plough. However, as far as harness for the cart is concerned, it can only be assumed that hames included all the caps, hooks or rings, needed for medieval draught.

Thus the records show in considerable detail the components of the medieval working harness which according to the prices was a considerable item of expenditure, second only to wheels.

27. Cockerell, James and ffoulkes (1927)

28. Oschinsky (1971) p 141

29. Thomas Hennell (1947)

SECTION 3 : C : FARRYING TECHNIQUES.

This section will try to examine farrying techniques for the simple reason that though it is difficult to separate riding and draught horses from evidence of shoeing, any improvement in the protection of the hoof would be bound to have an effect on the efficiency of the draught horse. As Lynn White has pointed out ' for the long haul, a draught animal is only as good as its hooves' ¹. Thus the function of the shoe is to protect, acting as a shock absorber to prevent concussion of the foot, ostosis of the pedal bones and strain on the tendons. Moreover in soft ground, shoes press more deeply into the ground and cause greater friction with the surface, making the animal more sure footed. As Fitzherbert emphasised in 1534, 'The horses that shall draw these harowes muste be well kepte and shodde or elles they wyl soone be tyred and sore beate that they may not drawe' . ².

CHAPTER ONE : ROMAN HORSESHOES.

There are three types of Roman shoe named in the sources, the hipposandal, the solea spartea and the solea ferrea. ³ They share the common feature of not being true iron shoes, being designed to be tied not nailed to the hoof. It is generally believed that the function of the hipposandal - which may be taken as a general term for this type of shoe - is analogous to the modern poultice boot or the straw and calico creations of the nineteenth century. However, while there is a distinction between a shoe for an animal with a damaged foot and one for better purchase for traction, it is not a very big step from one to the other. This may be moreover, encouraged by the practice of shoeing of a good foot in cases of hip injury. ⁴

1. Lynn White (1962) pp 59-60

2. Skeat (1882) p 15

3. For example, Columella VI,XII,III and VI,XV,II,Catallus XVII 25-26, Suetonius Nero XXX

4. De Blundeville, The True Art of Paring and Shoeing all Manner of Hooves (London 1565) Chpt. XIXI.

The question which surrounds the Roman shoe is whether it can be seen to be performing other than a therapeutic function. There would be little point in outlining step by step the heated and somewhat lengthy controversy over the existence of such a shoe in Roman times. It would perhaps be of more use to indicate that the argument rests on the way one believes that hipposandals may have been used and whether one is prepared to accept the material remains of the shoes from Roman north Europe. [69]⁵ Firstly it is possible to maintain that although Vigneron insists that the hundreds of existing shoes from nineteenth century museum collections should be ignored, there are finds from excavations on northern Europe, of both shoes and paring tools, which were found by using techniques sufficiently refined as to ensure that these were from Roman contexts.⁶ Secondly, recent papers by John Clark and Mrs. Littauer have presented modern examples of tied-on shoes (and an example from 1892) which are used for healthy hooves.⁷ One manufacturer in fact recommends his shoes as being better than the normal one for gripping slippery surfaces. Mrs. Littauer agrees that they would be suitable for healthy hooves but with the reservation that the need to protect the tender pastern from rubbing straps would necessitate the use of padding and this would restrict its use to draught horses with a slow enough gait not to dislodge the pads. It is interesting to note Curle's conclusions here as to the absence of hipposandals

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5. See Vigneron (1968) Heichelheim, An Ancient Economic History 11, pp 202-3, 111 pp 325-6 (Leipzig 1958) 'Man's Role in Changing the Face of the Earth in Classical Antiquity' Kyklos LX (1956) p 325 for bibliography.
 6. Vigneron (1968) R.E.M. Wheeler, Maiden Castle Dorset, Report Soc. Antiq. London 11 (1943) and T.V. Wheeler, Verulamium, Rep. Res. Comm. Soc. Antiq. London XI (1936) G. Ward 'The Iron Age Horseshoe' AJ XXI 1941, Piggott 'Three Metal-work hoards of Roman period' PSAS LXXXVII (1952-3) pp 1-50.
 7. LI (1977) pp 235-236. 'Hipposandals again Plus ce change' Antiquity

from Newstead cavalry barracks⁸ where he inferred that they must have been used exclusively for draught horses. The use of hipposandals for the same purposes as iron nailed shoes is not beyond the bounds of probability therefore.

The problem with this theory has always been the silence of the sources as to constant use of shoes. There are no descriptions of the noise of hooves on the streets for example. One might point out that neither are there descriptions of naked hooves poundingⁱⁿ the ear. One might assume that the classical authors were not fond of such descriptions. It has also been assumed that the meticulous descriptions of hoof care and ways of keeping the hoof hard indicated the absence of shoes.⁹ The need for shoeing is the direct consequence of domestication. The working of a horse on hard ground leads to a wearing away of the hoof wall at a greater rate than it is replaced. Conversely the effect of shoeing is that protected from wear the wall becomes unduly long. The shod foot calls for as much care and attention as the unshod foot. However, it is generally recognised that the adoption of the shoe for a sound animal was precipitated not only by Roman road construction but also by a damper northern climate. Silence of the sources would be more logically explained by the fact that shoes were only common north of the Alps. Shoeing is a difficult process. The problem is to fit a shoe securely without injuring the animal. Experimentation is not going to be conducted in an area where the presence of shoe is superfluous, namely in the south. An origin for the development of farriery techniques must be sought in northern Europe.

8. Anderson (1961)

9. K.D.White (1974) Anderson (1961) quoting Xenophon, Chiron and Vegetius.

CHAPTER TWO : THE MEDIEVAL SHOE.

'The Celtic inhabitants of the Alps invented the horseshoe about 400 B.C. ... as an assistance to overland transport'.¹ 'Nailed-on iron horseshoes are attested in western Europe from the late ninth century and unambiguous evidence for their common use comes in the eleventh century'.² 'Ce n'est que postérieurement à Charlemagne que la ferrure à clous apparaît sur les documents figures d'Occident'.³ The earliest unambiguous excavated evidence of horseshoes comes from ... the Yenisei region in Siberia in the ninth to tenth centuries'.⁴ Simultaneously nailed horseshoes are mentioned in Byzantine Tactica of Leo VI who reigned from 886 to 911. And in the west we probably hear the first sound of shod hooves in the last decade of the ninth century when Ekkehard's Waltharius says "ferrata sonum daret ungula equorum".⁴ There is some question therefore as to the date at which the horseshoe was commonly used in western Europe. However, it is no longer necessary to look to transmission from the east. Evidence from northern Europe for the Roman period cannot simply be ignored. While there are no representations of pre-tenth century shoes while the Vaison relief is in doubt,⁵ excavated evidence shows continuity in style and function for horseshoes in northern Europe from the late Roman period to the thirteenth century.

There were two forms of shoe in northern Europe as displayed by the material finds, though these are subject to local variation and difference in size according to to the size of the beast. Though both existed contemporaneously, the regular shoe as opposed to the lobate form was gradually

1. Heichelheim (1956) p 325

2. Leighton (1974) p 16

3. Des Noettes 'La Question du Fer à Cheval' Bulletin de la Société National des Antiquaires de France (Paris 1936) pp 76-83

4. Lynn White (1962) pp 58-9.

5. Des Noettes L'Attelage 1 pp136-143

refined in the middle ages until it developed into the modern shoe.

The lobate or wavy lined shoe has a continuous history in north Europe from the late Iron Age.⁶ They are found in contexts with both the hipposandal and the regular shoe but have been regarded technically as an interaediante form. Its distinctive shape is caused by the punching of holes to take the nails. This shape is still used in farriery when the holes are punched from the road side of the shoe. The Roman lobate had six holes, three per side, while the medieval shoe had up to eight. The nail used had a broad flat head - the 'fiddle Key' nail - which fitted into the punched hole. The calkins or turned over ends of the branches were regulated so that the horses' hoof stood on six nails and two calkins parallel to the road. [70] It is generally accepted that the Roman lobate was smaller, narrower and wider apart at the heel ends. This shoe is commonly found on medieval sites.⁷

The regular outline horseshoe is found as early as the lobate form but is more common by the thirteenth century. Though high calkins still exist in the Alpine, Upper Danube areas and toe calkins are sometimes introduced to correct bad posture in a horse, they had disappeared from the medieval horseshoe at least in Britain. The regular outline shoe is not only found on medieval sites,⁸ it is also represented in miniatures by the fourteenth century, for example, British Library Harley 6563 folios 63b and 69 and Add. 49622 folio 154b.

6. J.B. Ward Perkins London Museum Medieval Catalogue (1940) p 112ff

7. Wheeler (1943); C. Green, 'The Purpose of the Early Horseshoe', Antiquity XL (1966) pp 305-6, Stanley E. West, 'Brome, Suffolk. The Excavation of a Moated Site 1967', JBAA XXXIII (1970) pp 81-121, Ward Perkins (1940) pp 112 ff.
8. Colin Platt, Excavations in Medieval Southampton 1953-1969 (Leicester 1975) Vol 2 pp 282-90; S.E. Rigold, 'Excavations at Dover Castle' JBAA XXX (1967) pp 87-121; E.M. Jope and R.I. Threlfall, 'A twelfth century castle at Ascott Doilly Oxfordshire', AJ XXXIX (1959) pp 219-273.

Though the shoe was in due course fullered, the protuberant nail survived well into the late sixteenth century, in the illuminated manuscripts. It is shown in miniatures from the thirteenth century onwards, for example in the Luttrell Psalter, the Chertsey tile (1260),⁹ British Library Cotton Nero C 1V folio 22, Royal 12 F XIII folio 3 and as late as the sixteenth century in the Portuguese manuscript, Bodleian Douce b2 65-35 folio 34.

Another feature of the miniatures is the depiction of the clenched-over nail, clearly shown on the outer face of the hoof, for example British Library Royal 1901 folio 6, Add 18358 folio 4b, Royal B XX 464 (French XVth century), Add 21143 folio 90 (XVIIth century French), Add 10294 folio 45b and Lansdowne 1179 folio 104. A fullered shoe, however, is shown as early as the thirteenth century in the English manuscript Bodleian Douce 88 folio 51.

Moreover, the difference between English and continental methods of shoeing is indicated by a comparison of Bodleian Douce 88 folio 51 and the fifteenth century Flemish manuscript Bodley 264 folio 107. The continental method of shoeing would appear to have been to work behind the horse with the animal in a wooden cage while the English smith worked from the side with a squire holding the horse by the bridle.

Finally the manorial accounts give further information about shoeing, in particular costs. Entries appear thus;

9. P. Verdier, P. Breiger, M. Marquhar Monpetit Art and the Courts of France and England 1259 (Ottawa 1972).

East Farleigh 1277	10	In X bobus ferrandis per Ij vices 3/4d.
" " 1282		In X bobis ferrandis superpedibus anterioribus 3/4d.
West Farleigh 1279		In X bobus ferrandis per vices 4/4d Unde Iij ferrat super ped.posterior et anterior et Vij super ped. anter tantum.
Loose, Kent 1286		In Iij bobus bis ferrandis super omnes pedes 4/-d pro quolibet pede qualibet vice Ijd.
Great Chart, Kent 1343		In XVIIj bobus ferrandis 6/-d.
Vernham Deans, Hants 1335		In VIj bobus et j vacca in pedibus anterioribus 3/4d.
Holcombe Regis, Devon 1306		In ferrandis le male 6d.
" " " 1339		In ferrandis j affrus 3d.
Cottenham, Cambs. 1322	11	In ferrura Iij affrorum et j jument p.a.extra conventionem 3/6d.
Hokyton, Cambs. 1320		In VIIj affris ferrandis in anterioribus 20/-d. In ferrura eorundem in posterioribus 3/-d. In ferrura IIIj affrorum ante et retro 2/3d.
" " "		In stipendio fabri pro ferrura equorum caretteriorum p.a.2/-d.

The records indicate that shoes were bought ready made. If the price of iron is compared to the cost of shoes, remembering that the cost of working iron was almost the same as the actual price of iron itself, it is possible to reach the conclusion that the medieval shoe weighed about half a pound. Sometimes dearer entries would seem to indicate heavier shoes. Generally the difference is between carthorse shoes and affer or stott shoes, the latter usually being heavier. Hennell says that

10. Drew
11. Page (1936)

there are three grades of shoe for a carthorse, heavy, medium and light.¹² The cheapest shoes were probably made with old iron, where a worn shoe is heated and sandwiched over a good half shoe. Nails are purchased at the same time and places as the shoes, bought generally by the hundred. The price indicates that they were two thirds heavier than the lathe nail but only half the size of the broad nail. Horseshoes are bought for the front and rear hooves individually, the former at about 2/-d for the dozen, the latter at around 1/6d. By the fifteenth century the prices rose to 3/-d and 4/-d, the two kinds no longer being bought separately. Moreover, by the 1370's shoes were no longer bought individually but were part of the costs of the annual fee paid to the smith. This no doubt indicated a change in the smith's status.

Oxen shoeing consisted of two plates or cues, one for each hoof, sometimes with a flange upwards. In the last century when bullocks were sent from Aberdeen to London or from Wales to Sussex and London, they travelled by road and a smith accompanied them to mend or replace shoes.¹³ On the medieval desmesnes, however, it depended on the finances of the individual manor. If they were used only in the fields, it is unlikely that they were not shod at all. Recent custom was to have the oxen shod on all four feet, on their forefeet or simply on the off-side clove of the hoof because oxen 'strike' on that side. For shoeing they had to be 'flung' that is, laid on their sides in the smithy.¹⁴ The ox cannot be taught to lift one foot at a time, an early lesson for all horses. When the ox was thrown, the smallest ox-boy sat on its neck to keep it from struggling and the four feet were bound to a tripod of poles. In Berkshire, an account of oxen-shoeing by Maude Robinson, in 1938, says that it was always known when bullock shoeing was in prospect because the blacksmith sent for a piece of fat pork for a pincushion.

12. Hennell (1934)

13. *ibid.*

14. Hartley and Ingilby (1972).

The long nails were stuck into this, so that each was slightly greased. In some countries or regions where shoeing had to be done regularly, a frame was built, and the ox hoisted from the ground by means of a broad canvas belt. Sometimes on very rare occasions, a blinder, used normally for savage bulls, was put on a difficult ox at shoeing time. ¹⁵

Finally while the shoeing of oxen form a large part of the stock to be shod in the southern records, this does not seem to be the case with the northern records, which tend to record only the shoeing of horses.

15. The Countryman 1971 p 136-7

SECTION FOUR : USES OF MEDIEVAL WHEELED VEHICLES.

In a series of short chapters, it is hoped to consider in this section the major uses of wheeled vehicles, to try to indicate that the general viewpoint which has predominated in the past, namely that land transport was inefficient and therefore, little used in the middle ages, is erroneous.^[72] Moreover, in a thesis of this nature, it is important to consider not only the material aspect of technological developments in land vehicles but to fit these into the general pattern of the medieval economy. 'At one extreme was the underlying uniformity of peasant life based on a common agricultural practice... at the other were the cultural activities of specialised groups of individuals, the elite or initiate in social intellectual or spiritual spheres. Between these lay the activities of specialised groups of humbler origin bound by craft ties but essentially part of the peasant community' ¹. In this section moreover, we will take this analysis of the social structure of medieval society to try to show that whatever the 'culture grouping' one link between all three - no matter how tenuous - was the need to move self and goods from one place to another and that the needs of all three, no matter how indirect, resulted in utilisation of wheeled vehicles.

1. E.M.Jope Regional Cultures of Medieval Britain, in Culture and Environment : Essays in Honour of Sir Cyril Fox, L.Alcock and I.Li. Foster (London 1963) p.328

CHAPTER ONE : THE VIABILITY OF LAND CARRIAGE.

The general impression persists that in medieval times communication was infrequent and carriage expensive. It is hoped to put forward a case for the viability of land transport in early medieval Europe. Specific function will be dealt with later. Here it will be discussed in general terms with reference to the cost of carriage.

Firstly it would be fair to say that carriage by sea was less expensive than by land. However, it should not be forgotten that even if the medieval merchant was exploiting sea and river resources to the best of his ability, this did not do away with the need for land transport as some historians seem to imply.² Land carriage was always needed, even where this was to be used in conjunction with seaborne facilities and there were some areas in Europe where fluvial transportation, so emphasised by economic historians, is impossible.^{2a}

Secondly, it must be emphasised that land routes continued to be exploited from prehistoric times into the medieval period. On routes which were undesirable, impassable, disturbed by robbery or military activity, in other words, highly unsuitable for active trade, active trade did not take place. An alternative route was used. In practice, those engaged in the major European trades could normally find routes which were so expensive that they restricted the demand for the commodities and affected their supply.

Thirdly, the costs of land transport should be kept in proportion. In most cases it was only a fraction of the costs which the merchant or manorial reeve would be expected to meet. No doubt there were grumbles but like anyone else

2. Makkal, (1977)

- 2a In this connection, and in relation to my earlier (pp 82-3) discussion of the Trier evidence, it is useful to highlight the differences between Southern Burgundy, where the Saône/Rhône valleys, and associated fluvial routes provided major though not exclusive carriage, and Northern Burgundy/Champagne, where fluvial transport was but one element in a complex transportation system which was marked by considerable road development: the still controversial 'routes Brunehauts' may be instanced here.

running vehicles with high running and maintenance costs, they paid for the service and the convenience. If one takes an example from the wool trade, expenses on a sack of Yorkshire or Shropshire wool was around two pounds to be met both by individual merchants and the London companies, but of this only up to six shillings was the actual cost of carriage. It may be interesting to notice in passing that freighters among these merchants such as de la Pole charged at least a shilling less when handling the king's wool, and carting it to the ports.³ As far as local transport was concerned, most of the carriage was done by service but where carts were hired, depending on the nature of the load, carriage cost in general about 1d. per ton per mile, sometimes less. Professional carters charged about 3½d per ton per mile because of having to cover the legal responsibility of the cargo delivery. At these rates the cost of transporting goods was about 1% of the value of cargo up to 15% for grain for every fifty miles carried.⁴

Fourthly, the number of illustrations and recorded references to vehicles indicate the frequency of their use. As Willard emphasises 'The burden of transport was not just pack-horse and barge. The wagon was widely used in the transportation of goods particularly of bulky material throughout the fourteenth century'.⁵ In other words, the wagon and the cart were practical vehicles well able to meet the competition from other forms of transport.

In the long run, it must be remembered that sweeping generalisations about the costs of transport cannot be made. In his analysis of Transport Technology for Developing

3. PRO E507/22, E358/15, E.B. Fryde, The Accounts of William de la Pole a study of some aspects of the English wool trade at the start of the Hundred Years War, Borthwick Institute of Historical Research XXV (York 1964)

4. Thorold Rogers IV p706-13., II p600-05V p755-778.

5. James Field Willard 'Inland Transportation in England during the fourteenth century', Speculum I (1926) pp 361-374
'The use of carts in the fourteenth century', History XVII (1932-33) pp 246-250.

Regions, Soberman⁶ pointed out the obvious often forgotten fact that any model constructed for the use of vehicles has to be sensitive to difference in cargo characteristics - weight, bulk, density, perishability, - route characteristics and the quality of the transport - speed, safety, reliability. No special notice of any or all of these aspects has been taken into consideration in the past.

Medieval land transport therefore was certainly less efficient than it could have been, wasteful of manpower and other resources but it suffered just as much from instability, caused for example by political activities. This much may also be said of medieval agriculture and industry not just of carriage. The former may well have been more expensive than the latter. The proportion of carrying costs to total production costs was probably less in the medieval period than it is today.

6. R.K. Soberman, Transport Technology for Developing Regions
(Cambridge Mass. / London 1966)

CHAPTER TWO : THE STATE OF THE ROADS.

'One has only to walk across open heather country to see that in their most primitive form, roads are the invention neither of civilisation nor of humanity'.¹ The Road is one of the great fundamental institutions of mankind. We forget this because we take it for granted... not only is the Road one of the great human institutions because it is fundamental to social existence but because its varied effect appears in every department of the State. It is the Road which determines the sites of many cities and the growth and nourishment of all. It is the Road which controls the development of strategies and fixes the sites of battles. It is the Road that gives framework to all economic development. It is the Road which is the channel of all trade and what is more important, of all ideas. In its most humble function it is a necessary guide without which progress from place to place would be a ceaseless experiment... A road system, once established, develops at its points of concentration the nerve centres of the society it serves, and we remark that the material rise and decline of a state are better measured by the condition of its communications - that is of roads - than by any other criterion'.² These are two conflicting statements as to the importance of the road to society. The theory of the viability of land transport has been dependent upon the solution to the argument as to the state of repair of the road system in medieval Europe. It has been generally assumed that the roads were in a poor condition after the end of the Roman period. 'If the economic and social decay of the Dark Ages affected any technique adversely, it was that of road building'.³

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1. C.T. Flower, Public Works in Medieval Law, Selden Society XXXII (1915) 1 p. xxii
 2. Hilaire Belloc, The Road (London 1924).
 3. Lynn White Jr., (1940) pp 141-159

The necessary conclusion which follows this thinking is that since the Imperial system had decayed, therefore transport by land was no longer possible. 'A public servant in California made something of a stir when he published a bit of muckraking titled "Confessions of a Highway Commissioner". He wrote "I am not an engineer, which may explain why I believe there are fewer facts in this world than points of view"'.⁴ It is the purpose of this chapter to contend that the idea that land carriage was not feasible because Roman road system had fallen out of use is mistaken, not least because it is based on views like those of Flower and Belloc as to the fundamental nature of a road and trade route.

The dilapidation of the public road at Rouen in the eighth century is only one of many examples brought forward to illustrate the decay of what has been considered to be one of the greatest achievements of the Roman Empire, namely its road network. Decentralisation according to this argument, resulted in lack of repair, which resulted in diminished traffic. However, the records make it clear that the volume of trade of the thirteenth and fourteenth centuries must indicate that the roads of the period were not quite so bad as is often pictured. It is noteworthy that carting continued throughout the winter months, when the roads as described by some modern authors should have been impassable.⁵ In 1439-40, 1,637 carters paid dues at Bargate, Southampton, compared with only 17 packhorses and that fewest carts went through in summer, most probably because the carts were needed on the farm in summer-time. For example a letter to⁶

4. Joseph C. Houghteling, Cry California 1 (1966) Rae, Pursell and Fergusson, 'The Car and the Road; Highway Technology and Highway Policy' D.H.D. Roller, Perspectives in the History of Science and Technology (Oklahoma 1971) pp 99-123

5. Willard (1926) p 374

6. W.O. Hassall, How They Lived: An anthology of Original Accounts written before 1485. (Oxford 1962) pp 77-8

the bishop of Chichester from his agent asks that he send his long cart to collect provisions and cloth bought on his behalf at Winchester Fair, because the small carts are busy since 'the time of sowing is at hand'.⁷ Secondly common law in England required that main highways be kept in a state of repair.⁸ Any destruction or obstruction of the king's highway, which included not only roads of strategic importance but also roads leading to ports and market towns, was an offence against the king.⁹ Any tampering was illegal and this included the building of new roads where old ones were blocked. Monasteries played a particular role in keeping the means of communication between houses open. Indulgences were frequently granted for the building and repair of roads and bridges both for those who did the physical work and those who paid.¹⁰ Work was frequently undertaken in return for prayers for the soul. Grants of land given by the king from the ninth century onwards were freed from all responsibilities except for the trinoda necessitas: repair of bridges and highways, castle building and military services.¹¹ Roads were widened and repaired at the king's pleasure for reasons of state security¹² and for sport.¹³ Steps were taken to clear bushes and hedges to prevent highway robbery. The statute of Winchester of 13 Edward 1 says in chapter 5 that... 'if by the defaulte of the lord, that wil not aboyde the dyke, underwoode or bushes in the maner aforesayde, any robberies bydone therein, the lorde shalbe answerable for the felony. And if murder be done, the

7. F. Bisher Unwin, Medieval England (1066-1350) (Oxford 1903) p 251

The letter dates to 1330's A parallel might be seen perhaps in Jane Austen's Mansfield Park where Miss Crawford cannot find a cart to transport her harp and is told by Edmund that 'you could not be expected to have thought of the subject before, but when you do think of it, you must see the importance of getting in the grass'. quoted by Hassall p 78

8. Calendar of Close Rolls 1360-64 (1909) 35 Edward III m. 15d p 285

9. Thorold Rogers VI p 654

10. Flower (1915) Canon C. Wordsworth, Wiltshire Archaeological and Natural History Mag. XXXVIII (Devizes 1913-14) pp 15-33

11. Chancery Files New Series II, LXIX, XXV Douglas English Historical Documents (London 1955) I, 85, 93, p 602

12. Calendar of Welsh Rolls HMSO (London) 1278, 6 Edward II p 164 1283
11 Edward II p 274, 1291 p 333 Chancery of Inquisitions Misc. II
1307-49, no. 27, file 63, 1308

13. C.C.R. 1360-4 p 285, 1369-74 p 592.

the lord shall make a fine at the king's pleasure and if the lord be not able to fell the underwoodes the country shall aide him therein'. Indictments were made against those who failed in their obligation to keep the highways open.

Thirdly, while many roads were metalled, many were also paved, particularly in the fourteenth century. After this period, pavloirs and paved streets appear in the illuminations.¹⁴ Worcester Priory had cartloads of paving stones entered in the records for 1432. There are, moreover, frequent references to stanestretes in the records,¹⁵ though this may mean a quarry road rather than a road paved with stone. Street cleaners operated in London by 1230.¹⁶ A road sweeper in the ward of West Cheap, London, is mentioned in 1299 and in 1364 official inspectors or 'scavengours'. Actual removal of rubbish in 14th century London was done by rakers. In Coventry an official carter was supposed to receive 1d. from each hall and ½d. from each shop in 1426.¹⁷ Though there were ruts probably, this was not altogether prohibitive of vehicles. Vehicles managed to travel despite ruts in streets, at Pompeii for example and in nineteenth century England. The strength of the road depends largely on the quality of the subgrade, so that its load carrying capacity is decided more by the nature of the soil than the top dressing.¹⁸ Vehicles could always be diverted into the meadows to avoid bad stretches of road. The idea of impassable roads in England, stems not so much from contemporary evidence but from the idea that since the roads were bad in the eighteenth century¹⁹ they must have been so much worse in the middle ages. Extra carriage weight (of up to four tons) and more frequently used roads certainly contributed to the bad conditions of the 1700's but this is not to say that roads of the 1400's were equally as dilapidated.

14. Singer et al 11 figs.477,478,R.J.Forbes (1955)Hamilton (1910)

15. Dorothy Whitelock (1930)p 41

16. Forbes (1955)

17. Hassall (1962) p 211

18. Soberman (1966)

19. Thorold Rogers IV p 693

Fourthly, it would be impossible to deny that there were difficult routes. Illustrations show grass-covered roads and stretches of mire with vehicles and draught horses bogged down. ²⁰ In Prussia, the Earl of Derby's accounts recorded that 'pro caragie domini in le Wyldrenesse et quid caruce non potuerunt ulterius transire'. Moreover after the whole expedition had crossed the Stygian Alps, the iron bound tires had to be repaired. ²¹ In England, the poor condition of the road between Wytteley and its parish church of Holt, a distance of about two miles, was recorded in the papal registers. ²² It cannot, furthermore, be denied that some stretches of road were neglected. If one picks any county at random some of the local roads would be flooded not least because the ditches were not cleaned out. In Berkshire, for example, the road from Basingstoke to Reading was impassable due to flooding and the abbot of Reading was indicted in 1398. The road to Cholsy was in the same condition. The Garford road in the Hundred of Wantage between Garford and Gildenbrigge was muddy by default of the tow of Garford. The Southcot ditch caused the flooding of the road between Newbury and West Woodhay, while the Stamford road ran with water which should have been drained by the Faringdon Hundred ditch which should have been cleaned in the name of the prioress of Amesbury. ²³ The worst record is of the high road between Stoneham and Otterbourne, Hampshire, which was so flooded in winter that none could pass without danger of drowning. ²⁴ Moreover roads were often

20. for example British Library Sloane 2474, Stowe 54 fol. 22

21. Derby Accounts 50/25, 203/32

22. W.H. Bliss, J.A. Threlow, Calendar of Papal Registers and Letters V 1396-1404 (London 1904) X Boniface IX 1400

23. Flower (1915) p 8

24. ibid 11 p 271

blocked by deliberate action. In the Highworth Hundred Rolls, There fifty four examples of ploughing, digging or general obstruction of the highway between 1275 and 1287.²⁵ Clearly, Fitzherbert's instructions as to the maintenance of a road in 1534 were long overdue.²⁶ However, all these examples come from records of indictments in the manor courts. 'Just as the police news paints an unrelieved picture of crime, the cases inevitably give the impression of universal decay'. These references are indications of a will to keep them passable rather than evidence of their evil condition. A sense of proportion must be maintained.

Fifthly, while a great deal of study has been made as to the construction and the routes of Roman roads - Margery for example, has traced 7319 miles in Britain²⁷ little study especially in the field, has been done on medieval highways. Certain steps have been taken in North Yorkshire to conduct a survey using local history groups to record methodically references to road use, route, natural resources, topographical data, historical information and to walk likely medieval roads. However, one wonders about the value of such a survey which is based upon the premise that 'all commercial transport was by pack animal'.²⁸

Finally, perhaps the answer lies in the actual conception of what a road is. Unlike Flower or even Belloc we should not forget that a road is not just a physical entity. Crump, in considering attempts to trace the 'Pilgrims' Way' between Winchester and Canterbury. He called it 'a fond thing grounded upon no certain warranty of history and so intrinsically absurd that it was not worthy of criticism'.²⁹

25. B. Farr, The Highworth Hundred Rolls, Wiltshire Archaeological and Natural History Society, Records XXI, XXII (1966-1968)

26. Flower, (1915) 11 xviii, Skeat (1882) p 81-2

27. Ivan D. Margery Roman Roads in Britain (London 1955-57, 1967, 1973).

28. Questionnaire compiled by the Yorkshire Archaeological Society 1963.

29. Crump 'The Pilgrims Way' History XXI (1936) pp 22-33

Yet the Pilgrims' Way appears to be an accepted medieval route. In considering the much misunderstood history of medieval roads, it may be of more use to forget maps and concentrate on roads as a combination of conveniences both political and social - of places to stay en route, guarantees of safe conduct, avoidance of duties. These are the roads affected by political conditions more than bad conditions and poor harnessing. These are the roads that can easily be changed in the face of adverse conditions.

CHAPTER THREE : THE USE OF WHEELED VEHICLES BY THE ARMY.

The use of wheeled vehicles for military purposes by the central government, is one of the most constant functions, particularly of wagons throughout the middle ages. There may be two possible ways to use a vehicle in this way, for offensives and as support. The contrast between the middle ages which saw the largest number of vehicles used for the carriage of supplies, and prehistory which used larger numbers of vehicles as instruments of war, is not entirely clear cut but does to some extent exist.

The ancient chariot with its psychological rather than practical effect, inheriting the mysterious, prestigious quality of the horse,¹ was used in the east as a mobile fighting platform and in Europe as a means of transporting the warrior into the field to fight in hand to hand combat.² However, the chariot as an instrument of war disappeared from Europe after the third century and from Britain and Ireland some time after the ninth. Vehicles were used in medieval armies primarily for supplies. However, it should be noted that 'wagonburgs' defensive armoured battle cars are recorded by Aeneas Sylvius as being used by the Hussites as late as the fifteenth century.³

The organisation of supplies was not a topic which concerned the medieval chronicler. The records, however, do indicate that an army sometimes took equipment with them sometimes not. Freissart describing the Scottish campaign of 1327 says that the Scots dispensed with equipment and the English left their supplies at Durham.⁴ However, his description of Edward III's

1. Anderson (1961)

2. Powell (1963)

3. Charles Oman The Art of War in the Middle Ages (London 1923)

4. Hewitt, The Black Prince's Expedition 1355-57 [2 Vols.
(Manchester 1958) p 31.

force at Calais in 1359, record 6,000 carts which followed the king's column and extended over two leagues, carting stoves, mills, all necessary supplies. He also says that up to 500 men with spades and axes went in front of the carts to clear away the thickets and give them easier passage.⁵ Between these two extremes, the normal campaign called for transport of armour, arrows, horseshoes, nails, food, wine, artillery⁶ and the transportation of the spoils of victory or of the injured.⁷

However, sumpters also appear in the accounts. These are most frequently used for the transportation of money which is only rarely carted by vehicle.⁸ In time of peace, money for the king's works arrived in this way.

On foreign campaigns carts and wagons were hired to swell the numbers of those brought from home. There are also records of the purchase of barehide or canvas - the medieval tarpaulin - to protect supplies. Armour was generally carried by cart but normally in barrels where it cleaned itself by moving around in the mixture of oil and sand which filled the barrels.⁹ Boats are recorded by William of Tyre as having been dismantled and taken on currus and plaustra across the desert, in c1094.¹⁰

Finally vehicles were often used to impress. The entourage of Richard in France in 1250 for example, included five wagons and fifty sumpters. Becket's procession in Paris in

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5. C.T.Allmand A Society at War-The Experience of England and France during the Hundred Years War (Edinburgh 1973)
 6. Hewitt (1958) Stenton (1957) Cockerell, James and Ffoulkes (1927)
 7. Hewitt (1958) p 47, Trajan's Column, Aurelian Column reliefs for example.
 8. PRO E101 /55/7. Hewitt (1958) p.35
 9. Derby Accounts 92/17,49/10,180/17,190/21-3,191/4.
 10. William of Tyre A History of Deeds beyond the Sea, Babcock and Krey (New York 1943) III, VI.

1150 had a large number of vehicles. ¹¹ The use of wagons and carts for display seems to have had a long history. Certainly it may be traced at least to the *tensa* and *carpenta* of the Roman period, if not to the wagons and carts found in prehistoric graves, from the second millenium B.C.

Leaving aside function, it might be useful to consider where these vehicles came from. Although some were hired, most were requisitioned from the Hundreds or from the monastic estates and granges. The sheriff and officers appointed by the crown were responsible for the purveyance of supplies and the mustering of the means of transport. During the campaigns of course, carts and wagons were taken from the enemy. ¹² After the truce which ended the Scottish campaign, though the vehicles were returned (1323), regular payments are still recorded for many of the carpenters who were hired at 4d. per day. Their new duties included not the care of engines and other strategic repairs, but the maintenance of the Household vehicles and taking part in the king's works. ¹³.

11. Matthew Paris V p 97

12. Hewitt (1958) PRO E101/28/8, E 372/201, Calendar of Patent Rolls (1313-17, 1333-7, Bain Calendar of Documents relating to Scotland p 292

13. PRO E101/308/4, E 101 469/8, Society of Antiquaries MS 122 Tout Chapters p 352.

CHAPTER FOUR : HOUSEHOLD VEHICLES.

The most frequent use of transport by the central government was for the movement of an itinerant court. All classes travelled for a variety of reasons but the medieval economy demanded the constant movement of the household of the king and the great landlords as a method of profiting by the products of scattered estates. The entry nihil remanent, recorded at Winchester after a visit by the king is eloquent enough. ¹

As far as can be seen from the records, each individual department of the household had at least one caretta and two carters, while those departments which dealt specifically with provisions like the kitchen and the buttery, had longae carettae. There is a clear distinction between the two types of vehicle in the household documents but just what this distinction was in terms of morphology is unknown. There is no evidence to suggest that a longa caretta might be a wagon. It seems more likely that it was a cart with side and rear ladders to increase leading capacity. The normal number of horses for each vehicle appears to have been three, though mules from the peerage of Gascony have also been mentioned in the LQCG. ² Ordnances for the l'hotel of Philippe de Valois show a similar number of carts per department and grans charettes for the kitchen. An ordinance of Edward 11 lays down that there should be twenty charettes for the household offices. ³

The Marshall, perhaps originating from the Norse or Frankish pre Conquest office of Stallere, was in nominal charge of the stables. ⁴ However, the 1318 ordinance for the household

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1. Hall The Pipe Roll of the Bishopric of Winchester 1201-9 (London 1903)
 2. LQCG p 77-9, 127, 185.
 3. Tout Charters p 352 ff
 4. L.M.Larson The Kings Household in England before the Norman Conquest, Bulletin of University of Wisconsin History Series 11 (1904) pp 55-204, A.J.Robertson Anglo-Saxon Charters (Cambridge 1929) - Stowe Charter 40 Cotton Vitellius D VII, 30

appointed the chief usher as superintendent of transport for the wardrobe. The subusher was responsible for guarding it on its travels. The porter of the wardrobe had to carry the coffers and other harneys to and from the carts, load and unload, while during the journeys in open country, he kept the night watch, being paid an additional daily wage of 2d. to bring his salary up to 4d. per day. Beneath these officials were large numbers of valets and grooms.⁵ Only one other official is especially named as being important in connection with the transportation of the household, namely the valet carnaeur, the vet and the farrier.⁶

Loaded with all the necessary equipment, plate, tapestries, furniture, furnishings, beds and food for the journeys, the household carts also transported the state records not only on special occasions such as the transference of the exchequer documents between York and Westminster in the 1300's but also the normal records of the business transactions of the household.⁷

Carts were also hired, especially while on campaign. Sums for such provision were disbursed by the ostiarius garderobae to individual owners.⁸

Personal transport was uncommon, however, according to the LQCG the queen had a currus, with silk cushions and several litters.⁹ As far as the male members of the household were concerned only infirmity prevented them from performing the greater part of the long excursions in the saddle. It was only in the fourteenth century that carriages became truly fashionable.

5. Fleta, Selden Society LXXII(1953), LXXXIX(1972) p 276

6. P.J.Furnivall, Edward II's Household and the Westminster Ordinance, Clarendon society (1876 London) p 40ff.

7. Willard (1926) p 246ff

8. PRO E101/350/25-6.

9. LQCG p 77-9, 127, 185.

CHAPTER FIVE : INTERNATIONAL TRADE.

The conduct of business by the thirteenth century, required the development of services to transport goods particularly to and from the fair sites. On some routes, pack animals might be the only means of transport and the vectuarii, the Genoese professional freighters kept horses for this task. As a rule, however, carectae carried the bulk of goods from the Alps to Champagne and northern Europe in the thirteenth century.

These vehicles were not substantially different from normal agricultural vehicles and records of local transport show that carriage was in large part undertaken by local people. However, use of local carters was seasonal and regular traffic on the main trade routes was in the hands of men who specialised in the business of transport. On the continent it was not uncommon for whole rural areas to run carting services such as carriers from Alsace who carted wool to Flanders, and carters from Lorraine who carried on the Brabant route south and carriers from Bearn who worked the routes from Toulouse to the northern seaboard. The vectuarii were important in the carriage of goods north to the south but not in the other direction, accompanying goods from the northern fairs to Italy in the thirteenth century.¹

Sumpters were far less important than wheeled vehicles, being used largely for precious cargo or light articles such as fish and spices. Seaborne and fluvial transport was really the only feasible alternative to the use of a caretta or carrum but more often they were used in conjunction.

1. Face (1959-60).

CHAPTER SIX : LOCAL MANORIAL TRANSPORT

Only a few general points can be made about manorial transport which have not yet been brought forward in the discussion of the documents.

Firstly, there are no local professional carters engaged in transport on the manor. Though carts are sometimes hired they are hired from among the manorial servants of the estates.

Secondly, for transport within the manor, most of the work is done by service labour. Carting services are rarely commuted. The amount of carting demanded of course, varied, but one may say generally that if a high money rent was paid while tenants escaped the more obvious serf obligations, namely boon work, which in carting terms would mean agrarian tasks like harvest carriage and manure carrying, week work which included the major carting tasks still had to be performed. As a rule transport and stock moving formed part of the labour service due from the manors and the few records of hired carriages often refer to exceptional commodities or distant places.¹

Thirdly, there was transport to the desmesne from outside.² In general the more distant, the more likelihood of its being recorded.

Fourthly, a general survey of costs of carriage between the manors has been drawn up by Thorold Rogers.³ There seems little point in reproducing his results here.

Fifthly, though discussed in the previous section, it might be useful to emphasise here that the evidence does not support Jenkins' conclusion that there were no wagons in use until the advent of the Flemish spindle wagon in the

1. Lewis Thorpe, Medieval Studies XII (Cambridge 1953)

British Library Add 36581, Add Charter 70697

2. Hall (1903) p.xviii-xix.

3. Thorold Rogers V p 700ff

sixteenth century.

Sixthly, oxen continue to be used for hauling heavy wagons around the farm. They appear in western illuminations throughout the period. Their usefulness for all heavy duty tasks cannot be denied, and when the horses were busy with haymaking or harvest, the arable work was continued by the bullocks. This is true in England up to the early twentieth century.⁵

5. This apparently had one drawback, the fact the oxen became very clock conscious and nothing would persuade them to work after their recognised time for finishing unless the last run pointed for home. The Countryman, Spring 1971 p 139

CHAPTER SEVEN : THE TRANSPORTATION OF BUILDING MATERIAL.

This is the only category where we can be certain that the goods were moved by use of wheeled vehicles. Although building material was also shipped, at some stage in the proceedings a wheeled vehicle took part. For this reason and because the records do provide information on the use of wheeled vehicles, it was thought necessary to treat the carriage of building materials as a separate heading.

In the classical period, the large public and private building programmes laid a heavy burden on land transport, mainly that of the state. The Theodosian Code, however, forbids the use of cursus publicus for the transportation of marble for private purposes.¹

The medieval building programme was also large scale and may be seen to divide into two distinct sections; ecclesiastical and secular. The former is clearly a continental phenomenon which England of course shared. However, the second may be best illustrated by the king's works in England.

'The fabrics of the churches were rebuilt, although many of these were still seemly and needed no such care but every nation in Christendom rivalled with the other which should worship in the seemliest buildings so that it was as if the very world had shaken herself and cast off her old age and were clothing herself everywhere in a white garment of churches.'² Marble was brought from Italy to France. However, it is not merely the transportation of the material which is interesting but the extraordinary religious phenomenon associated particularly with the building of Chartres which focused on the 'cult of the carts'.² An allusion to this new religious observance appears in

1. Pharr (1952)

2. George Henderson Chartres (Suffolk 1968), E.G. Holt A Documentary History of Art 1 (New York 1957), p 49-50.

in a letter of c1145 where the archbishop of Rouen describes the dragging of the waggons and carts with materials for the cathedral by the people of Chartres. The movement which began at Chartres spread over the Ile de France and Normandy. It has been described as a 'Pentecostal revival' which affected all classes of society. One of the most popular books of the late medieval period was the Miracles of Nostre Dame de Chartres with incidents relating back to the 'cult of the carts' in the 1140's. Naturally enough a certain prestige was enjoyed by these cathedrals visited by this spirit. Similar claims were made for St. Denis by Abbot Suger c1145. It seems, however, that this outburst of popular emotion, the cult of the carts did not long survive the building of the towers of Chartres, perhaps because of the disapproval of the authorities. [73]

Less sensational was the English royal building programme in the thirteenth century. Stone was of course the material most frequently carted. Wherever possible use was made of local quarries, provided that the stone was suitable. Otherwise it was transported for anything up to twenty miles, from quarry to site. This was the case not only for castle building but for building operations in private and monastic houses also. Stone was transported for about 1d. per mile. Among the other materials which were carted were sand, (1,058 loads for 21/2d.) chalk, (for 7d. per day-ten carts for five days to Winchester) bricks, (5 for 6d. the the sand) water, (7d. per day per cart) flint, (400 cartloads for £1.6/-d.) charcoal, (200 cartloads 5/4d.) and timber. In some cases very large pieces of stone were transported and Vale Royal Abbey records 1278 two large pairs of iron bound wheels for carts carrying heavy stones. At Westminster Abbey the abbot bought twenty great stones, each too big for one cart. There was also a transportation of ready made stones.

For example in Nottingham there were carvers workshops and in 1368 a carving for Windsor required eighty horses and ten carts to transport it.

Firstly, therefore who met the costs of ³ transportation? The provision of materials by the mason was not uncommon and transport of materials might also be part of his contract. It is possible to distinguish four types of contract according to what the contractors had to provide, namely, workmanship: workmanship and stone: workmanship and carriage: workmanship, carriage and stone. Carriage could be considerable if one takes as an example Vale Royal Abbey where 14,708 loads were carted in the first year, with daily trips of 20 miles being made by the carts. In the case of the building programme of Edward I, costs were paid by the exchequer.

The usual method of hiring teams and carters was simply to do so as required. In most cases the quantities of materials were too variable to keep teams and carters steadily employed. If it was a royal project, the men were often pressed into service or manorial servants might be called on. Sometimes the carters were paid by the trip, at a rate of about 2d. per mile for the ton load. Therefore, carts were hired on a daily basis. There was no restriction to the building programme because of transport difficulties. On a few sites such as Dover Castle, the scale of work was such that some carters could be employed over a longer period. At Vale Royal Abbey the maximum number of

3. Knoop and Jones, 'The English Medieval Quarry' in EcHR (1938) pl7-37, Hassall, Wheatley Records (Oxford 1956), Knoop and Jones, 'The Rise of the Mason Contractor', Archaeological Journal XLIV pp 56-8, The Bolsover Castle Building Account, Als Quathor Coronatorum XLIX (1936), 'Castle Building at Beaumaris and Caernarvon in the Early Fourteenth Century', Transactions of the Quatuor Coronati Lodge XLV (1932) pp 4-47, 'The Evolution of Masonic Organisation', ibid XLV (1932) pp 267-301, 'The First Three Years of the Building of Vale Royal Abbey' 1273-80', ibid XLIV (1931) pp 5-47, 'Some Notes on three Early Documents relating to Masons', ibid XLIV (1931) pp 223-235

carters employed at any one date was forty eight as compared with sixty four masons and seventy diggers, thirteen carpenters and the same number of smiths. The craftsmen were brought from all over the country, but carters and diggers were normally more likely to be local men. At Vale Royal Knoop and Jones reached the following estimate that of the 261 carters, 96% were local as compared to 85% of the 140 diggers, 85% of the 85 quarrymen, 50% of the carpenters, 50% of the smiths and 5 to 10% of the 131 masons. ⁴

Finally at Vale Royal and Caernarvon, some of the masons were to be found supplementing their earnings by hiring out carts. This is also the case with some of the carpenters and smiths. There were not many craftsmen to be found supplementing their incomes by carting, but enough to show that the practice was not entirely unknown. Since about ninety per cent of highly skilled masons moved from job to job, the fact that some of the more highly paid possessed horses and carts and utilised these for freighting, suggests the manner in which they and their families moved about the country.

4. Knoop and Jones (1931) pp 504-7.

CONCLUSION

The theme of this thesis therefore, has been the recasting of previous classificatory and chronological schemes with regard to wheeled vehicles, and harnessing, and to examine how they were used to the sixteenth century. It is fair to say that statements are often repeated without a thorough examination of available evidence. The first aim of the thesis has been therefore, to examine previous assumptions and to determine how accurate earlier studies have been.

1 'Medieval transport thus owed little to Roman precedents may be examined. The study of pictorial representations of the Roman period and of medieval illuminated manuscripts has shown that, with the exception of the railed wagon or cart, there is general continuity in the range of vehicles in use from the Roman to the medieval period. Not only is there continuity with the Roman period, but also with the prehistoric period. The main forms of vehicle namely, tilt carts and wagons and box carts and wagons are common to all three. Only one vehicle - the ancient chariot - which is in basic form only a box cart, is lost in the middle ages, but may be regarded as having been replaced to some extent by the pageant wagon. However, there is one factor which has not changed and that is that it is not possible, whatever the period, to take vehicle names from the documentary sources and fit them to graphic representations. This may be possible for the Roman period only with the terms biga and quadriga and perhaps for the term Carpentum where it is taken to mean a ceremonial vehicle. The variation in specialised terms for the medieval period becomes smaller, since the words tensa, carpentum, cisium, pillentum, petorritum, essedum, bennus are lost and the vehicle name Carruca is applied almost without exception to the plough. This

1. Leighton (1972) p 179-180.

simplification in terminology provides less opportunity for isolating special characteristics which might then be applied to vehicle representations.

There is one important break in continuity, however, which is one of attitude rather than technology, namely the fact that vehicles were considered to have some sort of religious significance in the earlier period, hence their appearance in graves and at sacred festivals. In the medieval period wagons and carts become objects of shame and disgrace. The bull cart of the Merovingians and the Oseberg ship burial are perhaps remnants of the earlier tradition. This medieval attitude is broken only with the twelfth century socio-religious 'cult of the cart'. Personal travel in vehicles did not become acceptable until the modern period. In the prehistoric period to ride was godly, in the Roman to ride was suave, provided one's vehicle was fast, in all senses of the word. In the middle ages it was a disgrace punishable by loss of knighthood. This is a fundamental difference between the medieval and earlier periods which has not yet been fully acknowledged.

'(harnessing and shoeing) ... made possible the widespread application of horses to heavy transport duties'. However, Leighton envisaged this as being medieval. 'The middle ages proved that heavy materials did not have to move slowly'. Both efficient harness and the iron horseshoe without a doubt, aided the development of a rapid, more practical form of land transport. In the first place, the achievements of oxen draught should never be underrated. However, it is possible, in fact, likely, that the swifter transport of which Leighton speaks is the product of the Roman period and was achieved by the fourth century.A.D.

Des Noettes has emphasised that the introduction of efficient harnessing did for the eleventh century was the steam engine did for the nineteenth. He believed that the improvement in the European economy in the eleventh century was linked to the introduction of horses for arable work. Roman dates for a rational harnessing system upsets Des Noettes hypothesis.

2. Albert Leighton (1972) p 178.

No stark economic contrast exists between the classical and Dark Age periods and the middle ages. Just as it is dangerous to base grandiose generalisations of the state of medieval knowledge on one piece of evidence, be it archaeological or historical, so one should be extremely wary of attempting to explain major economic fluctuations in terms of one improvement in one sphere of knowledge. Inventive ability is extremely variable. One must agree with Bertrand Gille when he says that 'In the history of human intellect, the history of technology is perhaps the one most lacking in logic'.³ The whole topic of transport with its wide scope of evolution, specialisation, diversity in design and function, is only given coherence by the fact that it can be seen as 'un certain nombre de solutions ingenieuses pour faire face aux problemes d'agriculture et de distance'.⁴ One must abandon any idea of linear progress. Yet this idea is highly valued in our society and tends to influence our historical thinking no matter how much we deny it. The ancients were not affected by technological determination and were prepared to be careful 'Lest gold be reduced to the value of lead'. Fundamental influences in determining the introduction of technical improvements are not so much increased profits but environmental factors like terrain, soil quality, isolation from technical experts and simple economics. Such factors exist independently of inventive ability.

It certainly seems one of the paradoxes of history that in spite of the theoretical brilliance of the Stoics, Peripatetics or Euclid's geometrical insight or the remarkable ingenuity of the Alexandrian mechanics - all men who could differentiate, systematise and compile - the ancient western world never succeeded in solving the problem of harnessing horses efficiently.

3. The Evolution of Science edited by Metraux and Crouzet, New York (1963) p 170ff.

4. Haudricourt (1955)

Perhaps of course they did not try'.⁵ It is hard to believe that such a statement could be made in the face of so much evidence to the contrary. Representative evidence demonstrates a wide degree of experimentation throughout the late Roman period and the achievement of the rigid horse collar by the fourth century. There is evidence for efficient harnessing from North Africa which shows the modern harness in use and Bulliet has provided supporting evidence for its origin in the camel harness in use in the north of that continent from a very early period. Such evidence is similar to that previously put forward for the presence of modern harnessing in ancient China and Eastern Europe. However, the large number of western European representations showing varying forms of equid harness and the few which show probable hard collars are sufficient to indicate that an origin for rational harnessing need not be sought elsewhere. It has, moreover, been said that efficient equine harness had to await the better understanding of the anatomy of the domesticated animal. Textual evidence, however, shows a high degree of sophistication of the understanding of equid anatomy and veterinary medicine. It would be fair to say that Galen, Chiron, Herophilus, Eristratus and Vegetius or even Columella, Varro or Cato had a sound knowledge of the way a horse should be cared for and means of treating a variety of its ailments.

'The beneficence of technology remains an axiom of the west'. This is of course hardly acceptable. The ill-founded conceit of such statements has been clearly demonstrated by the results of the great survey of the achievement of eastern civilisation which spans every branch of science and technology. It must be concluded that the east enjoyed its share in the 'beneficence'. However, the tremendous work which has been done on eastern technology should not be

5. Needham (1965) IV 11

6. (1975) pp.194-7

7. Lynn White (1962)

allowed to overbalance interpretations. The creatively submissive role which has been envisaged for the Slavic peoples of the sixth century is unnecessary, at least in terms of the transmission of technological developments on land transport and related spheres. The Chinese achievements cannot be denied but like those of the Celts of the prehistoric period, they must not be allowed to detract from the achievements of the Roman and medieval craftsman or worse to loom so large in any exposition of evidence that they distort the picture entirely. The Roman reliefs are as early as any evidence presented for China. The linguistic evidence of Haudricourt which for years has stood as the certain confirmation of Needham's claims, for the eastern origin of the horse collar has been completely discredited by the fact that the camel harness from which his words are derived is not of the type which could easily be reversed to form a padded triangular prototype collar. It now seems as if eastern camel harness was affected by the invention of the rigid collar and not the other way round. Modern harnessing as far as the evidence stands at the moment, was achieved by at least the fourth century A.D., a product of long experimentation by Roman technologists. However, older forms of equid harnessing do continue into the medieval and modern periods. It might be noted in passing that whereas today it is taken for granted that the horse collar is the most efficient, humane means of equid draught, last century there was some argument as to the greater efficiency of the breast strap. With harnessing as with many other aspects of transport technology, it is personal preference based on personal experience and particular need which is important rather than any definitive theories about which is mechanically best.

One point which it is important to emphasise is

that earlier theories as to the achievement of the classical world in the sphere of transport technology were based to a large extent upon prejudice. Des Noettes' study was not only a major contribution to the history of all aspects of equid draught but also the history of slavery. The result - the standard work on ancient transport - is subtitled a 'contribution to the history of slavery'. His thesis in this and in following works such as La Conquête de la Force Motrice Animale et la Question de l'Esclavage and L'Esclavage Antique devant l'Histoire⁸ was that the invention of the collar harness was the primary factor in the disappearance of the institution of slavery. Although historians like Marc Bloch pointed out that the chronology did not quite fit Des Noettes theory, their criticisms did not affect the converse argument that while inefficient harnessing did not cause the decline of slavery, the institution prevented its invention. This was the theory which influenced Leighton when he implied that the Romans did not contribute to medieval technology in any way. This was the impression given by Needham when he stated that the ancients did not achieve efficient harnessing because they did not even try. The belief in the abundant resources of manpower which the ancient world had access to, the power to put thousands sous le joug if massive tractive effort was needed, has been completely discredited by Burford's work on heavy transport in antiquity. There can be little doubt that manpower was used, but the fact that this hampered the achievement of equid harnessing for constant draught work is nonsense. It is no longer possible to see the Romans as uninventive and slave-ridden. The fact that their draught achievements do not compare to modern standards should not detract from the fact that they invented modern harnessing or at least were aware of the concept behind it, the need to have the point

8. Bulletin de l'Association de France pour l'Avancement des Sciences LVI (1927)

of traction at the shoulders and away from the throat. To this achievement, the medieval technician added only the separate hames piece and the swingle bar.

The achievements of the medieval wagonwrights in understanding vehicle undercarriages have in the past been underestimated, because of the longstanding belief that the Dark Ages was a period of turbulence, destruction and degeneration. Historians such as Southern have suggested that views of this nature regarding medieval society were mistaken. I would suggest that as far as developments in vehicle construction are concerned this view is mistaken, particularly when it is taken as indicative of the whole state of medieval inventiveness: The general belief that the pivoted front axle was known in prehistory but lost during the Dark Ages to be rediscovered only in the fifteenth century is no longer acceptable. Prehistoric vehicles have been reconstructed on little evidence. They are not acceptable. Yet the most recent publication of information about wheeled vehicles, Mrs Littauer's paper Rock Carvings of Chariots in Transcaucasia, Central Asia and Outer Mongolia⁹ simply refers to the fact that there are ancient vehicles that do have articulating forecarriages and quotes Klindt-Jensen as her source without questioning the nature of his evidence. Mrs. Littauer cannot be criticised for this because she is simply following accepted beliefs. The opinion persists, however, not simply because historians are basing their work upon the work of others, without examining the foundations of their evidence, but because many believe it is inconceivable that a wagon could operate without a pivoted front axle. Until it is proved otherwise, we are forced

9. Proceedings of the Prehistoric Society XLIII (1977) pp 243-263 p.257, Klindt-Jensen op cit (1950) figs.59,60
However she does question the pivot from barrow 4, grave 7 in the Kalyuk A.S.S.R. (1974) pp 26-27.

to conclude that it did. Without the support of the prehistoric material it was necessary to reconsider the case for a Roman pivoted front axle. While the textual evidence does suggest that it is not beyond the bounds of possibility, that the Romans knew about articulation, the position as yet is ambiguous, Until further supporting evidence is put forward, it is more accurate to see articulation as the innovation of the medieval period. The evidence for articulation in the fourteenth century is entirely convincing. Lynn White's claim for a tenth century pivot is entirely acceptable, if one also is prepared to overlook the problems of his source namely the accuracy of the illustration. It entirely depends upon the standards which one is prepared to tolerate. The miniature is in fairness no worse than those of a later period which many scholars are prepared to accept as representing articulated vehicles. It is puzzling therefore, why so many are not prepared to accept this miniature in spite of its early date. It is perhaps possible that he should reject them all. However, the only secure evidence of pivoting comes from the fourteenth century so at least it possible to have a terminus post quam. The important factor in the acceptance of a medieval date for both articulation and suspension is of course the bearing which it has upon attitudes towards medieval technology. The increase in the use of vehicles in western Europe for both carting and personal transport is very clear. So too is the beginning of the change in attitudes with which contemporaries viewed riding in a vehicle. One cannot help but draw the conclusion that the two are somehow linked. The fundamental modifications in carriage design and sophistication in harnessing techniques were products of the skill of the wagonwrights and saddlers of the middle ages. This is a far cry from regression.

The only area where medieval regression may perhaps be seen is in the art of wheelwrighting, though even this is not entirely clear. While there is very little change in types of wheel available, the middle ages used exclusively strakes to tire their wheels while the more sophisticated process of single piece hooped tires appears to have been unknown. However, straking produces just as useful an end product so perhaps the idea of regression is unjustified. Account rolls offer evidence as to the nature and construction of medieval wheels but not unfortunately wood type. Solid, spoked, bound, unbound, cheap and expensive wheels all had a place in the transportation of the manor. Dishing does not become part of the European wheelwright's repertoire of skills until the late fifteenth or sixteenth century. It is moreover the only technological development where an exclusively eastern origin is indicated by the evidence.

As far as manorial vehicles are concerned, several conclusions may be reached. Firstly a manor by and large took care of its own carting. Professional carters are seen primarily on building sites or in the departments of royal or noble households where they are expected to be 'resolute, experiences, equable not choleric, learned and skilful in the art of loading, carting and carrying... to make ready and repair trappings, equipment and the small fittings connected with the carectae...to lie down with the horses belonging to his cart'. On the manor in contrast, it would appear that most tenants owned a cart or wagon and were prepared to do carting duties. As well as private services owed, which were seldom commuted, the manor had its own carts, the spare parts of which were entered on the reeve's account roll. Finally while costs for medieval manorial vehicles seem high, they form only a very small part of the expenses of the manor. Land transport was a very essential part of the running of the manor and was crucial to its economy.

'In the seventh century waterway travel was more common owing to deficiencies both of techniques and ovate organisation.. In short even small boats made possible the transport of far more merchandise than could be carried by cart especially since techniques in harnessing remained very primitive, as we know, up to the end of the tenth century.⁹ ¹⁰ This statement embodies all previous opinions as to the viability of land transport in the early middle ages. Harnessing has already been dealt with. However, the final criticism, and in the eyes of most historians the ultimate judgement of land transport in the medieval period was that it was badly organised, and because of the state of the roads unable to compete at any level with other forms of transport. This is simply unacceptable.

Evidence shows that land transportation has always competed successfully with waterway carriage, in fact withouthland carriage to complete the initial stage in the journey, fluvial transport would often have been impossible. Moreover when we think in terms of land transport, it is carts and wagons to which we should look and not the pack animal. Sumpters have never been a viable alternative to wheeled vehicles except for light, precious cargoes. Evidence shows frequent use of vehicles for carriage during the Roman period and on into the middle ages with the professional carter and carting services being well established by the beginning of the thirteenth century. Carts appear to have carried commonly a ton but if a team larger than two or three horses were used the load was proportionally increased. Here the influence of the great fairs of the north cannot be denied as having a stimulating effect on the carrying trade. While land transport may have been more costly than waterway transport, in proportion to the actual cost of producing the commodities it was possibly less than it is today. Not only was transport by land frequently used for international

10. Thrupp G.A. The History of Coaches (London 1977)

and local trade, it was also used for specialised tasks such as the moving of building materials, the distribution of army supplies, the carriage of the itinerant government, its household goods and records. Finally, the assumption that medieval transport was affected by the deterioration in the Roman system of roads is based upon a mistaken conception of what actually constituted a road or trade route and a wrong interpretation of the information given by one particular type of record. The evidence for neglect of stretches of medieval highway is drawn largely from indictments recorded in the manor courts. One kind of conclusion only may be drawn from records such as these. If the evidence is interpreted fairly, it is possible to maintain that the roads were adequate to support an efficient land transport system. Moreover former theses have not taken into account the nonphysical aspect of a road, the political and social network which was extremely flexible. While it is impossible to maintain the history of the land carriage has been one of uninterrupted advancement, it is possible to see a general continuity and a slow increase in the use of wheeled vehicles for carriage.

The aim of this thesis was to examine as much evidence as possible to establish an accurate chronology for the development of wheeled vehicles in Europe from the end of the Roman period to the sixteenth century. It has been concluded that as far as is known the available evidence points to a fourteenth century date for the use of articulated vehicles, a tenth century date for the invention of suspension, a Roman date for the horseshoe and the achievement of efficient harnessing. Eastern origins for all but the process of dishing wheels is no longer acceptable. Western Europe saw the independent innovation of many major techniques though suspension is largely an eastern European phenomenon. The information presented from English sources has allowed a consideration of the construction, maintenance and use

of wheeled vehicles throughout the middle ages. At another level it has been possible to consider the role of land transport in the economy of Europe and to show that it was in use throughout the period continuously. Thorold Rogers in his History of Agriculture and Prices, though he gave transport only a cursory glance, pointed the way to conclusions such as are to be found in this thesis. Thus it would be perhaps fitting to end by re-emphasising his findings.

'The stories of impassable roads and imperfect powers of conveyance are either relevant to a later age when society was in reality dislocated and intercourse far slighter than it was in the fourteenth century, or possibly pure supposition derived from the concept that because some modern conveniences were unknown in bygone times the people were barbarous and incapable of understanding and appropriating such advantages as lay before them' . 11

APPENDIX ONE:

THE WHEELBARROW

The history of the wheelbarrow in western Europe has never been fully considered, though several historians have drawn attention to the linguistic and chronological problems which its evolution presents. Its origins are obscure but it is generally agreed that it was invented during the middle ages or later.

'The wheelbarrow seems not to have been in existence in antiquity. There are no Roman remains or representations.'¹ 'Nous ne savons pas que le premier a dit que la brouette avait ete inventee par un sieur Dupin en 1669...c'est un question d'ordre public dans un certain monde, que tout, depuis l'art de penser jusqu'a la brouette inclusivement date du regne de Louis XIV'.² The idea of a wheelbarrow, a notable medieval invention, may have suggested itself to men who picked up the shafts of a light two-wheeled cart to shift it about. Such an origin fits in well with the latin name of birota which indicated that it originally had two wheels. However, no pictures exist of such wheelbarrows. From its earliest appearances it had only one wheel. '³ Thus there are three questions to consider, the origins of the wheelbarrow, the date at which it was known in western Europe and how, when its name is derived from the word birota, has it come to be depicted as having only one wheel.

Firstly what are the origins of the wheelbarrow? In undeveloped areas, particularly those with difficult terrains, the cheapest, most popular form of transport is human, a man with a load on his head, shoulders or back.⁴ However, it is more likely that the wheelbarrow was developed by a community already cognisant with some form of transport but looking for a vehicle for some specialised purpose.

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1. Leighton (1974) p 88
 2. E.E.Viollet-le Duc (Paris n.d.) 2, p 41
 3. Leighton (1974) pp 117-8
 4. Berg (1935) p 15

The wheelbarrow may have been developed from a litter or hurdle in which the front bearer was replaced by a single wheel. Flat litters were in use in Roman times and do appear in Roman representations such as a relief from Vienne⁵ which shows one such cratis stercoris⁶ a litter to carry manure to the fields. Made of wicker or hurdles, such Roman handbarrows differed little from those depicted in the middle ages, for example, from the miniatures of the fifteenth century hours of King Manuel of Portugal and those still in use in the twentieth century, for example in Wales.⁸ Such hurdles are often depicted in miniatures of building scenes. On sites they appear to have been used particularly for transporting stones from the mason's lodge to the construction area. Sometimes they were brought in to take heavy blocks up ladders.⁹ It is relatively easy to imagine that the addition of a front wheel to a litter would not have been a complicated matter. It must also be noted that the Luttrell Psalter wheelbarrow may be described as a litter with a front wheel.¹⁰ It is also interesting that in early miniatures two men were often involved, one pushing the barrow the other pulling, as in a litter.

It is possible also that the wheelbarrow was developed from a vehicle recorded from northern Europe, which is simply a draught pole with solid wheels in front, sometimes known as a tub pole. This was used in towns for portage, as early as the fifteenth century. Berg discusses three examples, one from Trystberg, Sodermanland, one from Burs in Gottland and one from Leksand in Dalarna.¹¹ It is primitive but demonstrates two aspects later incorporated into the wheelbarrow, namely that it

5. K.D.White (1970) pl 5b

6. ibid (1975) S.V.crates stercoriae

7. Galhano (1973) pl 121

8. I.Peate, Some aspects of agricultural transport in Wales(Cardiff 1929) p 122 fig. 2

9. British Library Yates Thompson 22 fol. 130b

10. Mullar (1932) fol 186b (1340)

11. Berg (1935) pp 147-58, pl XXVI 2, pl XXVI 3.

was pushed from behind by one man and that the wheels are positioned in the front. However, it is unlikely that this was the ancestor of the wheelbarrow. From its earliest inception, the wheelbarrow has always had two handles and a spoked wheel. Furthermore the tab pole is distinctively eastern and northern and the wheelbarrow was known at an early date in the west. However, it does show that the addition of front wheels has always been seen as a useful solution to the problem of adapting a vehicle, or parts of a vehicle, for heavy load bearing.

Berg also suggested that the wheelbarrow may have been developed from the sledge, particularly the wheeled sledge used in Sweden for corn transportation. He shows an example from Nysatra, Vasterbotten, which has solid wheels at the back and front runners.¹² However, the morphology of the sledge is very different from that of the wheelbarrow and it is unnecessary to look for an ancestor in the sledge.

The most likely origin and one borne out by its name, is that the wheelbarrow was developed from the idea of a cart being pushed backwards by its shafts. This concept is justifiable only if an answer can be found as to why a vehicle whose name and origin is derived from a two wheeled cart should consistently be depicted from its earliest representations as having a single wheel. 'The wheelbarrow is always represented as having a single wheel. This makes good sense from the standpoint of efficiency, economy and manoeuvrability but leaves unanswered the question of how the name of a two wheeled animal-drawn cart came to be applied to a one wheeled man-pushed vehicle.'¹³ Several points may be made. Firstly the latin name birota is used in the Theodosian code to describe a light two wheeled cart.¹⁴

12. *ibid* pl XXV 7

13. Leighton (1974) p29.

14. Pharr (1952) 6.29.2, 8.5.9.

Although there may be some question as to the development of brouette from birota¹⁵ it is also known that a caretta manualis¹⁶ existed in the fourteenth century and that a manuvectorium¹⁷ was also known in the early fifteenth century, both words pointing to a development in the wheeled vehicles towards a wheelbarrow-like form of transport. Secondly the matter of a wheelbarrow only having one wheel has always been accepted because it is normal to think of a barrow as having a single wheel. Careful scrutiny of the miniatures, however, may bring to light wheelbarrows which at first sight appear to have only one wheel but from which a second may be inferred. At least two miniatures exist in which this is the case, a Flemish manuscript from Oxford¹⁸ illuminated, 1320-30, and a fifteenth century French manuscript from the British Library.¹⁹ The former shows a jester seated in a barrow pushed by apes, the wheel being shown not fixed between the bottom planks as is common, but attached entirely on one side, indicating a pair. The British Library manuscript shows labourers' barrows with front wheels fixed directly to the side, again indicating a pair. One has to look carefully to determine whether these depict one wheel or two, but they should not be overlooked. It is far easier to see a wheelbarrow as an adaptation of a cart with one wheel eventually being removed to allow better manoeuvring. It may also be useful to remember that a gun carriage was simply a gun mounted on a small cart and that this was manhandled into place from the shafts. As Froissart recorded 'ces ribaudequins sont brouettes hautes, bandee de fer a lons picots de fer devent en la pointe que ils soulent (les Flammands) menot et brouetter avec eux.'²⁰

15. J. Peter Mahler challenges the common derivation of brouette from birota, private communication, Albert Leighton.

16. RMLML SV caretta

17. Gay and Stein (1929) s.v. brouette

18. Bodleian Library Douce 6 fol 136v

19. British Library Cotton Augustus AV fols 22, 51b, 416

20. Gay and Stein (1929) SV brouette

Leighton also makes an interesting point about the wheelbarrow being man pushed.²¹ This raises the question of whether it has always been pushed or if this is a modern idea. It must be said firstly that a majority of representations show barrows being pushed.²² However, while there are no representations of barrows being pulled, there are some which are shown as being both pushed and pulled. The Luttrell barrow²³ though pushed has attached to the handles, a pair of shoulder straps. Moreover, a number of miniatures show two people, one at the front pulling the other at the rear pushing, as in the Bayeux Tapestry wagon.²⁴

The method of propulsion may perhaps have some bearing on the area of origin. It has been considered that a wheelbarrow may have been invented in the east. While earliest western representations do show the barrow carrying passengers, there are no depictions of it being used like a rickshaw. In the west they did not adopt the Chinese way of using the man as a point of balance and propulsion. In any case, the wheelbarrow was known in western Europe at least by the eleventh century²⁵ though most are found in manuscripts of the fourteenth and fifteenth centuries.

From manuscripts it is possible to divide wheelbarrows into three types though all share the common features of two handles and a spoked wheel. In type 1 the barrow has a flat platform-like body and a single spoked wheel. Type 2 may be subdivided. Type 2a, the most common, appears as a flat platform but the front is blocked by a solid or reiled triangular section

21. Leighton (1974) p 29

22. British Library Add 19720 fol 1, Add 38126 fol 110, Royal 18E i fol.100, Bodleian Library Douce 6 fol 136v, Bodley 264 fol 133, Douce 8 fol 16 Laud 751, fol 165

23. Millar (1932) fol 186b British Library Royal 17E fol 8

24. Stenton (1957) Bodleian Library Douce 6 fol.136v Laud Misc. 751 fol 165

25. R.Capot-Ray Geographie de la Circulation sur les Continents (Paris 1946) p 83 Baudry de Saunier, Histoire de la Locomotion Terrestre. (Paris 1936,) 2, 70.

to keep passengers or packages from falling out when the barrow is lifted. ²⁶ Type 2b is similar in every way but the front block has become a simple T-bar. This appears to be later than 2a. Type 3 is akin to the modern barrow and is bucket-shaped. ²⁷ With the exception of 2b, all three types appear to be contemporary. Type 3 is as early as 1320. ²⁸ However, a refinement appears to have been introduced to types 2 and 3 by the middle of the fourteenth century, namely a small pair of blocks added to the handles to maintain balance when the barrow is laid down.

Wheelbarrows are depicted as being used in four ways; for passengers, on building sites, for baggage and for agricultural use. Their importance of course lay in the fact that they extended enormously the load bearing capacities of one man. Primarily they appear to have been used to carry passengers. ³⁰ They continued to be used for this purpose as late as 1533, particularly in the Low Countries. ³¹ They were also used on building sites ³² to carry bricks from the kiln in much the same way as in the English cottage industry of the early twentieth century. Their use for horticultural and agricultural tasks

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26. Bodleian Library Douce 6 fol 136v, Bodley 264 fol 133v
Auct D inf 2.13 fol 119v, Douce 8 fol 16, Laud Misc. 751
fol 165, Astor A 24 vol 2 fol 276, British Library Add 19720
fol 1, Add 38126 fol 110, Cotton Augustus A V fol 22, 51b,
Royal 17E 11 fol 8, Royal 18 E i fol 100, Singer et al fig 497.
27. British Library Cotton Augustus A V fol 416.
28. Bodleian Library Bodley 264 fol 22, British Library Add 19720
fol 22, E E Viollet le Duc V, Bib. Richel ms. franc. 146 fol 36
29. Bodleian Library Bodley 264 fol 22, Douce 8 fol 16, British
Library Add 38126 fol 110
30. Bodleian Library Douce 6 fol 136v, Laud Misc 751 fol 165,
Auct D inf 2.13 fol 119v, Beverley Minster Misericordia
Pevsner, East Riding of Yorkshire (London n.d.)
31. Die Bemalten Holzteller, Bekannte und Neuentdeckte ihr
Schmuck und seine Herkunft Jozef de Loo: Sonderdruck aus
dem Wallrab Richartz Jahrbuch, British Library pamphlet
2315 (Köln 1975)
32. British Library Cotton Augustus A V fol 22, 51b, Royal 17 E
11 fol 8.

appears in later manuscripts, perhaps indicating that this was a later development. ³³

The wheelbarrow was used in medieval England for a variety of tasks, on the manor. However, it not only appears in local manorial accounts but just as frequently in building accounts of the thirteenth, fourteenth and fifteenth centuries. It is known by a number of names and the most common have been selected here. It should be noted that these examples are by no means exhaustive.

BAROWE.

RMLWL : -

Petworth, Sussex 1347-48 ³⁴

Durham, 1430-31 ³⁵

ij berwes 3d.

Pro factura unius holl barowe,
ij stanebarowes 6d. Pro
operacione ejusdem (ferri) in
unua par del rakkez preassacione
carnium 14d.

" 1434-35 ³⁶

Pro sarracione de le barowes et
tubbarum Rice Jonson, carpentario,
operanti li campanili et
emendacione de lez barowes apud
quarreram per 12 dies ad 4d.4/-d.

CENEVECTORIUM

RMLWL : 1200 a wheelbarrow

Coggeshall House, Essex ³⁷

Wolverhampton, 1300 ³⁸

pro rota nova ad cenevectorii

Et in j cenevectorio manuali 2d.

CIVERA

RMLWL : - 1209 a barrow, bier.

civera virgea, a wicker hand barrow.

Dover Castle 1221

pro viij civeriis rotantibus
emptis apud Cantuariam 4/6d.

Winchester 1222

in duabus civeris 2d.

33. British Library Add 19720, fol 1, 10. Bodleian Library Douce
8 fol 16, Astor A 24 vol 2 fol 276.

34. Salzman (1955)

35. Surtees Society (1898) pp 400-415

36. ibid

37. PRO Duchy of Lancaster DL 41 Bundle X

38. Legal and Manorial Formularies (1933)

Wolverhampton ca 1300 ³⁹

Et in una civara cum rota
emendenda 3d.

Winchester 1258 ⁴⁰

in una civara eapta rotarea 7d.
IN V civeriis virgeis eaptis 4d. Pro
XII bordis ad faciendum civeres 3l.
Pro XXV 3d.

41

Merton College 1299

In dimid c de spiking ad sciver
jd. In ij rot. ligand ad ij sciver
16d.

PLAUSTRUM MANUALIS

RMLWL : caretta manualis 1364
a hand cart

Petworth, Sussex 1352-53 ⁴²

ij rota pro plastr' manual 3d.

WHELEBAROWE

RMLWL : -

Durham 1476-77 ⁴³

j whelebarowe pro coquine. pro
factura j whelebarowe 6d.

Several points thus arise. Firstly, if there is difficulty in accepting an origin for birota from a two-wheeled cart, how is plastr' manualis to be regarded? There surely can be little doubt that both caretta manualis and plastrum manualis are indicative of the origin of wheelbarrows. This is perhaps further confirmed by an entry from Wolverhampton for a convectorium manualis. Wheelbarrows cost about 2d. to 9d. from the thirteenth to the fifteenth century. According to the Bolsover accounts in the winter of 1612, three local carpenters were paid by task for making barrows and again in March 1613 for hods and barrows. Sometimes wicker was also involved, but whether for

39. Drew

40. Legal and Manorial Formularies (1933) p 137

41. ibid p 145

42. Salzman (1955)

43. Surtees Society (1898) pp 415-500

making the bodies or just for baskets to stand on the barrows is not clear. According to Knoop and Jones,⁴⁴ the equipment of a medieval mason's lodge included a barrow, a large truck with four wheels, (perhaps a plaustrum manualis), two smaller trucks and fifteen bering barwes (probably hods or litters). The word gatus⁴⁵ is also used (for example from Winchester; in gatis emptis ad deferendum mortarium,) probably to mean a hod for carrying mortar. It is noticeable that while both barwe and barowe were used, whelebarowe appears to a later word, probably not in common use until the fifteenth century.

One class of minor workers forming one third of the work force at Beaumaris and Caernarvon was the bayardores or baiardores⁴⁶. According to the New English Dictionary baiardour is an obsolete word meaning a mason's labourer who carried a baiard a large handbarrow with six handles on which building stone weighing up to a quarter of a ton each are carried to the lodge and then to the site. In the Vale Royal accounts⁴⁷ they are described as men working with handbarrows taking large stones to be carved at the mason's workshop. It is also known that at Dover Castle over one third of the work force was employed at various times to bring the stones from the ships to the site, in the 1220's. At Dover, the barrowman was known as the bernadensus.⁴⁸ It is interesting that RMLWL records a bermannus as a tenant charged with bernaenagium,⁴⁹ a carrying service. For the site workers, there seems to be no specific record of what they were paid for portage, but it may be assumed that they were being paid, probably along with other duties which they performed. The name, however, may have been taken over from the earlier days when portage was a feudal service.

44. Knoop and Jones Masonry p.14

45. Drew

46. The Medieval Mason p 60

47. Vale Royal Ledger Book, Lancashire and Cheshire Record Society LXVIII (1914) p 226

48. Knoop and Jones p 14 (1931).

49. RMLWL s.v. bermannagium

The wheelbarrow was known in western Europe by the eleventh century. There is no earlier record of its invention in the west. The earliest representations are from French manuscripts and there is no reason why a French origin should not be acceptable. Later, the wheelbarrow came to be used extensively in the Low Countries, particularly for passengers in towns.⁵⁰ However, the representations of wheelbarrows from Gothic marginals suggest that it was not altogether respectable to travel by barrow. Its use as an agricultural implement appears to be late, but it was in use on English manors and building sites from the thirteenth century onwards. It is possible that it originated as a development from a hurdle, though it is more likely that it began as a small version of a horseless cart. It remained popular for passenger transport and town portage until the eighteenth century, and its exclusive use as an aid to carting earth and stones is a relatively recent development.

50. Berg (1935) p 147

APPENDIX TWO:

THE LAND SAILING CARRIAGE,
THE EDINBURGH CONNECTION .


The land sailing carriage, recorded by European travellers to the orient in the sixteenth century, had existed in various forms in China since the sixth century A.D. ¹ These records from China captured the imagination of western Europe, so much so that almost every map to be published in the sixteenth century had a vignette of such a vehicle, including Ortelius' Theatrum Orbis Terrarum of 1584, Mercator's Atlas of 1613 and Speed's Kingdome of China of 1626. Even Milton referred to them in Paradise Lost. ² Robert Hooke demonstrated the principle to the Royal Society and wrote of the vehicles in his Elements of Philosophy. The French Academie des Sciences prepared a questionnaire on land sailing carriages to be taken by missionaries to China, in particular the Jesuit, Philippe Couplet.

However, it was not merely reports which generated such excitement but actual experiments. The Dutch mathematician Simon Stevin constructed a land sailing carriage ³ and in 1600 Prince Maurice of Nassau invited several distinguished guests, among them the learned Grotius, to take part in the vehicle's trials. These were run from Scheveningen to Pettin, along a beach, a distance of over fifty miles and this was completed in less than two hours. This would have taken fourteen hours to complete on foot. Grotius later discussed sailing carriages in his Arts deducing the Original Progress and Improvement of them, furnished with a Variety of Instances and Examples, shewing forth the excellency of Humane wit, published in 1661. It is possible that

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1. Needham (1965) IV, 11 pp 276-281
 2. F.L.Huntley, 'Milton, Mendoza, and the Chinese Land-Ship' Modern Language Notes LXIX (1954), Paradise Lost 111, 431
 3. R.J. Forbes, 'The Sailing Carriage', The Principal Works of Simon Stevin, E. Crone et al V (1963)

both Stevin and Grotius were cognizant with the Chinese cars and that the trials were the direct result of European contact with the east. Stevin's car was later copied by John Wilkins in 1643⁴ Emerson in 1753⁵ and Hooper in 1774⁶.

Stevin's trial is one of the few trials for which there is a contemporary record. A life of a Fabri de Peiresc published in 1606 recalls that the Prince 'stepped aside to Scheveling to make triall of the carriage and swiftnes of the waggon which some years was made wth such art, that it would run swiftly with sails upon land as a ship does in the sea. For he had heard how the Grave Maurice after victory at Nieuport for triall sake he got up into it with Don Francisco Mendoza taken in the fight and within two hours was carried to Putten which was fifty miles from Scheveling'.⁷

It is interesting also that this experiment was also recorded in an illuminated autograph book now in the library of Edinburgh University.⁸ This book contains the autographs of a number of members of the European nobility ca.1600 and folio 191 shows the land car at its trials . The miniature shows a short box wagon, with a bogie, large thick rimmed wheels and a central pole. It also has a large canvas sail. It had one driver and two boys to work the sail and could carry four passengers.

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4. Mathematical Magick (London 1643)
 5. The Principles of Mechanics (London 1753, 1773, 1782)
 6. Rational Recreations in which the Principles of Numbers and Natural Philosophy are clearly and copiously elucidated by a series of easy, entertaining and interesting experiments. IV vols. (London 1774)
 7. P. Gassendi, The Mirror of the Nobility and Gentry being the Life of N.C. Fabricius, Lord of Peiresk, translated by W.Rand (London 1657)
 8. Edinburgh University Manuscript La 111.283. I should like to thank Mr. C.P. Finlayson, Department of Manuscripts for bringing this manuscript to my attention. J.L. Nevinson, 'Sketches of Seventeenth Century London', Countrylife 16 (1967), pp 1256-7.

The land sailing carriage is common today on the north coasts of Belgium, France and in California. Nowadays they are made of fibre glass and of light tubular construction. Its ancestor may be thought to be a curiosity and of no practical value. However, there can be little doubt of the influence which it had on contemporary imagination. In the 1600's the wind car travelled at what must have been an incredible speed. The Dutch car must have travelled at over thirty miles per hour on some stretches to have covered fifty miles in less than two hours. This was the first vehicle to introduce the European to the possibility of high speed land transport and in this case, without horses. Today we are still witnessing the impact of the enjoyment of speed. As Gassendi reported 'how the flew over the ditches he met with and skimmed along upon the surface only, of standing waters which were frequently in the way; how men which ran before seemed to run backwards and how places which seemed an huge way off, were passed by almost in a moment' .

BIBLIOGRAPHY.

A. MANUSCRIPTS.

Bodleian Library, Oxford.

a) Catalogues.

Phicht, O. Western Illuminated Manuscripts in the Bodleian Library, Oxford, Oxford 1966.

b) Manuscripts.

Astor A 12.
" A 24.
Ashmole 1.
Aubrey 31.
Auct. D inf 2.11.
" 2.13.
Auct. D 3.4.
Auct. F 2.29.
" 3.14.
" 4.16.
Auct 2 Q inf 145.
Bodley 188.
" 270b.
" 614.
" 770.
" 971.
Buchanan c 4.
" e 10.
Canon Class Lat 185.
Canon Ital. 85.
" 196.
Canon Misc. 38.

Bodleian Library continued.

Canon Misc. 108.

" 280.

" 554.

Canon Pat. Lat. 187.

C. C. C. 161.

Digby 147.

Douce b 2 65/85.

Douce 6.

" 8.

" 27.

" 48.

" 80.

" 88.

" 91.

" 112.

" 117.

" 118.

" 134.

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" 313.

" 332.

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" 360.

" 371.

" 374.

" 383.

Douce F 4.

" FF 63.

Gough Liturg. 7.

Ital. c 73.

Jesus Coll. 124.

Lat. Misc. d 85.

" 501.

" 644.

" 751.

" 752.

Laud Gr. 7.

Lyell 67.

Merton H 22.

Queens Coll. 305.

Rawl. B 21.

" 214.

Rawl. Q b 6.

Seldon Supra 38.

British Library (formerly British Museum)

a) Catalogues.

Ayscough, S. A Catalogue of Manuscripts preserved in the British Museum London 1832.

Birch, W. de Gray and Jenner H. Early Drawings and Illuminations : an introduction to illustrated manuscripts with a dictionary of subjects in the British Museum London 1879.

--- A Catalogue of Additions to the British Museum Manuscripts XVII vols London 1830-1962.

Ellis, H. and Douce, F. A Catalogue of Lansdowne Manuscripts London 1819.

Ellis, H. and Forshall, G. A Catalogue of Additions made to the Library of Manuscripts in the British Museum since the publication of Mr Ayscough's Catalogue V vols 1819-27.

Forshall, G. A Catalogue of Manuscripts in the British Museum London 1834.

James, M. R. A Descriptive Catalogue of Fifty Manuscripts in the Collection of Henry Yates Thompson Cambridge 1898.

James, M. R. A Descriptive Catalogue of a Second Series of Fifty Manuscripts in the Collection of Henry Yates Thompson Cambridge 1902.

British Library continued.

- James, M. R. A Descriptive Catalogue of Twenty Illuminated Manuscripts LXXV-XCIV in the Collection of Henry Yates Thompson Cambridge 1907.
- Madden, F. Catalogue of Additions made to the Department of Manuscripts since the publication of Mr Ayscough's Catalogue XXIV vols 1831.
- Planta, S. Catalogue of Manuscripts in the Cottonian Library London 1802.
- A Rough Register of Acquisitions in the British Library 1961-65 List and Index Society Special Series 8.
- Scott, E. J. L. Index to the Sloane Manuscripts in the British Museum London 1904.
- Scott, E. J. L. Index to the Stowe Manuscripts in the British Museum London 1895-6.
- Turner, D. H. Romanesque Illuminated Manuscripts in the Grenville Library London 1960.
- Warner, G. F. Illuminated Manuscripts in the British Museum London 1903.
- Warner, G. F. and Gilson, J. P. A British Museum Catalogue of Western Manuscripts in the Old Royal and Kings Collection London .

British Library continued.

b) Manuscripts.

add 10292	37515
10293	38116
10294	38118
11698	38118
15268	38125
15277	39660
16999	39761
17294	40154
18193	40724
18850	40731
18852	42132
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20698	47772
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22569	50000
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British Library continued.

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3	745
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198	3567
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Vitellius A I	10 A V
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B II	17 A XVI
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D XXVII	20 B XX
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Cleopatra B XIV	20 C II
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British Library continued.

Royal	19 D VII	Stowe	12
	18 D IX		17
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	19 D I		21
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	16 F III		
	16 F IX		
	17 F I		
	17 F II		
	16 G V		
	16 G VIII		
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	24		
Sloane	2435		
	2468		
	2683		
	3983		
	4042		
	4288		
	4302		

By binding error pages 254 and 255 have been misplaced and appear at the end of the bibliography.

Cambridge University.

a) Catalogues.

- Munby, A.H.L. Cambridge College Libraries. Cambridge
1962.
- James, M.R. Western Manuscripts in the Library of Clare
College Cambridge 1909.
- James, M.R. Pembroke College, Cambridge, A Catalogue of
Manuscripts Cambridge 1909.
- James, M.R. A Catalogue of Western Manuscripts in Emmanuel
College Cambridge 1904.
- James, M.R. A Descriptive Catalogue of Manuscripts in the
Library of St Johns College Cambridge 1913.
- James, M.R. The Western Manuscripts of Trinity College ,
A Descriptive Catalogue. Cambridge 1900.
- James, M.R. A Descriptive Catalogue of the Manuscripts
in the Library of Peterhouse Cambridge 1899.
- James, M.R. A Descriptive Catalogue of the Manuscripts
in the Library of Pembroke College Cambridge 1905.
- James, M.R. A Descriptive Catalogue of the Manuscripts in
Sidney Sussex College Cambridge 1895.
- James, M.R. A Descriptive Catalogue of the Manuscripts in
St Catherines College Cambridge 1925.
- James, M.R. A Descriptive Catalogue of the Manuscripts in
Trinity Hall Cambridge 1907
- James, M.R. A Descriptive Catalogue of the Manuscripts in
Queens College Cambridge 1905.

Cambridge University continued.

- James, M.R. A Descriptive Catalogue of the Manuscripts in the Fitzwilliam Museum Cambridge 1895.
- James, M.R. A Descriptive Catalogue of the McClean Collection of Manuscripts in the Fitzwilliam Museum Cambridge 1912.
- James, M.R. A Descriptive Catalogue of Manuscripts in the Library of Corpus Christi Cambridge 1912.
- James, M.R. A Descriptive Catalogue of Manuscripts in Jesus College Cambridge 1895.
- James, M.R. A Descriptive Catalogue of Manuscripts other than Oriental in the Library of Kings College Cambridge 1895.
- James, M.R. A Descriptive Catalogue of Manuscripts in the Library of Gonville and Caius College Cambridge 1907, 1908.

b) Manuscripts.

Emmanuel 1.3, 18.
1.3.29.
Corpus Christi 261.
Trinity Hall 12 (Haenel 6).
Fitzwilliam 1.
9.
23.
62.
132.
165.
Kings 40.

Edinburgh University Library

a) Catalogues.

Borland, C. A Descriptive Catalogue of Western Medieval
Manuscripts in Edinburgh University Library Edinburgh
1916.

b) Manuscripts.

Phot. 1225

1269

La. III. 283.

Public Record Office

a) Catalogues.

Catalogue of Unpublished Lists and Indexes.

b) Manuscripts.

Exchequer, Chancellor's Roll. C2

Duchy of Lancaster, Ministers Accounts.	DL 29	40/940
		367/6126
		643/10435
	DL 41	10/7
		10/33
		10/43
	DLX	1/3
Exchequer Accounts Various	E 101	3/9
		3/28-29

Public Record Office continued.

Exchequer Accounts Various	E 101	4/24
		5/24
		6/2
		6/20
		6/29
		9/12
		9/22
		10/27
		13/3
		13/4
		13/43
		13/34
		22/13
		2 5/21
		35/15
		97/4
		98/10
		98/11
		98/19
		98/26
		98/39
		98/40
		99/8
		99/25
		100/10
		100/14
		100/22
		106/7
		107/5
		107/13
		167/20
		260/5-6
		260/8-9
		271/27
		349/20
		351/8

Public Record Office continued.

E 101 352/30
354/11
355/20
356/1-19
357/2-23
359/24
360/1
361/12
361/27
362/4
365/2-30
367/25
371/1-6
371/?
371/8
371/11
372/13
373/15-30
375/15-30
376/7-30
383/1
404-410
505/17
507/20
547/22-27
568/29
569/32
571/19
580/30
585/3
585/23
586/21
592/6-13
598/21

Public Record Office continued.

	E 101	598/22	
		612/22	
		613/15	
		613/16	
		684/11	
		684/13	
	E 106	2/1	
		2/5	
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		11/15	
Exchequer, Queen's Remembrancer Memoranda Roll	E 159		52
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		2/32	
		3/7	
		4/3	
		24/10	
Exchequer, Lord Treasurer's Remembrancer, Memoranda Rolls			
	E 368	1-172	
		1217-1400	
Foreign Accounts Enrolled on the Great Roll of the Exchequer			
	E 364	9	
Sheriffs Accounts Enrolled on the Great Roll of the			
Exchequer	P 12	52	
Enrolled Accounts, Great Roll of the Exchequer			
	P 26	41	
	P 38		

Public Record Office continued.

Exchequer Ministers Accounts Various	SG 6	742/1
		742/4
		747/15
		748/17
		750/22-29
		751/20
		811/3
		845/13
		856/15
		1070/5
		1078/14
		1131/2
		1131/3
		1132/9
		1132/10
		1142/25
		1143/18
		1144/1
		1144/7
		1144/16

Rental and Surveys, General Series

Roll 47
Roll 713
Roll 730

Facsimiles

- Alexander, J.J.G. Norman Illumination at Mont St Michel
996-1100 Oxford 1970.
- Boase, T.S.R. The York Psalter London 1962.
- Beckwith, J. Early Medieval Art London 1964.
- Blanchard, P. Heures de Savoie London 1910.
- Blaum and Lauer Heures d'Adelaide de Savoie Paris n.d.
- Blaum, A. and Lauer P. La Miniature Francaise aux XVe et
XVIe Siecles Paris 1930.
- Bockler, A. Das Goldene Evangelienbuch Heinrichs III
Berlin 1933.
- Bourdichen, J. Les Heures d'Anne de Bretagne Paris 1943-6.
- Breiger, P.; Weiss, M.; Singleton, C.S. Illuminated
Manuscripts of the Divine Comedy London 1970.
- Byvanck, A. W. Les Principaux Manuscrits a Peintures
De La Bibliotheque Royale des Pays Bas et du Musee
Meermanno-Westreenanum a la Haye Paris 1924.
- Buchthal, H. The Miniatures of the Paris Psalter
London 1938.
- Buchthal, H. Historia Troiana London 1971.
- Chamison and Matisse Les Heures du Coeur d'Amour Epris
du Roi Rene Paris 1943.

- Cockerell, S.C. and Walter, E. A Book of Hours of Yolande of Flanders London 1905.
- Cockerell, S.C. A Psalter and Hours executed in 1270 for a Lady connected with St Louis, probably his sister Isabelle of France London 1905.
- Cockerell, S.C.; James, M.R. and Ffoulkes, G.J. A Book of Old Testament Illustrations of the mid thirteenth century sent by Cardinal Bernard Maciejowski to Shah Abbas the Great King of Persia, now in the Pierpont Morgan Library Cambridge 1927.
- Cockerell, S.C. The Work of W. de Brailes, an English Illuminator of the thirteenth century Cambridge 1930.
- Colledge, M.A.R. The Art of Palmyra London 1976.
- Crawford, H.S. A Handbook of Carved Ornament from Irish Monuments of the Christian Period Dublin 1926.
- Crosset, B. L'Art Roman Paris 1962.
- D'Ancona, P. and Aeschlimann, E. The Art of Illumination London 1969.
- D'Anjou, R. Le Mortifiement de Vaine Plaisance pour Isabelle de Portugal Brussels.
- Delaisse, L.M.J. Miniatures Medievales de la Librarie de Bourgogne Geneva.
- Delaisse, L.M.J. La Miniature Flammande a L'Epoque de Philippe le Bon Italy 1956.
- Denny, N. and Filmer-Sankey, J. The Bayeux Tapestry London 1966.

- Diedrichs, E. Deutsche Leben der Vergangenheit in Bildern
II vols Jena 1908.
- Dodwell, C.R. Painting in Europe 800-1200 London 1971.
- Dodwell, C.R. The Great Lambeth Bible London 1959.
- Dorigo, W. Late Roman Painting London 1971.
- Durrieu P. La Miniature Flammande Paris 1927.
- Esperandieu, E. Recueil General des Bas-Reliefs de la Gaule-
Romaine Paris 1908.
- Focillon, H. The Art of the West; Romanesque London 1963.
- Folena, G. and Mellini, G.L. Bibbia Istoriata Padovana
Venice 1962.
- Formaggio, D. and Basso, C. A Book of Miniatures London
1962.
- Fouquet, J. The Hours of Etienne Chevalier London 1972.
- Galhano, F. O Carro de Bois em Portugal Lisbon 1973.
- Goldschmidt, A. German Illumination New York.
- Grabar, A. The Beginnings of Christian Art London 1967.
- Graham, R. 'A Picture Book of the Life of St Anthony'
Archaeologia LXXVIII 1933 pp 1-26.
- Hassall, A.G. and W.O. The Douce Apocalypse London 1961.
- Herrad von Landsberg Hortus Deliciarum Alsace 1879-99.
- Hubert, J.; Porcher, J; and Wolbach W.F. Europe in the Dark
Ages London 1969.

- Buyghe, R. L'Art et L'Homme Paris 1957-61.
- James, M.R. Thirty Miniatures in the Hours of Joan II, Queen of Navarre Roxburgh Club 1899.
- James, M.R. The Rutland Psalter Roxburghe Club 1937.
- James, M.R. Peterborough Psalter and Bestiary Roxburghe Club.
- James, M.R. The Drawings of Matthew Paris Walpole Society XIV 1925-26.
- James, M.R. The Apocalypse in Art London 1931.
- James, M.R. The Dublin Apocalypse Cambridge 1932.
- James, M.R. The Trinity College Apocalypse Roxburghe Club 1909.
- James, M.R. The Holkham Bible Walpole Society XI 1922-23.
- Kauffmann, C.M. Romanesque Manuscripts 1066-1190 London 1975.
- Kochler, W. Die Karolingischen Miniaturen Berlin 1971.
- Lehmann-Hartleben, K. Die Trajanssäule Berlin/Leipzig 1926.
- Les Grandes Heures de Jean Duc de Berry London 1971.
- Les Tres Riches Heures du Duc de Berry London 1969.
- Les Tres Belles Heures de Duc de Berry Paris 1902.
- Loomis, B.S. and L.H. Arthurian Legends in Medieval Art London 1938.

- Ludovici, S.S. Illustrazione de Libro E Incisione in Lombardia nel ' 400 e 500 Modena 1960.
- Maunde Thompson, E. English Illuminated Manuscripts London 1895.
- Millar, E. The Parisian Miniaturist Honore London 1959.
- Millar, E. English Illuminated Manuscripts London 1926, 1928.
- Millar, E. The Luttrell Psalter Princeton 1932.
- Mitchell, C. A Fifteenth Century Plutarch London 1961.
- Morand, K. Jean Pucelle Oxford 1962.
- Neuss, W. Die Katalanische Bibelillustration Bonn 1922.
- Pacht, O. The Master of Mary of Burgundy: The Berlin Hours London.
- Pacht, O. Dodwell, C.R. and Wormald, F. The SE Albans Psalter London 1960.
- Panofsky Early Netherlandische Painting Harvard 1953.
- Pearsall and Salter Landscapes and Seasons of the Medieval World London 1973.
- Pirani, E. Gothic Illuminated Manuscripts New York 1966.
- Porcher, J. French Miniatures from Illuminated Manuscripts Netherlands 1960.
- Porcher, J. The Bohem Book of Hours London 1959.
- Reinach, S. Repetoire de Reliefs Grecs et Romains Paris 1909.

- Randall, L.M.C. Images in the Margins of Gothic Manuscripts
Berkeley and Los Angeles 1966.
- Ross, A. Illustrated Medieval Alexander Books London
1963.
- Thirty-Two Miniatures from a Book of Hours of Joan II
Roxburghe Club 1899.
- Miracles de Notre Dame, collected by Jean Mielot
Roxburghe Club 1885.
- The Guthlac Roll Roxburghe Club 1928.
- Two East Anglian Psalters at the Bodleian Roxburghe Club
1926.
- Illustrations of Ancient State and Chivalry Roxburghe
Club.
- The Bohun Manuscript Roxburghe Club 1936.
- The Sherborne Missal Roxburghe Club 1920.
- A Thirteenth Century Bestiary in the Library of Alnwick
Castle Roxburghe Club 1955.
- The Metz Pontifical Roxburghe Club 1902.
- The Gospels of Matilda Roxburghe Club 1917.
- Der Sachsenspiegel Leipzig 1952.
- Salmi, M. Italian Miniatures London 1957.
- Stenton, F. The Bayeux Tapestry London 1957.
- Strong, D.E. Roman Imperial Sculpture London 1961.

- Swarcsonski, H. Early Medieval Illumination Berne 1951.
- Talbot-Rice, D. The Beginnings of Christian art London 1957.
- Temple, E. Anglo-Saxon Manuscripts 900-1066 London 1976.
- Tolhurst, J.B.L. 'An Examination of two Anglo Saxon Manuscripts of the Winchester School; The Missal of Robert of Jumieges and the Benedictional of St Aethelwold' Archaeologia LXXXIII 1933 pp 27-44.
- Toynbee, J.M.C. Art in Britain under the Romans Oxford Oxford 1964.
- Toynbee, J.M.C. Animals in Roman Life and Art London 1973.
- Tristan, E.W. English Medieval Wall Painting Oxford 1944.
- Unterkircher, F. La Miniature Antrichienne Italy 1954.
- Verdier, P.; Brieger, B. and Montpetit, M.F. Art and the Courts of France and England 1259-1328 Ottawa 1972
- De Wald, E.T. The Illustrations of the Utrecht Psalter Princeton, London.
- De Wald, E.T. The Stuttgart Psalter London.
- Warner, G. Queen Mary's Psalter London 1912.
- Webster, J.C. The Labors of the months in Antique and Medieval Art to the end of the Twelfth Century. Evanston 1938.

- Willis, R. Facsimile of the sketch book of Wilans de Honcourt
London 1859.
- Woodruff, H. The Illustrated Manuscripts of Prudentius
Cambridge Massachusetts 1930.
- Wormald, F. The Miniatures of the Gospels of St Augustine
London.
- Wormald, F. The Winchester Psalter London 1973.
- Wormald, F. The Benedictional of St Ethelwold
London 1959.
- Wormald, F. The Utrecht Psalter Utrecht 1955.

Printed Texts.

- Archaeologia XXVI 'A Brief Summary of the Wardrobe
Accounts of the tenth, eleventh and fourteenth
years of King Edward II contained in a letter
addressed by Thomas Stapleton to John Gage.
- Ash, H.B.; Forster, C.S. and Hoffner, E. De Re Rustica
and De Arboribus Cambridge Massachusetts 1955.
- Babcock, E.A. and Kroy, A.C. William, Archbishop of
Tyre; A History of Deeds done beyond the Sea
New York 1943.
- Barley, M.W. Documents of the Manor of Newark, Nottingham
Post Mortems 1437-85. Thornton Record Society XVI-XVII
Nottingham 1955-56.

- Brand, J. and Lysons, S. Copy of a roll of expenses of King Edward I at Rhuddlan Castle, in Wales, in the tenth and eleventh years of his reign, remaining among the records in the Tower. Archaeologia XVI.
- Clanchy, M.T. Civil Pleas of the Wiltshire Eyre 1249 Wiltshire Record Society XXVI 1971.
- Cole, A.H. and Watts, G.B. The Handicrafts of France as recorded in the "Description des Arts et Metiers. Cambridge Massachusetts 1952.
- Davis?Weyer, C. Early Medieval Art 300-1150 Sources and Documents in the History of Art London 1967.
- Drew, J.S. 'Manorial Accounts of St Swithun's Priory, Winchester' EHR LXII 1947 pp 20-41.
- Duffus Hardy, T. Rotuli de Liberate ac de Misis et Fraestitis Regnante Johanne London 1844.
- Ellis, H. Chronica Johannis de Oxenedes Rolls Series XIII London 1859.
- Farr, B. Highworth Hundred Rolls Wiltshire Record Society XXI XXII 1966, 1968.
- Finberg, H.P.R. Tavistock Abbey Cambridge 1951.
- Flower, C.T. Public Works in Medieval Law Selden Society XXXII XL 1915.
- Fussell, G.E. Robert Leder's Farm Accounts Camden Society LIII London 1936.
- Gregory of Tours Historia Francorum Monumenta Germaniae Historica : Scripto res, rerum Merovingicarum I

- Granger, T. Vitruvius, De Architectura London 1931
- Hall, H. The Pipe Roll of the Bishopric of Winchester
London 1903.
- Hall, H. The Red Book of the Exchequer London 1896.
- Hamilton Thompson, A. Northumbrian Fleas from the De Banco Rolls Surtees Society CLVIII London 1950
- Harmer, F.E. Select English Historical Documents of the ninth and tenth century Cambridge 1914.
- Harvey, P.D.A. A Medieval Oxfordshire Village: Cuxham 1240-1400 Oxford 1965.
- Hooper, W.D. and Ash, H.B. Cato and Varro: De Re Rustica
Cambridge Massachusetts 1934.
- James, M.R. Walter Map, De Nugis Curialium Cymmrodorion Record Series IX London 1923.
- Kitchen, C.W. The Manor of Manydoun London 1895.
- Knoop, D. and Jones, G.P. 'The First Three Years of the Building of Vale Royal Abbey 1278-80' Transactions of the Quatuor Coronati Lodge XLIV 1931 pp 5-47.
- Knoop, D. and Jones, G.P. 'Some notes on three early documents relating to masons' Transactions of the Quatuor Coronati Lodge XLIV 1931 pp 223-35.
- Knoop, D. and Jones, G.P. 'Castle Building at Beaumaris and Caernarvon in the early fourteenth century' Transactions of the Quatuor Coronati Lodge XLV 1932 pp 4-47.

- Knoop, D. and Jones, G.P. 'The Evolution of Masonic Organisation'
Transactions of the Quatuor Coronati Lodge XLV
 1932 pp 267-301.
- Knoop, D. and Jones, G.P. 'The Bolsover Castle Building
 Accounts 1613 Are Quatuor Coronatorum XLIX 1936.
- Lennard, R. 'The desmeene of Glastonbury Abbey in the
 eleventh and twelfth centuries' ECHR VIII
 1955-6 pp 355-363.
- Liber Quotidianus Contrarotulatoris Garderobae Society of
 Antiquaries of London 1787.
- Madden, F Matthaei Pariensis, Monachi Sancti Albani
Historia Anglorum Rolls Series London 1869.
- Pugh, R.B. Court Rolls of the Wiltshire Manors of Adam
de Stratton Wiltshire Record Society XXIV
 Devises 1970.
- Oschinsky, D. Walter of Henley and other treatises on
estate management and accounting Oxford 1971.
- Page, F. The Estates of Crowland Abbey Cambridge 1934.
- Page, F. Wellingborough Manorial Accounts 1258-1323
 Northants Record Society VIII 1936.
- Palladius On Husbandrie Early English Text Society
 London.
- Percy, J.W. York Memorandum Book Surtees Society CLXXXVI
 Gateshead 1973.
- Postan, M. 'Glastonbury Estates in the Twelfth Century:
 A Reply' ECHR IX 1956-7 pp 106-118.

- Rackham, H. and Jones, W.H.S. Pliny, Natural History
London 1948.
- Robertson, A.J. Anglo-Saxon Charters Cambridge 1939.
- Ruston, A.G. and Whitney, D. Hooton Pagnell: The Agricultural
Evolution of a Yorkshire Village London 1934.
- Skeat, W.W. Fitsherbert: The Book of Husbandry 1534
English Dialect Society Series D Miscellaneous 1882.
- Webb, J. A Roll of the Household Expenses of Richard de
Swinfield, Bishop of Hereford 1289-1290 Camden
Society London.
- Wolldon Finn, R. Domesday Studies: The Liber Exoniensis
London 1964.

A Selective List of Secondary Sources.

- Adcock, F.E. The Roman Art of War London 1940
- Anderson, J.K. Ancient Greek Horsemanship Berkeley
and Los Angeles 1961.
- Arkell, W.J. Oxford Stone London 1960.
- Barraclough, G. Social Life in Early England London
1960
- Berg, G. Sledges and Wheeled Vehicles Nordiska Museets
Handlingar IV 1935.

- Berlow, R.K. 'The Development of Business Techniques used at the Fairs of Champagne' Studies in Medieval and Renaissance History VIII 1971 pp 3-33.
- Blunser, H. Technologie und Terminologie Leipzig 1875-87.
- Boissonade, P. Life and Work in Medieval Europe London 1927.
- Bona, I 'Clay Models of Bronze Age Wagons and Wheels in the Middle Danube Basin' Acta Archaeologica Hungarica XII 1960 pp 83-111.
- Borhegyi, S.F.De 'Wheels and Men' Archaeology XXIII 1970 pp 18-25.
- Boyer, M.N. 'Medieval Pivoted Axles' Technology and Culture I 1960 pp 128-38.
- Boyer, M.N. 'Medieval Suspended Carriages' Speculum XXXIV 1959 pp 359-66.
- Boyer, M.N. 'Roads and Rivers: Their Use and Disuse in Medieval France' Medievalia et Humanistica XIII 1960 pp 65-80.
- Boyer, M.N. 'A Days Journey in Medieval France' Speculum XXVI 1951 pp 597-608.
- Brøgger, A.W. and Sjetelig H. Osebergfundet Oslo 1928.
- Burford, A. 'Heavy Transport in Classical Antiquity' EAHR XIII 1960-61 pp 1-18.
- Casson, L. Travel in the Ancient World London 1974.
- Chadwick, D. Social Life in the Days of Piers Plowman Cambridge 1922.

- Chapotat, G. 'Le Char Processionnel de la Cote-Saint-Andre'
Gallia XX 1962 pp 33-78.
- Cheyney, E.P. English Manorial Documents Philadelphia
1896.
- Childe, V.G. 'The First Waggon and Carts from the Tigris
to the Severn' PPS XVII pp 177-195.
- Childe, V.G. 'The Final Bronze Age in the Near East and
Temperate Europe' PPS 1948 XIV pp 177-195.
- Colvin, H.M. The History of the King's Works London
London 1963.
- Cook, A.S. 'Augustine's Journey from Rome to Richborough'
Speculum I 1926 pp 375-97.
- Crofts, J. Packhorse, Waggon and Post London 1967.
- Crump, G.G. 'The Pilgrims Way' History XXI 1936
pp 22-33.
- Curtis, J. Wheeled Vehicles in Ancient Western Asia
London 1975.
- Dumas, M. Histoire Generale des Techniques Paris 1962.
- Berry, T.K. and Williams, T.I. A Short History of
Technology Oxford 1960.
- Des Noettes, L. L'Attelage du Cheval de Selle à travers
les ages Paris 1931.
- Diderot, D and D'Alembert, J. Encyclopedie ou Dictionnaire
Raisonne des Sciences des Arts et des Metiers
Paris 1771-80.

- Douglas, D.C. English Historical Documents London 1955.
- Duncan-Jones, R. The Economy of Ancient Roman Empire
Cambridge 1974.
- Edwards, J.G. 'Edward I's Castle Building in Wales'
Proceedings of the British Academy XXXII 1951
- Erin, K.T. and Reynolds, J. 'The Aphrodisias Copy of
Diocletian's Edict on Maximum Prices' Journal of
Roman Studies LXIII 1973 pp 99-111.
- Face, R.D. 'The Vectuarii in the Overland Commerce
between Champagne and Southern Europe' ECHR
XII 1959-60 pp 239-246.
- Farrer, W. 'An Outline Itinerary of King Henry I' ECHR
XXXIV 1919.
- Fenton, A. 'Brought Oxen in Britain' Narodopisny Vestnik
Ceskoslovensky III-IV 1969.
- Finberg, H.P.R. The Agrarian History of England and Wales
- Finley, M.I. 'Technology in the Ancient World' ECHR
XII 1959-60 pp 120-5.
- Finley, M.I. 'Technical Innovation and Economic Progress
in the Ancient World' ECHR XVII 1965 pp 29-45.
- Finley, M.I. The Ancient Economy Berkeley 1973.
- Foltiny, S. 'The Oldest Representations of Wheeled Vehicles
in Central and Southeastern Europe' AJA
LXIII 1959 pp 53-58.
- Forbes, R.J. Studies in Ancient Technology Leiden 1955

- Fox, C. 'Slods, Carts and Wagons' Antiquity V 1931
pp 185-199.
- Fox, C. A Find of the Early Iron Age from Llyn Cerrig Bach,
Anglesey Cardiff 1946.
- Gay and Stein Dictionnaire Archeologique du Moyen Age Paris
1928.
- Golomshtok, A.A. and Griaznov 'The Pasirik Burial of Altai'
AJA XXXVII 1933 pp 30-45.
- Grasden, A. 'Realistic Observation in the Twelfth Century in
England' Speculum 1972 pp 29-51.
- Haddon, A.C. 'The Evolution of the Cart' The Study of Man
London 1898 pp 161-199.
- Hall, A. Rupert 'More on Medieval Pivoted Axles' Technology
and Culture II 1961 pp 17-21.
- Hancar, F. Das Pferd in Prähistorischer und Früher Historischer
Zeit Munich 1955.
- Harbison, P. 'The Chariot of Celtic Funerary Tradition'
Harburger Beiträge zur Archäologie der Kelten : Festschrift
für Wolfgang Dehn Frey, G.H.(ed) Bonn 1969 pp 54-58.
- Hartley, D. and Elliott, M.M. Life and Work of the People of
England London 1928
- Haudricourt, A.G. and Delamarre, B.D. L'Homme et la Charrue
a travers le monde Paris 1955.
- Heichelheim, F.M. Wirtschaftsgeschichte des Altertums
Leiden 1958-70.

- Hill, H.C. The King's Messengers 1199-1377 London 1961.
- Hodges, H. Technology in the Ancient World London 1970.
- Hennell, T. The Change in the Farm Cambridge 1934.
- Hennell, T. British Craftsmen London 1943.
- Hennell, T. The Countryman at Work London 1947.
- Jacob, G. Arabische Berichte von Gesandten an Germanische Fürstenhöfe aus dem 9 und 10 Jahrhundert Berlin 1927.
- Jacobsthal, P. Early Celtic Art Oxford 1944.
- James, M.K. 'A London Merchant of the XIVth Century' EchE
VIII 1956 pp 364-376.
- Jenkins, J.G. The English Farm Wagon Reading 1961.
- Jennison, G. Animals for Show and Pleasure in Ancient Rome Manchester 1937.
- Joffroy, R. Sepultures a Char du Premier Age du Fer en France Paris 1958.
- Joffroy, R. and Bretz-Mahler, D. Les Tombes a Char de la Tene dans l'Est de la France 1959.
- Jope, E.M. 'Chariotry and Paired-Draught in Ireland during the Early Iron Age' Ulster Journal of Archaeology
1953-55 pp 37-45.
- Jope, E.M. 'Saxon Oxford and its Region' Dark Age Britain
Harden, D.B.(ed) London 1956 pp 234-258.
- Jusserand, J.J. English Wayfaring Life in the Middle Ages
London 1889.

- Klindt-Jensen, O. 'Foreign Influences in Denmark's Early Iron Age' Acta Archaeologica XX-XXI 1949-50.
- Kreisel, H. Frunkwagen und Schlitten Leipzig 1927.
- Landon, L. The Itinerary of King Richard I London 1935.
- Lane, R.H. 'Waggons and their Ancestors' Antiquity IX 1935.
- Larson, L.M. The King's Household in England before the Norman Conquest Wisconsin 1904.
- Latham, R.E. Dictionary of Medieval Latin Fascicule I A-B Oxford 1975.
- Lauffer, S. Diokletians Preisedikht Berlin 1971.
- Leighton, A.C. Transport and Communication in Early Medieval Europe Devon 1972.
- Littauer, M. and Crowel, J.A. 'Early Metal Models of Wagons from the Levant' Levant V 1973 pp 102-126.
- Littauer, M. and Crowel, J.A. 'Terracotta Models as Evidence for Vehicles with Tilts in the Ancient Near East' PPS XL 1974 pp 20-36.
- Lopez, R.S. 'The Evolution of Land Transport in the Middle Ages' Past and Present IX 1956 pp 17-29.
- Lorimer, H.L. 'The Country Cart of Ancient Greece' Journal of Hellenic Studies XXIII 1903 pp 132-151.
- Lucas, A.T. 'A Block Wheel Car from County Tipperary' Journal of the Royal Society of Antiquaries of Ireland LXXXII 1952.

- Mahr, O. 'Sur l'histoire des Wagenrade' Technikgeschichte
Beträge zur Geschichte der Technik und Industrie
 XXIII 1934 pp 51-61.
- Margary, I.D. Roman Roads in Britain London 1973.
- Markland, J. 'Some Remarks on early use of carriages
 in England' Archaeologia XX 1824 pp 443-7.
- Notefindt, H. 'Die Entstehung des Wagens und Wagenrades'
Mannus X 1919 pp 31-63.
- Needham, J and Lu G.D. 'Efficient Equine Harness: The
 Chinese Inventions' Physis II 1960
- Needham, J. and Lu, G.D. 'A Further Note on Efficient
 Equine Harness: The Chinese Inventions' Physis
 VII 1965.
- Needham, J. Science and Civilisation in China, Cambridge
 1960.
- Needham, J* and Lu, G.D. 'The Wheelwrights Art in
 Ancient China I, The Invention of dishing,
 II Scenes in the Workshop Physis I 1959.
- Newton, A.P. Travel and Travellers of the Middle Ages
 London 1930.
- Oman, C. The Art of War in the Middle Ages London
 1923.
- Philipson, J. Harness as it has been, as it is and as
 it should be London 1882.
- Piggott, S. 'A Wheel of the Iron Age from County
 Durham' PSAS 1949 p 191

- Figgott, S. 'The Earliest Wheeled Vehicles and the Caucasian Evidence' PPS 1968 XXXIV pp 266-318.
- Rest, W. 'Das Grabhügelveld von Bell in Hunsrück' Bonner Jahrbuch 6XL 1948.
- Roxburghe Club The Itineraries of William Wey.
- Roxburghe Club The Duke of John Maundeville.
- Roxburghe Club Manners and Household Expenses of England.
- Roxburghe Club The Household Book of John of Norfolk and Thomas of Surrey.
- Salzman, L.P. English Life in the Middle Ages Oxford
- Sanders, N.K. 'Wheelwright and Smiths' Celticus III 1962 pp 79-81.
- Shirt, D.J. 'Chretien de Troyes and the Cart' Studies in Medieval Literature and Languages in Memory of Frederick Whitehead Manchester 1973 pp 279-303.
- Singer, C.; Holmyard, E.J.; Hall, A.R. and Williams, T.I. A History of Technology Oxford 1956.
- Stephenson, C. 'Medieval Feudalism' AHR XLVIII 1943 pp 245-65.
- Stretton, G. 'Some Aspects of Medieval Transport' Transactions of the Royal Historical Society VIII 1924 pp 77-98.
- Tarr, L. The History of the Carriage Hungary 1969.
- Tout, T.F. Chapters in Medieval Administrative History London 1920.

- Toynbee, J.M.C. Death and Burial in the Roman World
London 1971.
- Tylor, E.B. 'On the Origin of the Plough and Wheel Carriage'
Journal of the Anthropological Institute of Great
Britain and Ireland X 1881 pp 74-85.
- Vigneron P. Le Cheval dans L'Antiquite Greco-Romaine
Nancy 1968.
- Vinogradoff, P. Villainage in England :The Growth of the
the Manor London 1905.
- Ward, G. 'The Iron Age Horseshoe and its derivatives'
Antiquaries Journal XXI 1941 pp 9-28.
- Ward Perkins, J.B. 'Medieval and Early Renaissance
Architecture in Malta' Antiquaries Journal
XXII 1942 pp 167-176.
- Wheeler, R.E.M. and T.V. Verulamium Oxford/London 1936.
- Wheeler, R.E.M. Maiden Castle, Dorset Oxford 1943.
- White, K.D. Agricultural Implements of the Roman
World Cambridge 1967.
- White, K.D. Roman Farming London 1970.
- White, K.D. A Bibliography of Roman Agriculture Reading
1970
- White, K.D. Farm Equipment of the Roman World
Cambridge 1975.
- White, L. Jr. Medieval Technology and Social Change
Oxford 1922.

- White, L. Jr. 'Technology and Invention in the Middle Ages'
Speculum XV 1940 pp 141-159.
- Willard, J.F. 'Inland Transportation in England during the
fourteenth century' Speculum I 1926 pp 361-74.
- Willard, J.F. 'The Use of Carts in the fourteenth century'
History XVII 1932-33 pp 246-290.

Unpublished Material

a) Bodleian Library.

- | | | | |
|----|-----------------|-----------------|--|
| MS | B. Litt. c 164 | Major, K. | A Study of the Household
of Stephen Langton. |
| | B. Litt. d 58 | Humphreys, D. | Aspects of Social Life
from the Manuscripts of Gerald of
Wales. |
| | B. Litt. d 655 | Wilkinson, J.W. | The Register of
Robert of Hallam. |
| | B. Litt. d 1274 | Soss, F. | A Study of the Treatment of
Romance Subjects. |
| MS | D. Phil. c 101 | Hunt, R.W. | Alexander Neckham. |
| | D. Phil. d 230 | Hutchings, G. | An Edition of that
Part of the Prose Romance of Lancelot
du Lac which corresponds to Chretien
de Troyes Conte de la Charette. |
| | D. Phil. d 523 | Fryde, E.B. | Edward III's War Finance. |
| c | D. Phil. d 1593 | Martin, G.E. | The Borough and
Merchant Community of Ipswich 1317-
1422. |
| | D. Phil. d 4252 | Freetwick, M.C. | Edward I's Wars and
Their Financing 1274-1307. |

- D. Phil. d 5176 Morgan, H.E. The Old French
Continuations of the Chronicle of
William of Tyre to 1232.
- D. Phil. d 5529 Howard-Johnston, J.D. Studies in
the Organisation of the Byzantine
Army in the 10th and 11th century.

b) Others.

Catalogue of unpublished indexes ,Public Record Office.

Jones, J. Spoke-wheeled vehicles in Prehistoric Europe,
North of the Alps, to circa 700 B.C. H.A.
Dissertation(Edinburgh 1970).

Fenton, A. The Difficulties of Mapping the Distribution
of Carts and Wagons (Edinburgh).

Piggott, S. Roman Vehicles: The Lexical Evidence.

Additional Bibliography

- Freund, W.H.C. 'A third-century Inscription relating to
angareia in Phrygia' Journal of Roman Studies
XLVI 1956 pp 46-56.
- Graziosi Paolo L'arte dell' antica età della pietra
Firenze 1956.
- Rostovtzeff, Michael The social and economic history of the Roman
Ivanovich Empire, Oxford 1926, 2nd ed. rev. by P.M.
Fraser, Oxford 1957
- Schmid, W. Der Kultwagen von Strettweg Leipzig 1934.