Capturing Horsepower

A first- principal guide to EQUINE HARNESSING

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Introduction.

The relationship between humans and domesticated equids is a long and illustrious one, dating back over 4,000 years. The ancient technology originally developed for driving equids, and then for equitation, meant that the horse-human relationship evolved into a force par excellence, something that was to serve human ambitions well in almost every aspect of life right up until the early twentieth century.
History demonstrates that equids were ridden, driven, and used to good effect in warfare, industry, agriculture and in both commercial and public transport where they became our preeminent 'beast of burden'.
The rapid growth of mechanisation in nineteenth century Europe and North America impacted heavily on equids which resulted in their numbers becoming substantially reduced by the twentieth century.
Today in the developed world, equid numbers are seriously depleted and mainly confined to leisure/pleasure activities with a small number still being used by enthusiasts in low-scale agricultural situations.

The 18th – 19th century was a significant highpoint for the use of equids. It was during this period that we see them at their best and most numerous. With the onset of Europe's Industrial Revolution, which started in the 18th century, a major turning point in manufacturing processes was reached in which equines were to play a fundamental role. They had the power and stamina to transport, sometimes over great distances, the vast quantities of coal and iron-ore needed for smelting and mass production. This in turn lead to increases in manufacturing processes, which subsequentially, required the transportation of manufactured goods for which the horse as a pack and carting animal was perfectly suited.

It is said that without equids the Industrial Revolution would never have happened. Ironically, their role in establishing this new industrial age was to be the means of their downfall.

For centuries it was known that equids were a valuable resource even though initially they were still quite small. So how did these versatile beasts come to play such a central role in human development?

Prior to the rise of the horse oxen were the main means of heavy draught. They were however regarded as slow and ungainly in comparison to equids who, with their agility, versatility, and faster pace were an attractive replacement. Centuries of selective breeding programmes saw the horse develop to match any draught power of oxen.

There were however, difficulties such as knowing how best to capture this precious energy and to use it to good effect. It was thought that the yoking system used by oxen would be appropriate, but this was not to be the case and so, an alternative harnessing arrangement for equine draught had to be developed.

This was the beginning of a long and complex journey of trial and error that eventually culminated around the 15th century with the advent of equine draught harness as we know it today. Further to this, advances had to be made in related equipment such as draught vehicles (carriages, carts, wagons etc.) and agricultural implements in accordance with the capabilities of the animals. Other issues came to the fore that necessitated advancement in complementary skills such as wheelwrighting, harness / collar making, farriery, blacksmithing, wainwrights and cartwrights, and coachbuilders; all these were essential for draught animals to successfully fulfil their tasks.

Based upon my own experience as a full-time harness and horse collar maker, this is a document in three sections, with Part one presenting a detailed, in-depth blueprint in layman's terms of the principles and significance of equine draught and a detailed description of corresponding harness component parts relative to these principles.

Part two. HEAVY HORSE DRAUGHT. (WORKING GEARS)
Part two looks at the rise of the Heavy Horse and the role it came to play in our everyday lives, from both public and commercial transport to agricultural field work. Although the four principles of equine draught apply, the focus is on the slightly different harnessing arrangements which came into being because of the nature of their demanding work. Heavy Horse harness had to be substantial and fit for purpose. There are also details on Oxen draught, which preceded the heavy horse. They too had their own draught requirements.

Part 3 Examines the here and now, particularly equids in developing nations
This highlights the difficulties faced by equids in the developing world where both bovids and equids are relied upon for livelihoods. A common feature in these countries is that poverty prevents owners from being able to give their animals the same level of welfare accorded to equines in the developed world. The focus here is to highlight the poor state of equine harnessing methods, and to present ways in which harness related injuries, most of which are preventable, can be overcome. This manual will also be of value to anyone wishing to know more about the principles of equid draught, and how to apply them.

PART ONE.

EQUINE DRAUGHT DYNAMICS.

Appropriate harness is the key to equine draught. Draught, by definition, means *'the act of moving a load by drawing or pulling.'*
Equids depend upon a simple, effective arrangement of strategically placed component parts, straps, and padding assembled in such a way that allows the animal to use its full strength to best effect with the minimum of suffering.
Designed to correspond with the conformation of the animal, these all-important harness components work in harmony with the movement of the animal during the act of draught.
For harness to work proficiently it is important these component parts fit the animal comfortably allowing it unrestricted movement without the risk of injury or distress.

While harness and its component parts vary internationally in terms of style and design, the basic underlying principles of equine draught remain the same irrespective of breed, shape, size, or location of animals. These principles are universal and apply to any animal in the act of draught and are explained in the subsequent pages.

Beginning with:

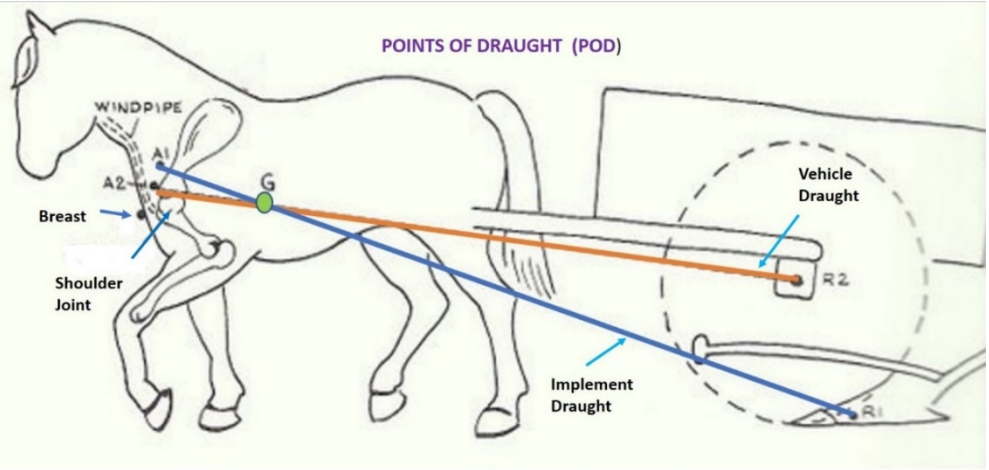
POINT OF DRAUGHT. (POD)

POD *(see Fig.1)* is the physiological area where equids can take the force of draught to best effect. Because all equids differ in shape and size, finding the POD can sometimes prove difficult.

As a rough guide, POD on a horse is positioned just above the point of shoulder and forward of the scapula. It does however vary depending upon the animal's activity. If it is in the act of drawing a vehicle, then the line of draught is more horizontal therefore *A2 -R2* POD *(See Fig.1)* is best suited for this purpose.

Should the animal be drawing an implement at ground level, i.e. a plough, harrow etc. then the point-of-draught sits slightly higher at *A1-R2 See Fig1).* Whichever line-of-draught is in use, it is important that the line runs through the animal's centre of gravity *G (See Fig.1)* These points-of-draught have long been acknowledged as being the most comfortable and effective region for equine draught. The distance between the higher and lower settings of A1 and A2 is perhaps 4" and is significant to draught efficiency.

(Fig.1)



The above illustration shows the optimum POD (A1 and A2) and line of draught relative to the vehicle or implement in use (R1and R2) (G) represents the centre of gravity through which the lines of draught pass.
B. indicates the position of a Breast Collar when in use.

Animals in draught are often referred to as 'pulling'. To the observer, in every sense of the word, that is what they appear to be doing.
However, this is a misconception. The power of draught comes from '*pushing*'. Using their hind quarters and full body weight, the animal leans forward to apply its energies into a collar worn round its neck, which in turn, is designed to be in line with the animal's optimum point of draught. In the act of pushing forward, the illusion of pulling is presented.

For draught to work effectively, there are all-important *codes-of-practice and a set of principles* that needs to be adhered to. These are as follows.
Please note that the illustrations used here are of single horse in driving harness. They are presented only to illustrate the arrangement of harness component parts and their fitting. While there are many variations in terms of harness style and design, the fundamental layout remains the same throughout harness application.

THE FOUR PRINCIPLES OF DRAUGHT*.*
These are:

- ***Transmission.***
- ***Steerage.***
- ***Load bearing.***
- ***Braking.***

Relative to these four principles are four corresponding component harness parts, each of which have their separate roles to play, at the same time collectively represent a complete working unit. Should any of these components be absent, misaligned, or poorly constructed the animal's efficiency will be undermined.

THE FOUR HARNESS COMPONENTS *relative to the four principles.*

- ***Collar****. …….* *(Transmission.)*
- ***Bridle****….* *(Steerage).*
- ***Saddle****…..* *(Load bearing.)*
- ***Breeching****….* *(Braking)*

Further description and a breakdown of these component parts are presented below.

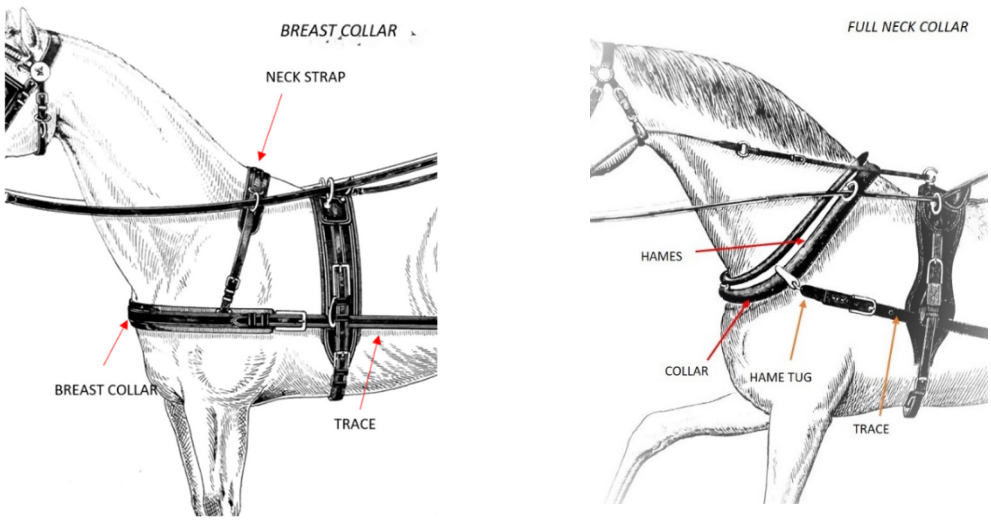
TRANSMISSION. *(Collars.)*

Off all harness component parts, collars are by far the most important. They come in two forms both capable of performing the same function to both greater and lesser degrees.

The Breast Collar and the **Full Neck Collar.** *(See Fig. 2)*

Both collars relate to *Transmission* and are designed to correspond with and sit comfortably around the animal's breast/shoulders/neck, as close as possible to the 'optimum' POD.

THE BREAST COLLAR & FULL NECK COLLAR (Transmission) ***(Fig.2)***



Breast Collars are a simple and effective way to implement draught. They consist of a narrow band positioned around the animal's breast and held in place by a neck strap.

To either end of the breast collar, traces (to *effect* draught) are attached. These reach back to a point on the vehicle enabling the animal to exert its force of draught by pushing into the breast collar.

They are best suited for use over smooth flat surfaces with light loads.

The breast collar was widely used by the Romans throughout their empire. It represented a means by which their horses could be attached to their light weight vehicles where speed and agility were the primary requirement.

Advantages:

1. Breast collars are simple to construct.

2. Cost-effective.

3. Interchangeable, one size fits most animals.

Disadvantages:

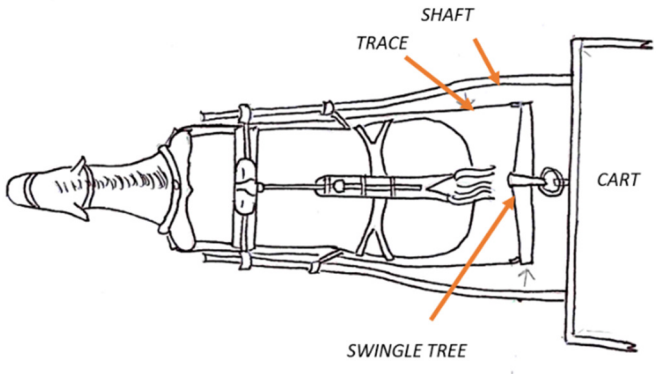
1. Breast collars concentrate the forces of draught over a narrow area of the animal's breast and sternum and somewhat below the recognised optimum POD. As a result, they have limitations in their use. Approximately ***25% of draft efficiency is lost*** *d*ue to restrictive usage.

2. Positioned around the breast of the animal it rests close to the trachea. As such, it has the potential to ride up and cause difficulties with breathing when pushing/pulling heavy loads,

NOTE.

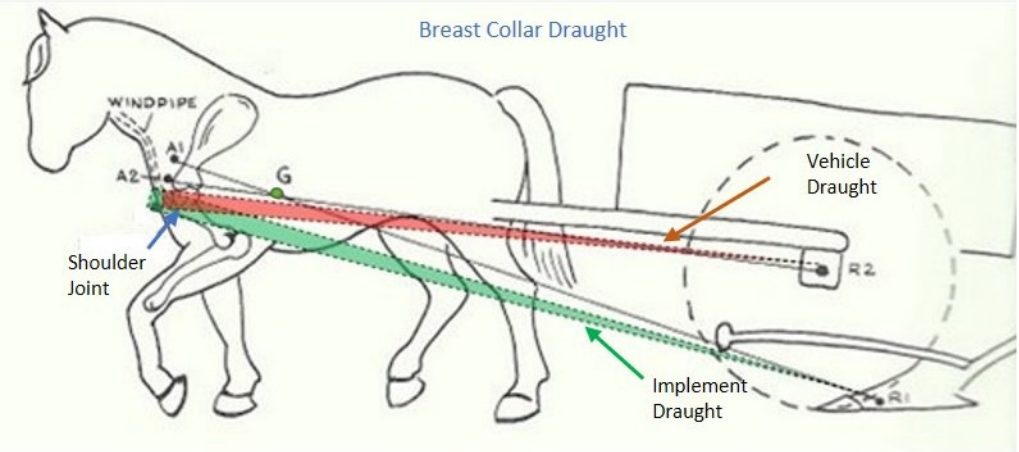
Breast Collars have the potential to cause serious injury if not attached to a swingle tree or are improperly adjusted. In drawing heavy loads, breathing difficulties can arise by it riding up into the throat. Rubbing is likely to occur on the animal's shoulders/breast if not used in conjunction with a SWINGLE TREE.

SWINGLE TREE (Fig.3)



The swingle tree is a simple but crucial device fixed to the front of the cart between the shafts. It is a short bar with a hook on either end, to which the traces attach, and a loose ring in the centre where it fixes to the cart. Its purpose is to 'pivot' from the centre allowing the breast collar to move in accordance with the animal's shoulders when in draught thus avoiding rubbing.

(Fig.4)



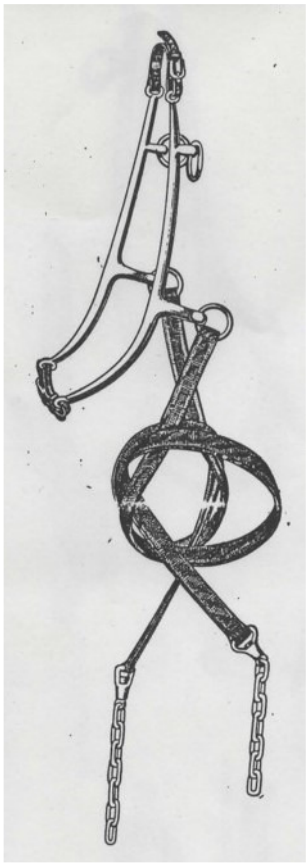
BREAST COLLAR DRAUGHT

The illustration above shows the line of draught when a Breast Collar is used. Green represents the direct line and spread of draught if used with an implement, and Red if used with a vehicle.
It clearly shows the spread of draught is concentrated on a narrow area of the animal's breast and is out of alignment with both A1, A2 and G the centre of gravity.

FULL-NECK COLLARS. (Transmission) *See Fig. (2)*

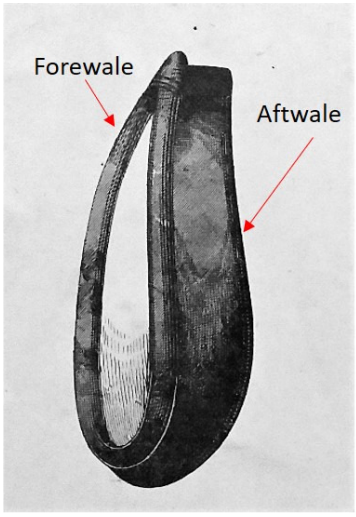
The advent of the full-neck collar around the12th century, ***(See Fig 6)*** was a turning point in equine draught. It was an innovative concept designed to go over the animal's head and *come* to rest on its neck and shoulders.
Developed essentially to carry hames, ***(See Fig.5)*** collars are, in essence, a carefully constructed shaped "cushion" to protect the animal from the forces of draught taken primarily by the hames. While the collar is made to correspond with the shape of the animal's neck and shoulders, and in line with the all-important POD, the hames also need to be in alignment.

(Fig.5) **HAMES.** Made in two parts *(a left and right side*) from metal or wood, are required to fit securely around the rim *(forewale)* of the collar and are held in place by hame-straps at the top, and a strap or chain at the bottom.



Approximately one third from the bottom of the hames, a "finger" or a hook is fixed onto which the Traces attach to effect draught. Near the top of the hames, rein-rings are attached to carry the reins on route to the bit.

Hames and collar represent the vital link between animal and vehicle / implement in use, they provide the means by which the animal is able to achieve efficient draught using its full body weight in line with the POD.



(Fig.6) *HORSE COLLAR*

Full Collar Advantages:

1. Comfort and unrestricted movement.

2. Highly efficient in achieving maximum draught by dispersing the applied forces of draught evenly over the shoulders and neck of the animal in alignment with the POD. *This is highly desirable in terms of efficiency.*

Disadvantages:

1. Collar making is labour intensive and takes many years of training to perfect.

2. Expensive to produce and time consuming.

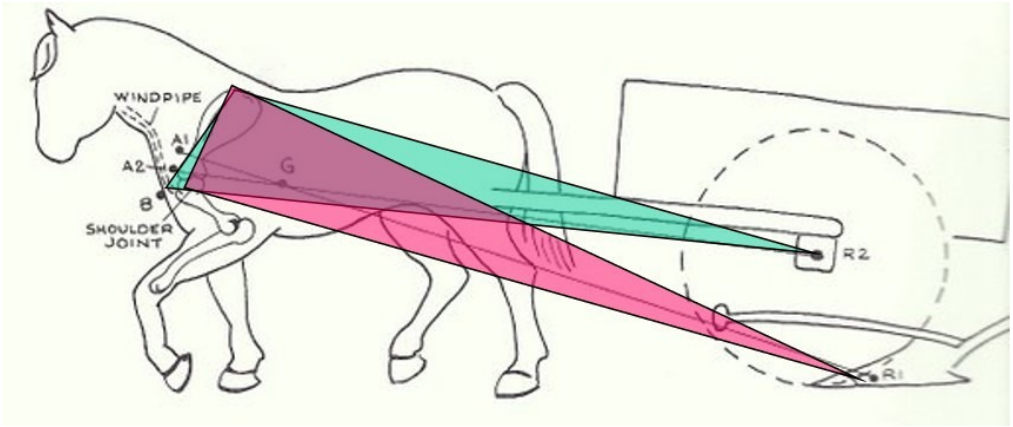
3. *Size matters*. As no two equines are the same, full-neck collars are required to be made for individual animals. The rule of 'one horse, one collar' applies.

4. Collars that are too big will 'swing' and the resultant friction will cause injury. If too small, will cause choking, difficulties with breathing and rubbing if too tight.

5 Collars are required to be ‘firm’. Soft, floppy collars have the potential to tighten around the animal’s neck/throat in hard draught.

It is worth mentioning, that the fit of a full-neck collar to an animal’s neck, can be likened to the fit of a shoe on the human foot. In both cases they are required to be comfortable.

(Fig.7)



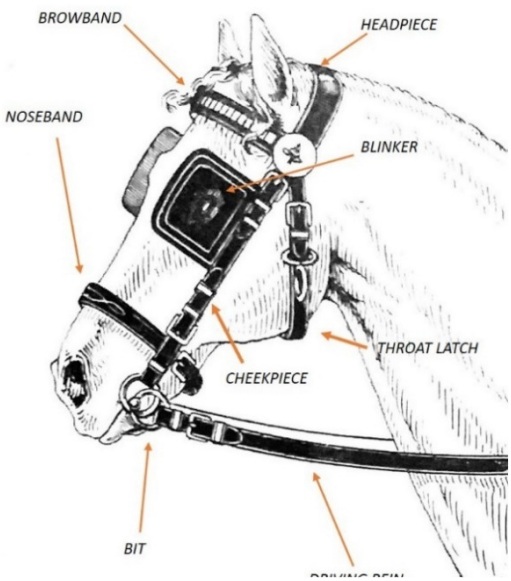
FULL NECK COLLAR DRAUGHT.

The illustration above shows the line of draught when a Full Neck Collar is used. The red highlighted area represents the direct line and spread of draught when used with an implement The green highlight, if used with a vehicle. It shows the area of draught coverage in both cases is largely the same indicating that a full neck collar will serve purpose with both activities.

Driving Bridle *(Steerage)*

(Fig.8)

The purpose of the Bridle is to retain the bit in the animal’s mouth to facilitate Steerage. Driving reins are attached to the bit allowing the handler to exercise control over the movement of the animal. The bit is held in place by cheekpieces, these buckle into the headpiece. In turn, the headpiece is kept in place by the Browband (to prevent it slipping back) and Throat latch (preventing



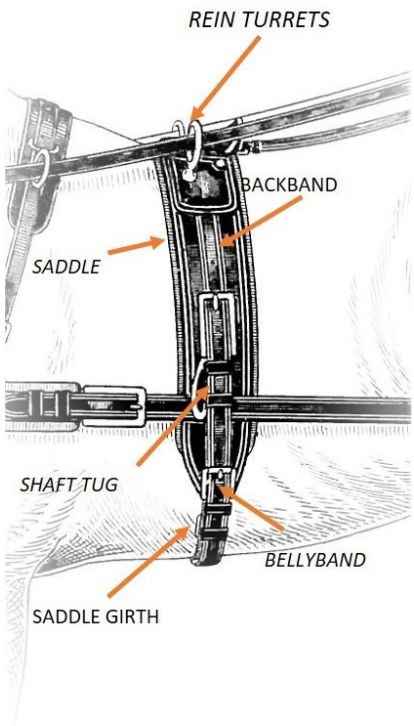
it from slipping forward). The noseband ensures that the cheekpieces are kept in alignment with the bit and headpiece.

Driving Bridles can be used either with, or without Blinkers.
The question is, are they or are they not effective, and do they serve purpose? The answer lies with the animals' owner and in training methods from the outset.
The principle behind blinkers is that they prevent the animal from being alarmed by objects closely behind it. To these ends they serve purpose.
A bridle without blinkers, known as an *open bridle*, is used by those who believe it is better for the animal to have clear all-round vision.

The use of Bits, and one that suits the animal, is a wide and varied topic. The relationship between the bit and the animal's mouth is an important one, and one that can only be determined by its owner/user/trainer who, with their knowledge and understanding of the animals temperament, are best able to assess the bit most suitable
There is an enormous diversity of bits from jointed snaffles to straight-bar, Liverpool bits, halfmoons, Buxton's etc. The choice of bit is of prime importance. Selecting one of the wrong size or shape could produce severe consequences.

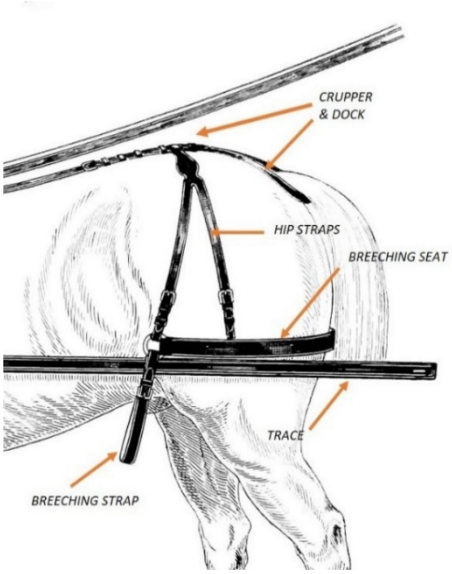
Saddle *(Load-bearing)* ***(Fig.9)***

For the purposes of load bearing, a suitably padded saddle is needed to avoid injury to the spinal column.
Prior to the animal being positioned between the cart shafts, the saddle is placed on its back, just behind the withers, and secured using a girth strap. *(See Fig,9).* Using a backband inserted into a covered channel on the top of the saddle, shaft tugs are buckled into either end of it to support the shafts. The covered channel allows the backband and shaft tugs to "float" freely in accord



with the movement of the shafts while the saddle remains static. In addition, a bellyband is used to ensure the vehicle shafts are held down in the event of unbalanced loading.

FULL BREECHING. ***(Fig10)***



Full breeching is used by an animal between shafts to hold back a vehicle when going downhill, when reversing, or coming to a halt.

Similar in appearance to a breast collar, it consists of a breeching seat positioned around the animal's hindquarters where it is held in place with adjustable hip straps.

At either end of the breeching seat rings are fixed to carry the *breeching straps*.

These are attached to the vehicle shafts thereby preventing it from rolling forward into the animals rear-end.

The crupper, attached to the back of the saddle, lies along the animal's spine where it 'docks' under the tail by means off a shaped dock. It is designed to fit comfortably (not too tight or too loose) to hold the saddle in position and only comes into play when needed. An example of this would be when going downhill, It also supports the hip straps which hang over the rump of the animal from which the breeching is suspended.

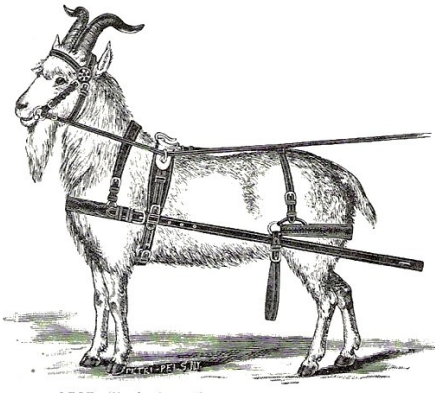
FALSE BREECHING is an alternative way of holding the vehicle back in the event of it rolling forward. It consists of a strap reaching across between the shafts of a vehicle behind the animal's hindquarters. When the vehicle moves forward, i.e., when going downhill, reversing, or coming to a halt, the false breeching prevents the vehicle from running into the animal.

With the use of false breeching, care needs to be taken in size of animal and its compatibility with the vehicle. Should the shafts of the vehicle sit too high or too low,

or the animal be too large or too small, it could be misaligned causing difficulties for the animal.

The emphasis, up to this point, has been on *SINGLE* harness as used by an animal between shafts drawing a two or four wheeled vehicle.
It demonstrates the importance of equine harnessing as directed by the *FOUR PRINCILPES OF DRAUGHT* and the corresponding *FOUR COMPONENT HARNESS PARTS*.

Simply put, they represent a unique formula that has been handed down by generations of skilled harness technicians. Today, they still represent

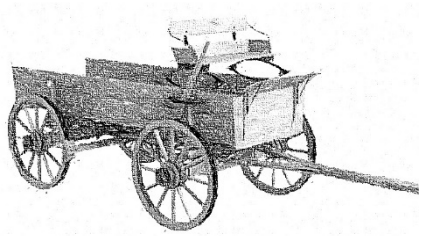


the fundamental basis for harness production and are relevant to any quadruped, regardless of size or shape. By way of illustration, the images here show a camel, and a goat, harnessed using this formula.

WORKING WITH EQUIDS IN PAIRS.

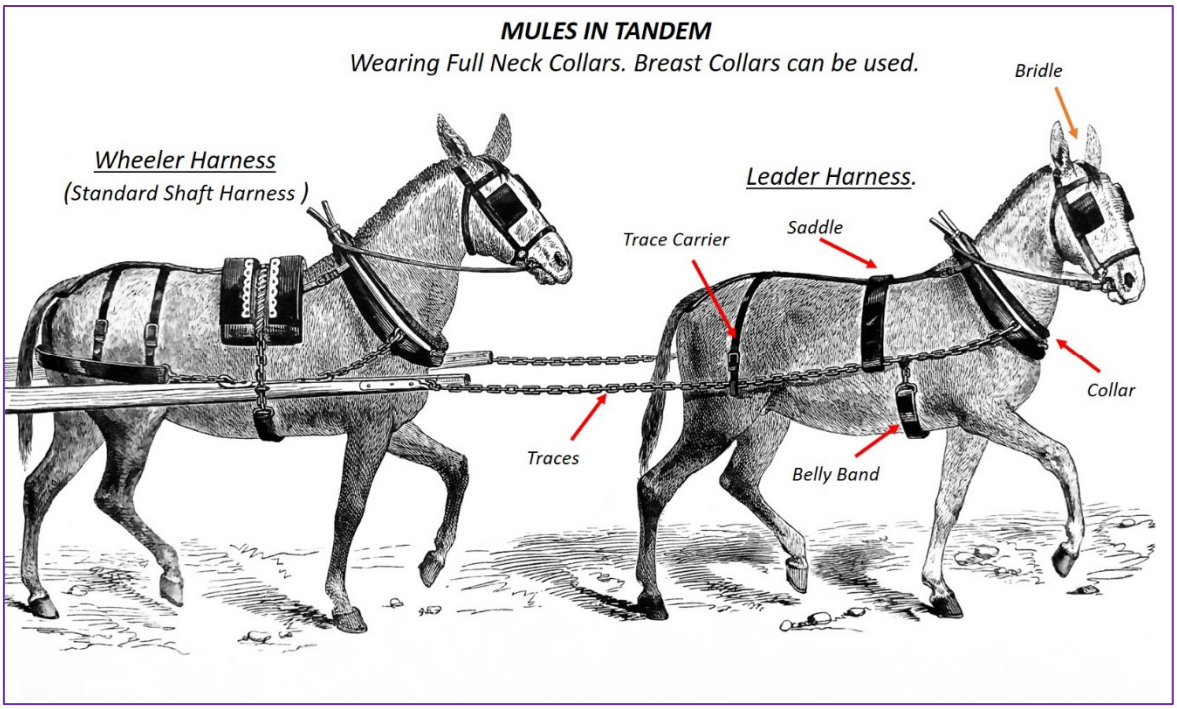
There are times when extra power is needed. This is achieved by using them either in pairs, ***side by side***, or in ***Tandem***, one in front of the other. The Principles of Draught remain relevant regardless of animal grouping, however, Harness Component Parts are subject to alteration.
Tandem *(See Fig11).* offers up an effective way of achieving extra draught. Going up a steep incline is when hitching up additional animals can be helpful. The Tandem arrangement can be used with either a ***two wheeled vehicle with shafts (Cart)*** or a ***four wheeled vehicle (Wagon) with a pole.***

Wagons can be dual-purpose by shafts and poles being interchangeable. With shafts, animals in



Tandem can be hitched up in line, with a pole, they can positioned side by side.
The overall advantage of wagons is that animals are spared the burden of load bearing as the weight of a fully loaded vehicle is taken upon its twin-axles and not the animals back. ***Wagons*** eliminate the need for balanced loading.
For the animal between shafts (***known as the wheeler***) and the one in front (***the leader***) two sets of slightly different harness are required. *(See. Fig 11)*
For the wheeler, single harness as previously described will serve purpose, while the leader requires a more simplistic arrangement.
Leader harness, as it is called, consists of a ***Bridle, Collar, (Breast* or *full neck)*** and, as load bearing is not a feature for the leader, a lightweight saddle designed only to support the traces will suffice.
Breeching is not required as leader animals play no role in braking.
A trace carrier, to keep the traces clear of the animal's hind legs is required along with a Bellyband to stop the traces from rising.
By connecting the leader traces to the traces of the animal between shafts, a direct line of draught is established to the vehicle thereby enabling both animals to implement draught.
Driving animals in tandem from the seat of a vehicle is regarded as challenging and requires a skilful pair of hands to exercise control. Should yet further power be needed, more animals can be attached to work one in front of the other using the same leader harness connection as described.

(Fig.11) *TANDEM HARNESS*



SIDE BY SIDE DRAUGHT. *(*An overview)

Working in pairs, side by side, a ***four-wheeled*** vehicle with a ***centre pole attached*** is required. The centre pole is fixed to a turntable on the hub of the wagon's front axle, where it can turn the front wheels freely from side to side thereby enabling steerage. It is also hinged to allow for any up and down movement.

With the animals positioned on either side of the pole, either breast, or full neck collars can be used. *(See Fig.12).* Pole straps are used for the connection between the pole and the collars, where it is suspended between the two animals for the purpose of steerage.

It is however the harness, in this instance double-harness, one set for either horse, that is the overall connection between animal and vehicle.

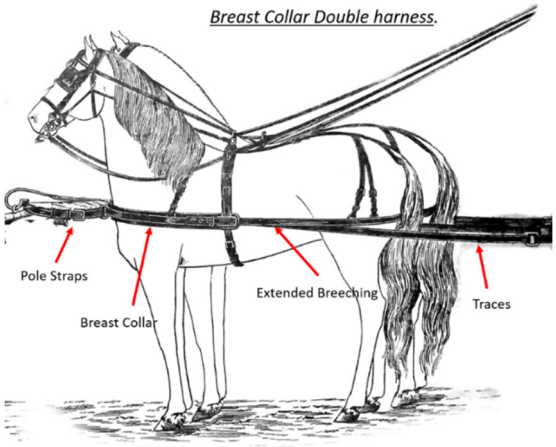
The component parts of double-harness are fundamentally the same as those of single-harness (*consisting of Bridles, Collars, Saddles and Breeching*) and work largely in the same way. However, only three of the four principles are brought into play. ***Steering, Transmission, and Braking.***

Saddles differ in that while single-harness saddles are designed to be loadbearing and therefore appropriately padded, saddles used for double-harness are not. They need only be lightweight with little to no padding as loadbearing is negligible.

Held in place by girths, their role is primarily to support the traces and to give overall harness stability.

(Fig.12)

Breechings, as part of pair horse harness, perform much in the same way as that of single harness, they represent a braking system, or in having to reverse, or coming to a halt. However, to function correctly, they need to be extended to reach forward to connect with the animal's collars, where they need to work in harmony with pole straps.



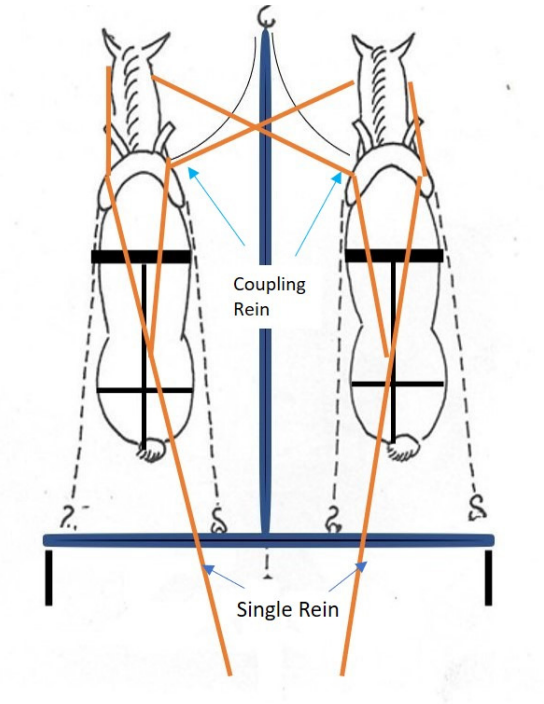
Double Harness showing Breast-Collars, with extended Breeching and Pole-Strap

If using ***full-neck collars*** breechings can be abandoned if so desired.
In the absence of breechings, the act of 'braking' is implemented by other means, in this instance through the combination of the centre pole, pole-straps and collars.
When slowing down, going downhill, or drawing to a halt, the weight of the vehicle *pushes* the pole forward. Pole-straps, connected to full-collars, enable the animals to hold the vehicle back by taking the strain on the top of their necks, via their collars, thereby preventing the vehicle from running forward.
Animals trained in this method can bring the vehicle to a halt effectively.
Some four-wheeled vehicles have in-built braking mechanisms that allows the driver some control of braking and in easing the efforts of the animals.

With the use of Breast Collars, the overall dynamics remain the same as above except, in this instance, ***breeching become essential*** to enable braking.

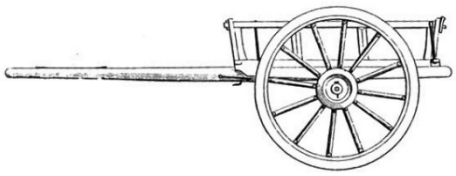
Positioned around their hindquarters, breechings need to be extended to connect to either end of the breast-collars. In turn, from rings fixed slightly off-centre to the front of breast-collars, pole straps provide attachment to the centre pole.
Again, as the weight of the vehicle *pushes* the pole forward, ***the breechings and pole-straps*** work in conjunction to take the braking strain preventing the vehicle it from running forward. ***(Fig.13)***

To drive animal's side-by-side, split-reins are required. *(See Fig 13)* These consist of a single rein going from the driver to the outside bit ring of each animal with an adjustable ***coupling rein*** buckled into it roughly mid-way.
On the animal to the ***left*** *(nearside)* the ***single*** rein *(draught)* runs through the left terret ring on the saddle then through the ***left rein*** ring on the Hames, to the ***bit***. The ***coupling rein*** splits off from the single rein,



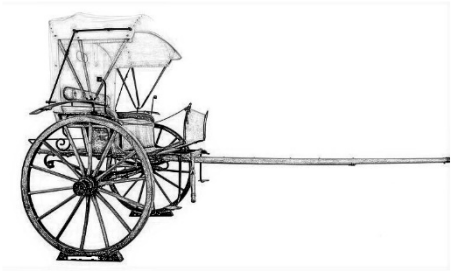
through the ***right*** saddle terret ring on to the ***right*** rein ring on the Hames, then ***diagonally*** across to the bit of the animal on the ***right*** *(offside) (See Fig.13)* For the animal on the ***right***, the rein setup is the same as described except in reverse.

Ref : ***Cart with Single-Pole***



Using a ***two-wheeled cart with a single pole*** is a relatively rare occurrence and not often seen amongst modern equine users.

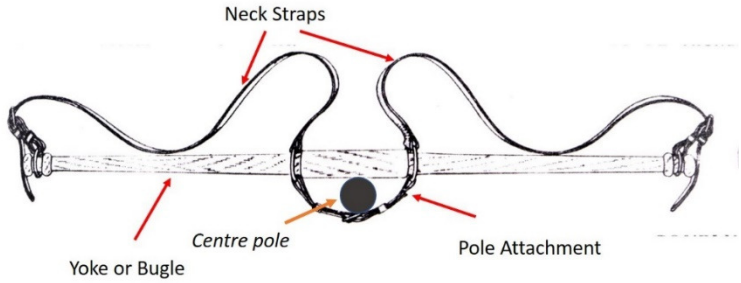
Carts with a ***single-pole*** require two animals for the purposes of draught which in turn, introduces a new dynamic and one that requires careful preparation.
While the harnessing arrangements are reasonably simple, a double-harness with breast-collars and extended breeching *(See Fig.15)* will serve purpose. For it to work effectively it requires an additional component part called the ***Yoke or "Bugle"*** *(See Figs.14 &15)*
Suspended by neck-straps, the ***yoke*** hangs horizontally across the breasts of both animals and is attached to the centre pole by a loose-fitting loop which helps support its movement. From a fixed ring on the front of the breast-collars of each animal, pole-straps connect to the end of the centre pole where they prevent the vehicle from rolling forward when coming to a halt. *(See Fig.15). Yellow highlights yoke attachment)*
In accordance with the ***yoke***, the height of the vehicle and thus the pole become important. The centre-pole is required to lie horizontally between the two animals to correspond with their centre of gravity. This can be determined by wheel size. It is also important for the two animals to be compatible in terms of size and temperament.
Being a two-wheeled vehicle, it is subject to imbalance. To offset this, care needs to be taken when either passengers or cargo are loaded ensuring that any weight is positioned just above the axle. The yoke is ***integral to a single-pole cart*** as it is subject to a great deal of multi-directional movement



when in motion. With the addition of the ***Yoke*** a degree of stability can be achieved. One example of a single-pole cart is the Cape Cart so called because it has its origins in South Africa where it is still used.

(Single-pole CAPE-CART)

(Fig.14)



Frontal image of the Yoke.

(Fig.15)

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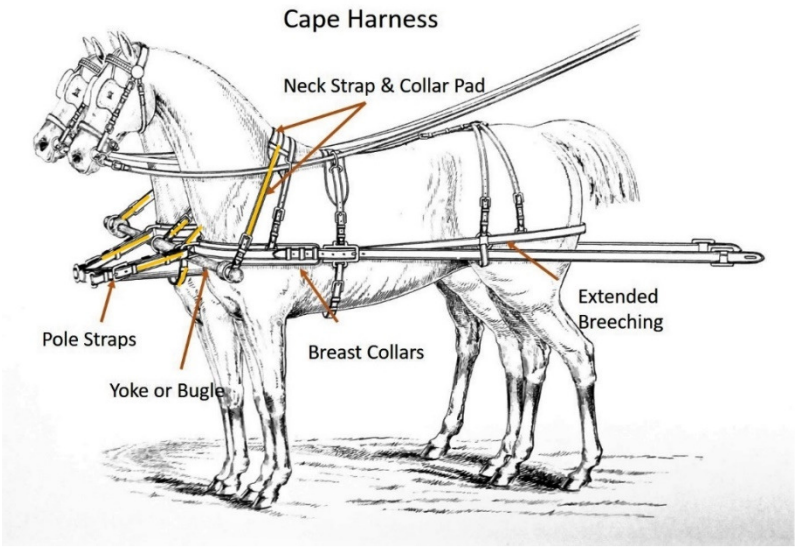
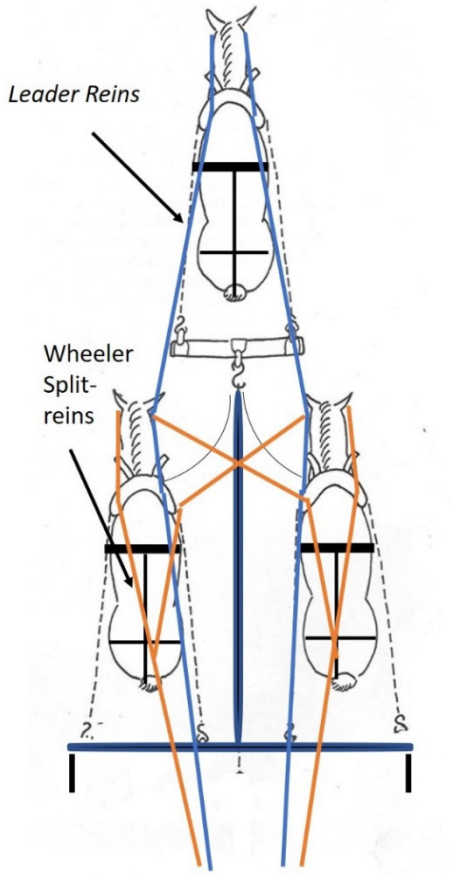


Complete Cape Harness showing the Yoke and its attachment in yellow.

Using Equids in multiples. *(Fig16)*

There are many variations in the way multiple animals can be harnessed for the purposes of draught, this will depend upon the task they are required to fulfil. The intention here is to give a broad understanding of how this can be achieved, and the equipment required to enable multiple draught.



Continuing from the use of ***Pairs*** in double harness, harnessing an additional ***third animal*** (collectively known as a ***"Unicorn" Hitch***) is an effective method to implement extra draught.

By attaching a ***swingle-tree*** to the front end of the centre-pole, the third animal ***(leader***) attired in leader ***Tandem Harness*** *(ref: Fig.14)* (Bridle, Breast or Full-neck Collar, Lightweight Saddle and Traces) can be directly attached to the ***swingle-tree via Traces***. This is a flexible method of draught as the leader animal can be hitched/unhitched as required.

In addition to the split-reins used on the wheelers, a longer set of ***Leader Reins*** is necessary to achieve steerage. *(Ref: Fig.19 in* ***Blue****)*

These are an extended set of ***single reins*** that pass-through rings fitted to the inside of the ***bridle headpieces*** of the ***wheeler animals*** to the bit in the mouth of the ***leader animal.***

Overall, the dynamics and principles of draught remain the same whether it be two or more animals. The only difference is in harnessing arrangements.

TEAM HARNESS (four or more)

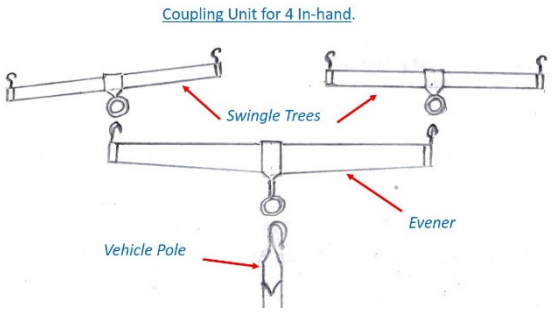
Should four animals be used for the purposes of draught, they can be put-to in pairs, two ***Wheelers*** and two ***Leaders*** side by side.

With the *wheelers* already harnessed in double harness as previously described, and attached to the vehicle, one on either side of the centre-pole, the leaders can be attached.

The harnessing arrangement for leaders is the same as that used in ***Tandem,*** only doubled up. With leaders, their only purpose is that of forward draught, so they require only a ***Bridle, Breast or Full-Neck Collars, Lightweight Saddles, and a set of Traces.***

Attachment to the vehicle is a relatively simple affair requiring a three-piece set of swingle-trees. *(See: Fig.17)*

(Fig.17)

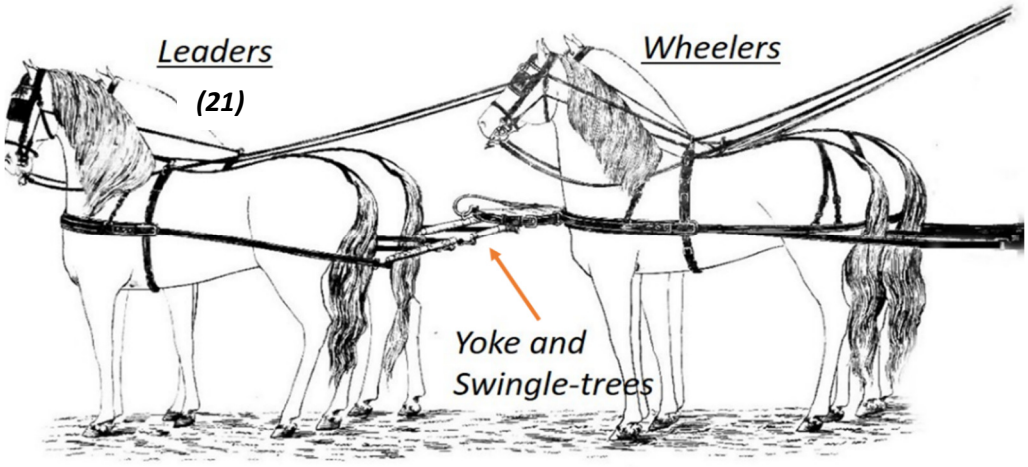


Consisting of a central bar called an "***evener,"*** with a ring at its hub, two smaller swingle-trees are attached to either end of the evener.

Using the ring at the hub of the evener, the three-piece unit can be connected to the hook on the end of the centre pole. The leaders can then be attached to each of the swingle-trees via their Traces thereby implementing draught.

Should more animals be required for additional draught i.e. six, eight, ten, they can be put-to in pairs ad Infinium in a similar manner. *(See Fig 18)*

(Fig18)



Up to this point, the rudimentary principles of equine draught, along with the necessary component parts of harness, their application, usage, and overall importance have been presented. Fundamental to equine draught and universally applicable, they represent a means of efficient draught that has been in use for some 2000yrs and proved effective throughout this period. Working in accordance with them, the risk of serious injury is kept to the minimum,

It is worth mentioning that even harness produced in compliance with the above principles has the potential to cause injury if wrongly applied, badly adjusted or animals are subjected to long hours of work and excessive payloads.

PART TWO

Heavy Horse Draught. (Working Gears)

One area where harnessing differs slightly is that of Heavy Horses. Like all modern horse breeds, the Heavy Horse breeds such as Shires, Clydesdales, Percherons, Suffolk Punches, Ardennes, etc. started their journey some 4000yrs ago.

Prior to the first domesticated horses, most of which were small (pony-sized, as we define it) oxen were the primary source of draught. Slow and cumbersome they may have been, but they had the strength to draw heavy loads and to plough fields successfully. Their power is captured through the use a yoke which is unique to oxen. The yoke enabled two oxen to work together side by side and consisted of a baulk of timber mounted on top of their shoulders and held in place by a wooden throat piece. From the centre of the yoke a cart or plough could be attached thereby enabling draught. To this day, in both developed and developing countries where oxen are still in use, the yoke remains the means of draught.

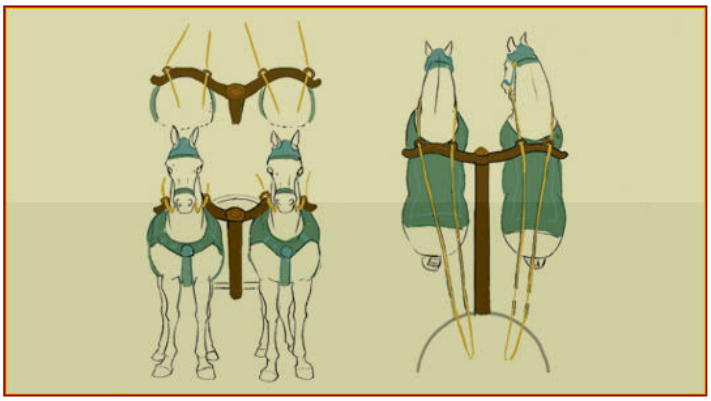
(Fig.19)

With the continuing growth of horses, both in numbers and size over many centuries, it did not go unnoticed that they could be used for the purposes of draught and would in fact be quicker than oxen. Initially it was thought that the oxen yoking system would serve purpose for equine draught, but it was soon discovered not to be the case.

Several centuries were to pass before the observation was made that anatomically, bovine and equine were two very different animals.

With oxen, their point of draught is high up on the shoulder and so the yoke system suited them well. The point of draught on equines however is lower down on the shoulder (*See page 4)*

(Fig.20)



The Romans used a form of breast collar as an accessary to bring stability to the yoking system which was still in use with equids. It was initially a neck strap attached to the yoke resting on the horse's withers to hold it in place but was eventually repositioned horizontally around the animal's breast where it proved to be more effective for both horses and lightweight chariots in terms of speed and manoeuvrability. (*See Fig.20)*

It was not until the Middle Ages that we begin to see the rise of larger, stronger horses. These were the famous "Great Horses" needed to carry knights in armour into battle. However, even they were not the giant animals that are seen sometimes in media representations. They stood between 14hh to 15hh and were more like modern breeds such as a Welsh Section D or Morgan horse. With armour weighing in at approx. 15 – 25kgs, plus armour for the horse, stronger horses were needed.

As the size of horses grew, so too did advancement in Cart and Wagon design which opened the possibility of improvements in both commercial and public transport. However, the issue of efficient equine draft and suitable harnessing arrangements was still unsatisfactory.

The breast collar continued to be used for the purposes of vehicle draught, but it had its limitations. By this time, with its bulk and strength, the larger, stronger horses were being viewed as a potentially beneficial asset to agriculture. The breast collar however, proved unsuitable for tillage and implement draught.

It was not until around the 9th century that a breakthrough was presented via China with the introduction of the Full Neck Collar. This was the key to efficient equine draught that was to finally bring together all the discordant knowledge that had been accumulated over many centuries of trial and error.

It was however, not until the 12th century that we see the horse collar appear in Europe, and come into use around the 15th century before reaching the UK where it was to virtually revolutionise the use of equines.

There can be no doubt that the innovation of the Full Neck Collar was transformational. With the onset of the Industrial Revolution in1760, the heavy horse, in full harness, became our beast of burden in almost every aspect of life.

Through the application of the full neck collar, designed to be in alinement with the animals POD, and with improvements to harnessing arrangements, equines were given the ability to draw carts, wagons, farm implements, buses and barges and to power machinery with greater efficiency. (*See pages 3-4)*

While the four principles of equine draught still applied, changes in component parts became necessary. Given the nature of these working horses, the requirement was for stronger harness and on a larger scale than that of carriage horses.

Specially tanned leather, in the form of harness backs had to be produced, along with heavier, specialised hardware fit for purpose.

As much of their work is demanding, the full-neck collar takes precedence with heavy horses. It is required to be the correct size and to fit the animal comfortably allowing it to apply its forces of draught without injury or discomfort. *(See Fig.7)*

For these reasons, competent collar makers are required, who will measure the horse to ensure a comfortable fit in line with the above criteria.

Working collars differ from carriage collars in that they are more full-bodied allowing the horse a larger area to push against when in draught.

To absorb sweat generated by strenuous effort, and for comfort, they are lined with woollen collar-check material which prevents rubbing or potential blistering, as would be the case with leather lining.

Working Hames are integral to equine draught and differ in design from driving Hames. Made from either steel, brass, or wood, hames are designed to carry two large, steel hooks onto which the trace chains attach in line with the important POD on both the horse and the collar. It is here where the full force of draught is taken and of prime importance that these be made and fitted correctly.

Working collar with Hames attached

(*Fig.21*)

Photo by T. Davis

Heavy horse harness, known as Working Gears, comes in three distinct styles designed to cover the array of tasks working horses perform. They are, Plough Gears, Trace Gears, (also known as Leader Gears,) and Cart Gears with an accompanying range of hardware and chains designed to serve purpose.

Plough Gears. *(See Fig.22)*

As the title suggests, is used for ploughing, harrowing and general tillage. It is a simple arrangement consisting only of three component parts, a bridle, collar and backband for drawing agricultural equipment.

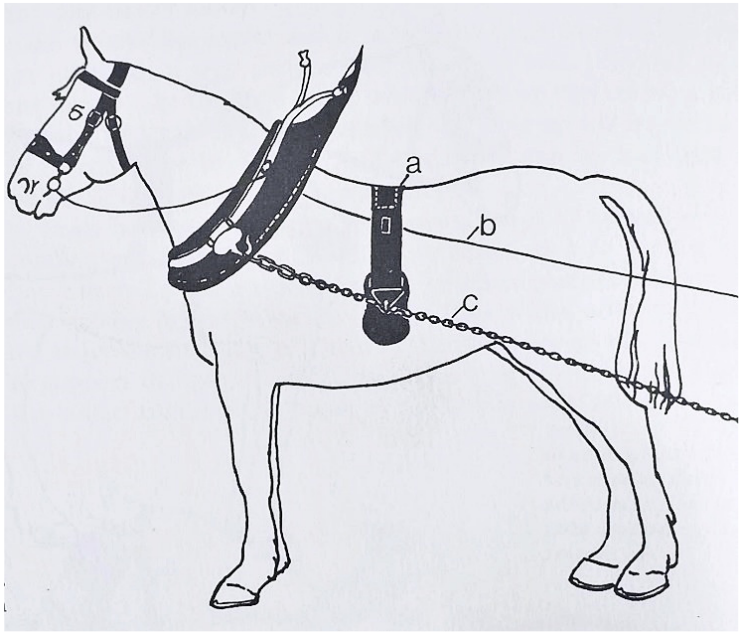
Only two of the four principles of equine draught come into play, Steering (Bridle) and Transmission (Collar)

Load bearing is not an issue with plough harness thereby eliminating the need for padding. However, a simple backband, unique to working horses, is required to support plough chains necessary for the purposes of draught.

Backbands consist of a narrow strip of leather approx.120mm long with large, triangular hooks on either end that rest across the horses back onto which plough

chains are attached. Its sole purpose is to keep the plough chains suspended thereby preventing them from becoming tangled around the horse's legs.
It should be noted that leather reins are replaced by rope lines to ensure a better grip for the ploughman.

(Fig.22)

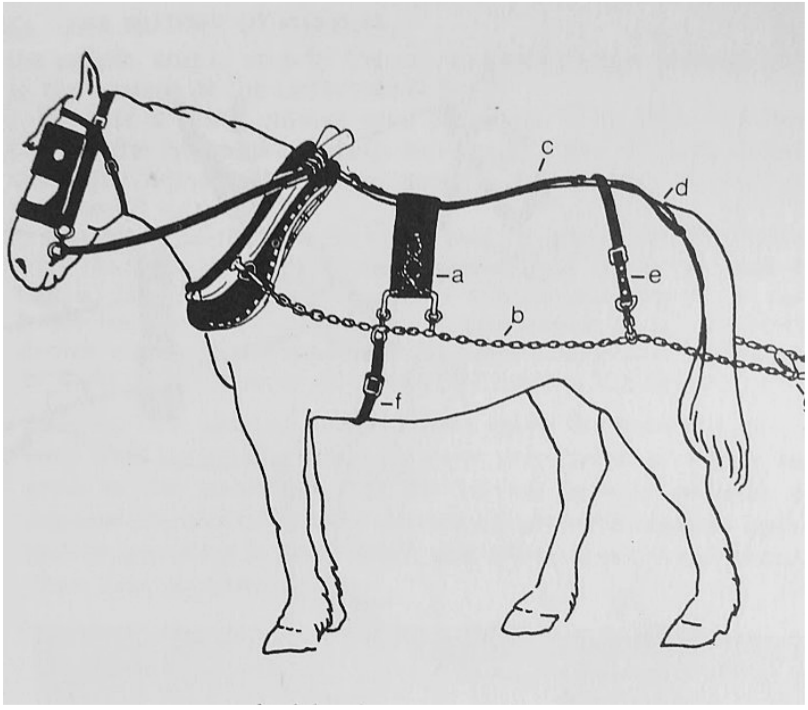


In addition to the Bridle and Collar (a) shows the Backband,
(b) rope lines, (c) Plough Chains

Trace Gears *(See Fig.23)*

In appearance like Plough Gears but with some additional parts. Trace Gears serve purpose when working animals in tandem, (one animal in front of another in a straight line. *See Fig 14*). Their purpose is to give assistance to the horse between shafts when extra power is required. By attaching the trace chains of the leader horse, to the trace chains of the horse between shafts, extra draught can be achieved. More horses can be attached using the same in-line method if more draught is required. (*Ref illustration (15) pages 16/17.*)

(Fig.23)



Trace Gears consist of a Bridle and Collar with the addition of the component parts listed below.

(a) Backband. Used to carry the trace chains.

(b) Trace chains to enable draught. If several horses are working in line, the trace chains will connect to each horse in turn and then to the shafts of the vehicle in draught.

(c) Crupper and (d) dock work together to prevent the collar from tipping forward.

(e) Hip straps stop the trace chains becoming entangled in the horse's hind legs.

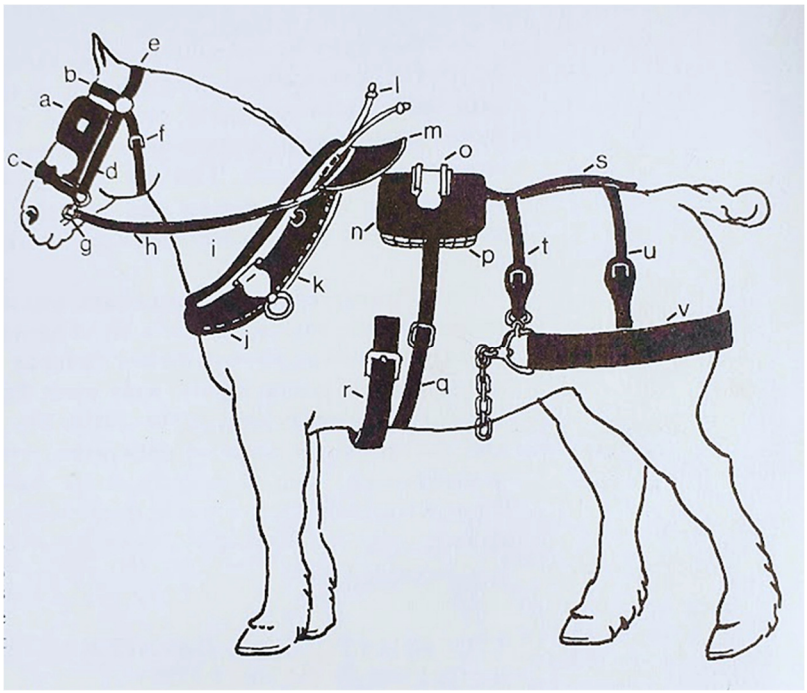
(f) Bellyband. Used to hold down the trace chains from rising.

Cart Gears. *(See Fig 23)*

Cart Gears are designed to enable heavy horses to apply their strength and forces of draught effectively when drawing a heavily loaded wagon or cart. Relatively speaking, and in contrast to driving/carriage harness, draught harness for heavy horses is required to be more substantial and in scale.

Given the nature of their work drawing heavily laden wagons and carts, all four principles of equine draught, along with the respective component parts necessary to effect draught are required *(see pages 5-6*.)

Fig.(24)



Component parts.

Bridle	*Collar*	*Saddle*	*Breeching*
(a) Blinkers	*(l) Forewale*	*(n)- Saddle*	*(s) Crupper*
(b)Browband	*(j) Collar facing*	*(o) Saddle ridge*	*(t) Loin Strap*
(c)Nose band	*(k) Aft-wale*	*(p) Pad*	*(u) Hip Strap*
(d) Cheek Piece	*(l) Hames*	*(q) Girth*	*(v) Breeching seat*
(e) Headpiece	*(m) Housen*	*(r) Bellyband*	
(f) Throat latch			
(g) Bit			
(h) Bearing rein			

(Part Three)

EQUIDS IN THE DEVELOPING WORLD.

(Southern Mexico 2008)

What follows is based on personal observations made on professional visits to developing countries such as, Mexico, El Salvador, Guatemala, Honduras, Ethiopia, Kenya, Tanzania, Morocco, and Egypt on behalf of Animal Welfare Organisations. These visits were to reveal the hardships endured by working animals because of inappropriate, poorly crafted harness. The intention here is to focus on the consequences of harness related injuries **(HRI's**) and their cause, most of which are largely preventable.

Appropriate harnessing, as already illustrated in the preceding pages, is the key to efficient equine draught. With its application, the latent power of equids can be captured and used competently. For harness to be appropriate, it is required to be strong, comfortable and allow freedom of movement without restraint or risk of injury. In other words, fit-for-purpose.

In our developed world, from the early 20th century onwards the number of working animals has been steadily declining and with it, the important affiliated skills / crafts that make draught animals sustainable (*See page 2 listing these necessary skills)*

To see working animals today, we need to look to the *developing world* where *donkeys, horses, and mules,* not to mention *camels, elephants and oxen* are still used extensively and represent an essential power source.
They play an important role in agriculture and in commercial activities where both in towns and villages and peri-urban areas, livelihoods depend upon them. In rural areas they are used in small scale farming for the conveyance of goods to market, powering machinery and for public / commercial transportation.
However, most working equine fail to reach their full potential. There are multiple reasons for this, but the central issue is one of poverty which puts their owner / users at a disadvantage. Consequently, difficulties arise by animals having to work in poorly designed and often crudely made apparatus which in turn undermines their abilities to perform at their best.
Inadequate animal husbandry and handling skills also add to their difficulties.
In general, lack of knowledge in equine management and usage proficiency, along with low-level affiliated trade skills, has consequences in terms of equine efficiency and productivity.

HARNESS RELATED INJURIES (HRI's)

Harness development has long been recognised as a problem area and one of importance. It is widely accepted that many of the debilitating injuries seen in equines are as a direct result of inappropriate harnessing methods.
Throughout the developing world many of the harnessing problems that occur are of a similar nature. Common injuries, most of which are essentially preventable, are seen to the *animal's head, back, shoulders, breast, abdomen and under the tail*, HRI's can all be attributed to poor harness design and construction methods using unsuitable materials and / or misapplication, and the absence of important harness component parts.
Materials such *as rubber car tyres, inner tubes, nylon rope, polypropylene sacking, plastics, wire etc.* are frequently used. While this could be regarded as a commendable effort of recycling, they are inappropriate for equids.

INDENTIFCATION OF HRI's. ***(Fig.25)***

Here is a typical DIY "harness" where the swingle-tree, traces, breeching, girth, bellyband and bridle are missing.

One outstanding feature is the absence of experienced harness producers. For this reason, approximately 80% of harness used in developing countries is of the ***DIY*** variety. Using their limited knowledge, animal owners proceed to produce their own harness in a manner most cost-effective to themselves. This usually results in a misguided array of unsuitable materials arranged in such a way that can only be described euphemistically as "harness". Praiseworthy as these efforts are, they invariably turn out to be a misconceived array of improvised components most unlikely to be comfortable for the animal.

Harness such as this impacts heavily upon working animals resulting in, as often as not, veterinary intervention.

Veterinarians play a vital role in the welfare of working animals. Much of their time is consumed in treating HRI's which are, to restate, largely preventable. This they do with a proficiency that is second-to none for the benefit of the animal. Regrettably, all too often their efforts are rendered ineffective by the animal being returned to the offending harness.

PROBLEM RECOGNITION

Recognising the cause of HRI's is the first step to resolving them. To do so requires an understanding of equine draught dynamics and careful assessment of the harness in use.

Vets represent the frontline in equine welfare, it is they who have the task of dealing with the ill-effects of HRI's. To understand the cause of injuries, an assessment of lesions and swellings on the animal's body relative to the harness in use is

necessary. Should the injury correspond with a particular harness component, then close inspection of the component is necessary, and steps taken to correct the fault.

GUIDE TO HARNESS DEFICIENCIES. In 4 parts

(1) Misaligned Draught forces (*Forward motion*)

The misalignment of harness parts that enable draught can result in serious injury to the throat, breast and shoulders of the animal. I.e., If a *breast-collar* is in use and mistakenly attached directly to the shafts of the vehicle, the movement of the vehicle will impact across the breast and shoulders of the animal where the force of draught is centred. Such an arrangement will result in injuries as depicted in Fig.29.

Injuries such as these are preventable. Using a *Swingle-tree (ref Fig.4. page 8)* to which Traces attach for the purpose of draught, allow the breast-collar to move in accordance with the animal's shoulder movement and as such, rubbing can be avoided.

(Fig.26)

Ill-fitting, poorly produced Full-Neck collars give cause for concern. Misshapen collars of an incorrect size and lacking in smoothness at point of contact, can result in serious injury to the neck, breast, and shoulder of the animal. While vets can treat the ill effects of harmful collars admirably, it will not be until the faults in the collar are addressed by specialist collar maker that the problems can be resolved.

Full-neck collars are required to be comfortable. *(ref: page 8)* For this, they need to be custom-made. Too small a collar, will result in rubbing, breathing difficulties and potential choking, while collars that are too big will "swing" resulting in injuries to the shoulder and top of neck. Figs. 30, 31, shows damage caused by an ill-fitting collar.

Collar Injury*. *Caused by the collar being too small, misshapen and ill-fitting.

(Fig 27)

(Fig.28)

The offending collar*. *The collar shown here is the one used by the animal above. The results are plain to see. The wound to the back is the result of an ill-fitting saddle.

(2) **The absence of essential harness parts*.***

Harness, as previously described, can be separated into four component parts. *The Bridle, Collar, Pad or Saddle, and Breeching* which relate to the *Principles of Draught (ref: page 5)* Each one of these component parts has its role to play and collectively, they enable animals to accomplish full draught.

Should any of these parts be absent, the animal's proficiency will be undermined making it difficult to apply themselves fully to their set endeavours. All too often items such as *swingle trees, traces, breeching, girths, and bellybands* are absent causing hardship for the animal in draught.

The image below is intended as a guide to evaluating the overall condition of harness used by equids in countries where there is livelihood dependency. It considers some of the unfortunate errors all too often seen including the misapplication of component parts which can have serious consequences.

Many of these errors are the result of a lack of knowledge and manufacturing skills yet to be addressed *(Ref. Draught Principles Pages 4 & 5)*

(29)

Harnessing errors and component absences:
(1) Bridle blinkers out of alignment. (2) No Breeching. (3) Missing Bellyband. (4) Saddle improperly positioned. (5) Breast-collar attached to shafts. (6) Absence of Swingle-tree.

(3) Defective component parts.

In previous pages *(5,6,7)* the founding principles of equine draught are presented. These act as the fundamental guide to harness production. Should they not be complied with, the outcome can only result in what the images presented here portray most of which this document is attempting to overcome.
Animals in draught are subject to pressure points that require adequate padding to prevent injury. For example, collars (*both breast and full collar)* and saddles require appropriate padding. Saddles are designed to support the weight of the vehicle hence the need for suitable back protection. Padding also provides protection for the animal's spinal column which should always have adequate clearance.
Collars, used for forward draught into which animals push, also need sufficient padding to avoid pressures on their necks and shoulders. Pressure point injuries are usually due to inadequate padding or by components misalignment.

(30)

This image shows an improvised Cart Saddle made using nylon bags. The breast-collar is also clearly seen to be attached to the vehicle shafts. All-in-all, this DIY effort is inadequate and not fit-for-purpose.

Make-shift pads as shown here *(Fig.30)* illustrates an improvised saddle pad made from nylon sacks. Well intended as this is, it does little to address the overall problem and should not be regarded as an effective "fix". Improperly made component parts using inappropriate materials i.e., rubber, foam, plastics etc. are common features.

(31)

The image shown here *(Fig.31)* illustrates the potential for errors in the process of harness manufacture and its application. It highlights the need for a better understanding of both saddle design and application to avoid further potential injuries as seen in these images.

Wither injuries caused by poorly constructed, wrongly positioned saddles that also result in injuries to the elbow (See Fig's 32, 33) by excessively tight, misaligned girth-straps.

(32)

(33)

(34)

An infected wither injury because of an ill-fitting saddle.
The vehicle shafts were incorrectly attached directly to the saddle which meant the animal was"pulling" from its back.

(4) Poorly adjusted harness.

As we already know from preceding pages, harness, when applied to the animal, is required to be fit-for-purpose. Given that it is well made, it is still capable of causing serious injury by being incorrectly adjusted.

Harness is designed to be adjustable however, the tendency amongst owners/users in developing countries is that if it can be adjusted, then it needs to be adjusted '***tightly'.*** This is a common misconception and areas affected by this practice are *under the tail, abdomen, back, hindquarters, behind the ears and round the mouth.* There is no reason for harness to be excessively tight. If components are made correctly, they will remain in position and need only be made secure by slight tension being applied.

The girth-strap, to hold the saddle in place, is the only part of harness that needs to be taut but not overly so.

Cruppers are designed to fit loosely as is Breeching, Bridles and Collars. Their services only come into play as required, i.e., in forward draught, braking, or reversing.

On occasions, simply drawing attention to bad practices or making minor adjustments to harness can achieve the desired effects.

Before

After

Conclusions.

Harness related injuries (HRI's), most of which are preventable, remain prevalent amongst equids in developing countries where harnessing skills fail to reach the acceptable standards required to ensure efficient and safe animal draught. Poorly designed, ill-fitting harness made from inappropriate materials is often assembled in such a way that can only result in serious injury to animals and are commonplace.

While vets are at the forefront in animal welfare, they find themselves having to deal with the effects of harness related injuries caused by unsuitable harnessing methods that lies beyond their remit. With dedication, expertise, and due diligence, they treat HRI's only to see animals returned to the root cause of the problem. Poorly produced harness undermines the vet's efforts leaving behind a repetitive cycle of events ad infinitum along with a sense of frustration.

The solution can only arise by addressing the problem at source. To do so requires a different set of skills, those of harness technicians whose understanding of equine draught and harness production complements the efforts of the vet and is fundamental to the efficacy and wellbeing of working equine.

Although treatment by veterinary practitioners and the input of harness technicians serve common purpose, *treatment* of HRI's is unreservedly the domain of vets. P*revention,* however, is the jurisdiction of harness technicians who have the means to address the *cause* of injuries.

Together, they can address the long-standing, equine welfare issues that have prevented those who rely on equines from being able work with them to best effect.

While harness construction methods and materials may vary from country to country, the basic, underlying principles of equine harnessing, first established in the 12th century, remain the same and continue to be universally relevant.

In understanding and adhering to these principles, many of the issues relating to HRI's can be addressed.

It is hoped this presentation will help bring a better understanding of equine draught dynamics and the importance of harnessing methods. It may also be of assistance to those seeking to be more familiar with the dynamics of draught, in particular newcomers to equine harnessing and stakeholders in developing countries where these principles remain little known.

With the lack of progress in transferring this simple technology, the suffering and inefficiencies of working equines is likely to continue.

End

Acknowledgements.

I would like to extend my thanks to Walsall Leather Museum for their sourcing of images and cooperation in compiling this document. My thanks also to Alison Garbett for her kind permission to use illustrations from The Heavy Horse by Terry Keegan.

***Images,** Numbers 2,5,6,8,9,10,11,12,18, and 21, including Camel & Goat. – Hampton and Scott Equine Catalogue, Walsall. 1900.*

***Images,** Numbers, 1,4,7,22,23, and 24. Terry Keegan. The Heavy Horse.*

***Images,** Numbers, 17 and 25 – 34 by the T. Davis.*

Bibliography

Hampton and Scott Catalogue*. Walsall. Hampton and Scott, Saddlers. 1900.*

The Heavy Horse. Its Harness and Harness Decoration. *Terry Keegan, 1973. First American edition by A.S. Barnes and Co. 1974.*

The Country Life Book of Saddlery and Equipment*. Elwyn Hartley Edwards. Farm Harness Pages 176 – 185 Quarto Publishing Ltd, 1981. ISBN 0 600 38429 2.*

Farming with Horses. *Steve Bowers and Marlen Steward*. *First Published 2006 by .MBI, an imprint of MBI Publishing Co., Galtier Plaza, Suite 200, 380 Jackson St, St. Paul, MN 55101-3885 USA.*

Maquire, Rena. *Livin' on the Edge. Roman Influences on the Equestrian Equipment of Late Iron Age Ireland. The Liminal Horse: Equitation and Boundaries. First Published in 2021 by Trivent Publishing 1119 Budapest, Etele ut 59-61, Hungary.*

Brownrigg, Gail. Crouwel, Joost. *Oxford Journal of Archaeology, Volume 36, Developments in Harnessing and Draught in the Roman World. First published 23 April, 2017.*

Davis, Terence. *The Liminal Horse, Equitation and Boundaries. Harnessing Horsepower; Then and Now. First published in 2021 by Trivent Publishing, 1119 Budapest, Etele ut 59 – 61. Hungary.*

Sells, Paula. *The Tack Room, First published in GB by Merlin Books Ltd 2018. Merlin Unwin Books, Ltd, Palmers House, 7 Corve Street, Ludlow, Shropshire, SY7 1DB. ISBN 978-1-91072377-7*