THE BALANCE OF THE HORSE'S FOOT

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INTRODUCTION

Of all the many time worn and hackneyed phrases, relating to the practice of farriery, "No foot, no horse" is by far the most noteworthy. Somehow, many of the basic fundamentals of shoeing have in some way got lost or have been corrupted by many practising farriers today. It is on this assumption that I am basing my thesis "The balance of the horse's foot".

All aspects of balance have to be considered in ensuring that the limb functions smoothly, and most certainly this has an important bearing on the useful working life of the horse. Imbalance can really be discussed under two headings, the hoof/pastern axis balance and the medial/lateral balance.

Firstly I would like to deal with the balance of the foot through the hoof pastern axis, and as the forefeet are usually the cause of most concern when affected by imbalance, I will start with these.

The pastern axis of the adult horse is a natural conformation that can only be altered either by injury or surgery. However the hoof axis in relation to the pastern axis can and often is, altered either by neglect on the part of the owner, or worse still, by carelessness or ignorance of the farrier. Textbooks are often unintentionally misleading. All too often one reads of the ideal forefoot angle as being between 45° and 50° (Hickman 1977). (Personally I have never measured a normal foot as low as 45°) but I feel this unfortunately focusses the readers attention to the front of the foot and in the process, the heels which should be parallel to the toe angle, are often totally ignored. In fact the heels are of the utmost importance and accordingly should command the greatest attention.

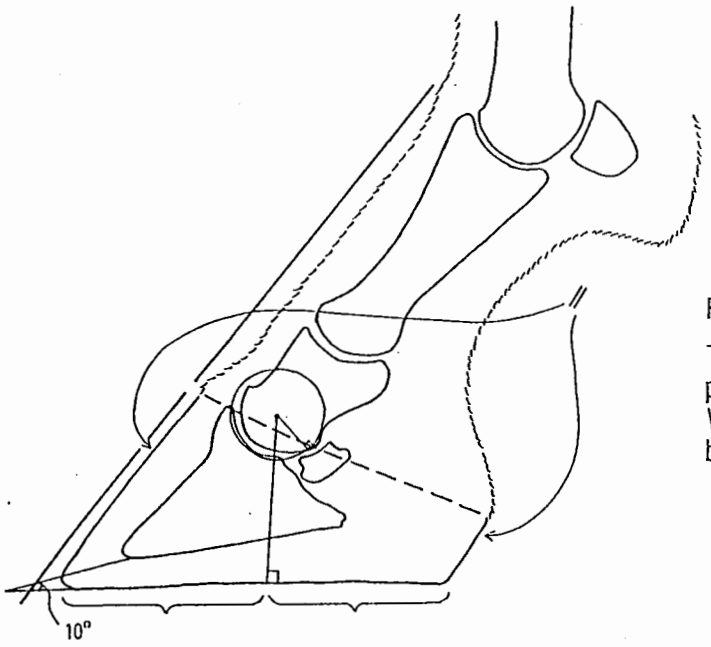


Figure 1

The wall of the foot should be same angle as pastern. Heels should be parallel to toe. Vertical line from coffin joint should equally bisect ground surface of the foot.

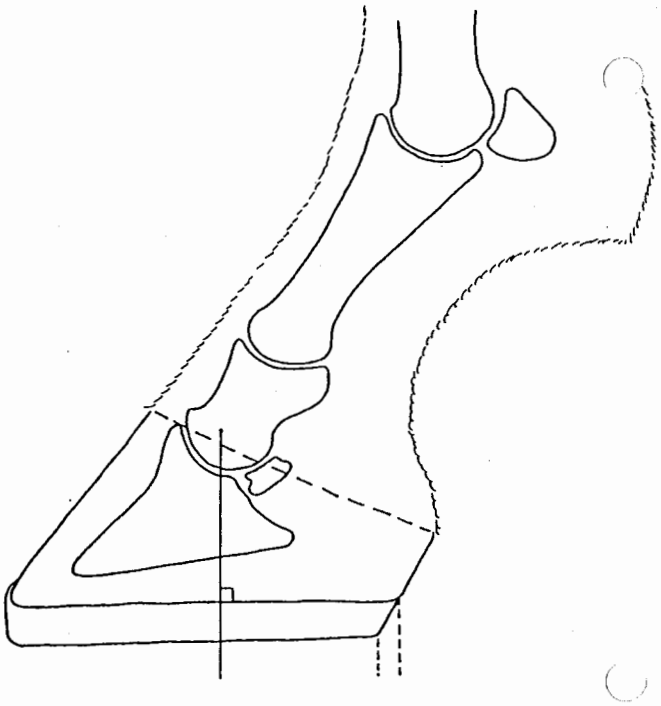


Figure 2

Dotted lines show loss of bearing surface when shoe is fitted.

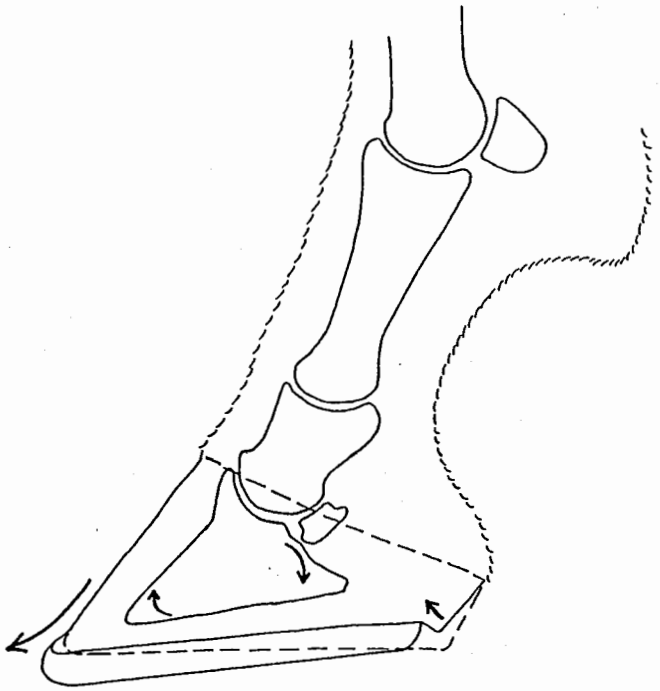


Figure 3

Further loss of support at heels due to shoeing excessively short. Animal now wants to fall over the back of the shoe.

Possibly the most common problem which can be related to farriery lameness is due to the long toe low heel syndrome (Moyer and Anderson 1975). From Fig.1 it can be seen that the wall of the foot should be the same angle as the front of the pastern when the horse is standing normally, taking weight on all four feet. Also the heel should be parallel to the toe. If a vertical line is drawn down from the centre of the coffin joint, it should equally bisect the ground surface of the foot (Colles 1983).

From Fig. 2 it can be seen that even in a foot of ideal conformation and balance, the moment a shoe of normal design (i.e. with conventionally dressed heels) is attached, the equally balanced ground bearing surface of the foot is immediately altered because the bearing surface at the heel is shortened. Consequently any shoe which is fitted short of this furthermost bearing point, progressively increases the weight of the animal on the heels, the result of which can now be seen in Fig.3. The horse wants to fall over the back of the shoe and the length of the toe has now increased considerably, due solely to the broken hoof pastern axis. In turn this also extends the breakover point of the foot as the animal moves forward. The breakover point thus moved to a point much further forward than is natural, also increases strain on the flexor tendons in excess of that which is already imposed by the lowering of the heels. To overcome this problem, the heels must be returned to their normal height, thus improving the hoof pastern axis. The use of either heel wedges or thickening the heels of the shoe to achieve this is an excusable but unpractical line of reasoning.

Either method of raising the heels, only gives temporary relief. After the initial flush of success the heels seem to come under ever

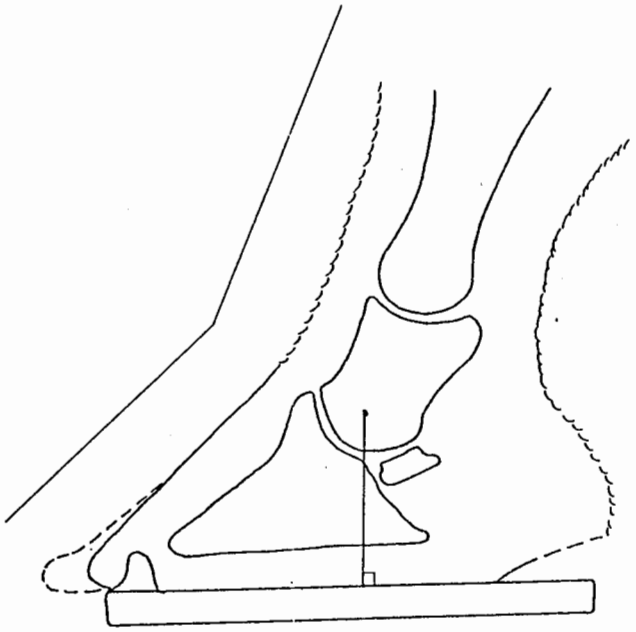


Figure 4

Actual length of shoe now fitted is such that the vertical line down from the coffin joint will now bisect this artificial bearing surface. In practice this never extends beyond the bulbs of the heels.

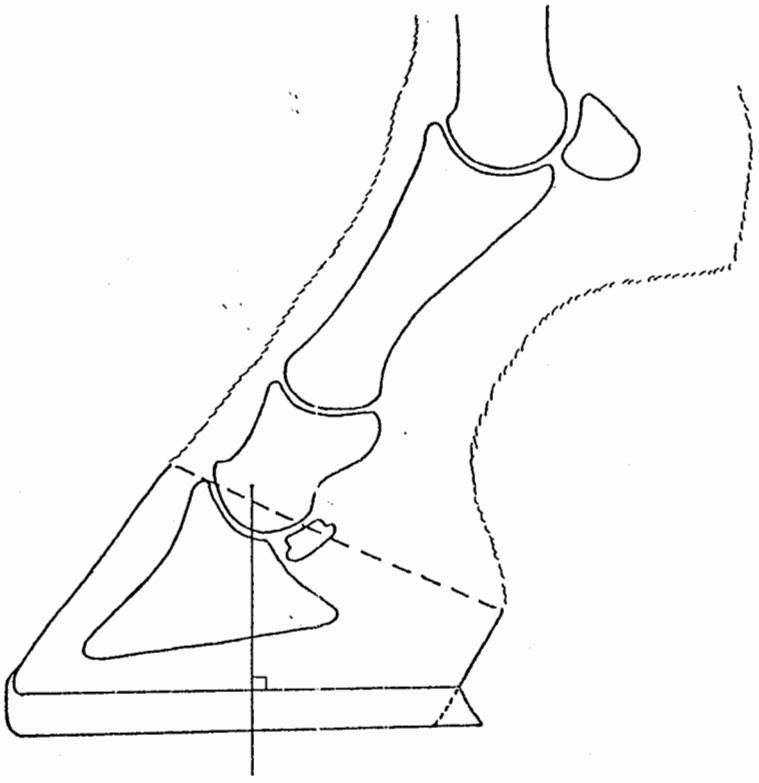


Figure 5

The shoe with reverse tapered heels shows the extra amount of ground bearing attained in relation to conventionally dressed heels.

greater pressure and progressively collapse even further. This can be seen from the extra wear on the ground surface of the shoe at the heels. The animal continually lands on the high portion of the shoe (i.e. raised heels) with the result that the concussion is placed on the very point that was in need of relief.

From experience, an extra length of shoe at the heels has a far more beneficial and improving effect. The actual length of the shoe should be such, that if we refer to Fig. 4, it will be seen that the vertical line down from the coffin joint will now bisect this artifical ground bearing surface. In practice this never extends beyond the bulbs of the heels.

In fact if shoes with a reverse taper heel Fig. 5, and wide in cover were fitted more as a standard practice, then I am sure a considerable number of foot problems would never materialise. Obviously with the vast amount of varied activities the horse is involved with, this is not always either practical or feasible. It is however remarkable how long the heels of a shoe can be fitted without fear of being pulled off. It is also interesting to observe the style of shoeing in Holland or Germany where these shoes are routinely used, and flat feet are a rare occurrence.

From observations over a number of years, it would appear that the low collapsed heels are usually associated with the broad flat foot. This is a problem that I feel is often encouraged by farriers who persist in trying to develop a "broad round foot". In reality, the ground surface of the foot is but a projected image of the coronary band. The slope of the wall can be redirected to a degree either by trimming or by shoeing, therefore altering the hoof shape at the ground surface, this alteration however can only be minimal.

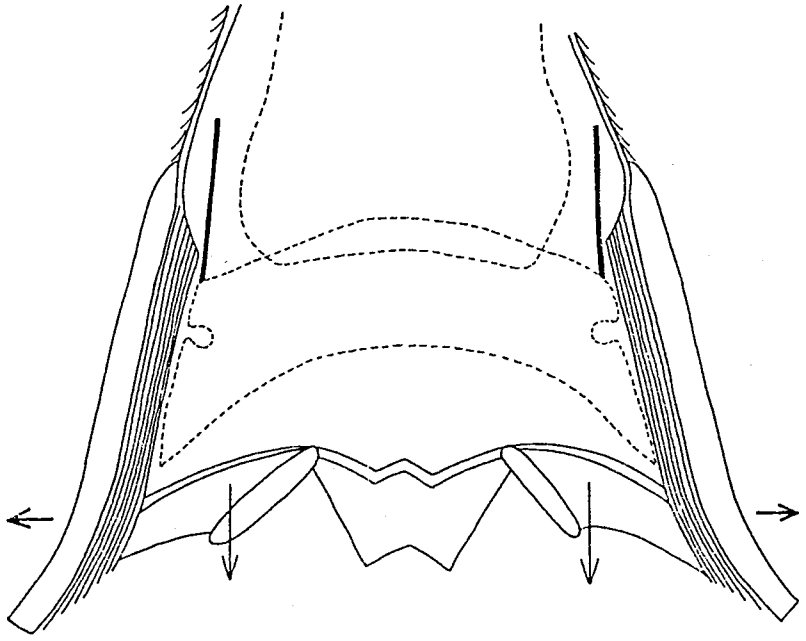


Figure 6

The outward spreading of the horn has now made the wall less supportive. The sole has to flatten to maintain contact with the wall. In losing concavity the sole can no longer fully support downward thrust of bones.

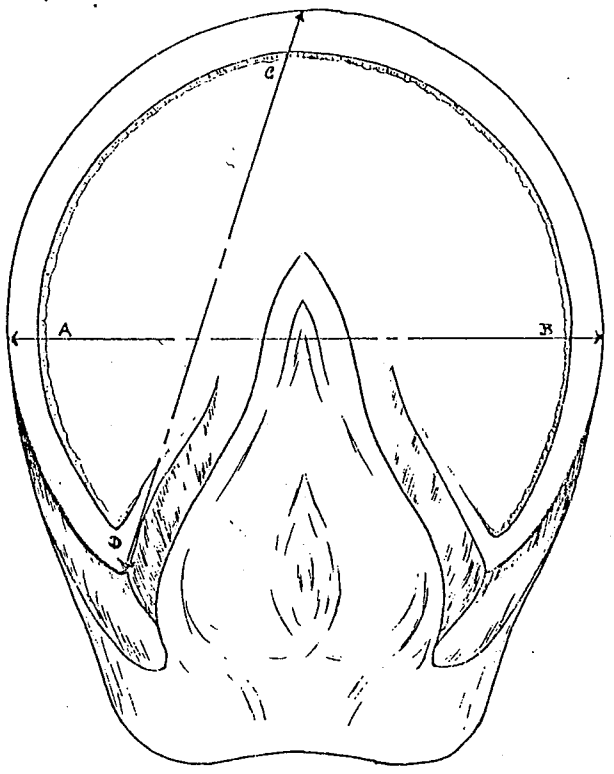


Figure 7

This is probably the most structually supportive hoof shape. Where the distance across the widest part of the foot A-B should be the same as that from a point at the toe to the furthermost bearing point of the heel C-D.

The actual length of the coronary band, that is from heel to heel, can only increase with the growth of the horse. Therefore in the adult where the secreting source of the wall cannot be increased, the length of wall at the ground surface is also fixed. If however the hoof is encouraged into developing a broad shape, then it behaves rather like a paper cone. If the mouth of the cone is pulled open one way, then it must shorten the other. As the peripheral length of horn cannot alter, and as the structure of the foot is such that the toe remains rigid because of its extensive attachment to the pedal bone, then the only other point where the foot can alter is the heels which will collapse forward. Likewise with the the sole. Although the sole is extremely flexible, it is inelastic and cannot stretch, therefore if the hoof wall is allowed to expand beyond its natural shape, the sole in turn has to progressively flatten to maintain contact with the wall (Fig. 6). Add to this the downward thrust of the bones above the sole and a flat foot with collapsed heels is in the making. All this can happen in a relatively short space of time but in my experience it can take as long as four years to reverse the process and even thereafter extreme care and attention must be paid to the heels. One of the major problems is that when heels have totally collapsed, the bars are also crushed and distorted so that they can no longer brace the heels. Consequently great difficulty lies in trying to encourage the horn tubules at the heels to grow down (rather than forward) in a supportive direction. Basing most of my practise on this theory, I believe that the ideal structurally supportive hoof shape should be that where the distance across the widest part of the foot should be the same as that from a point at the toe to the furthermost bearing point of the heel (Fig. 7).

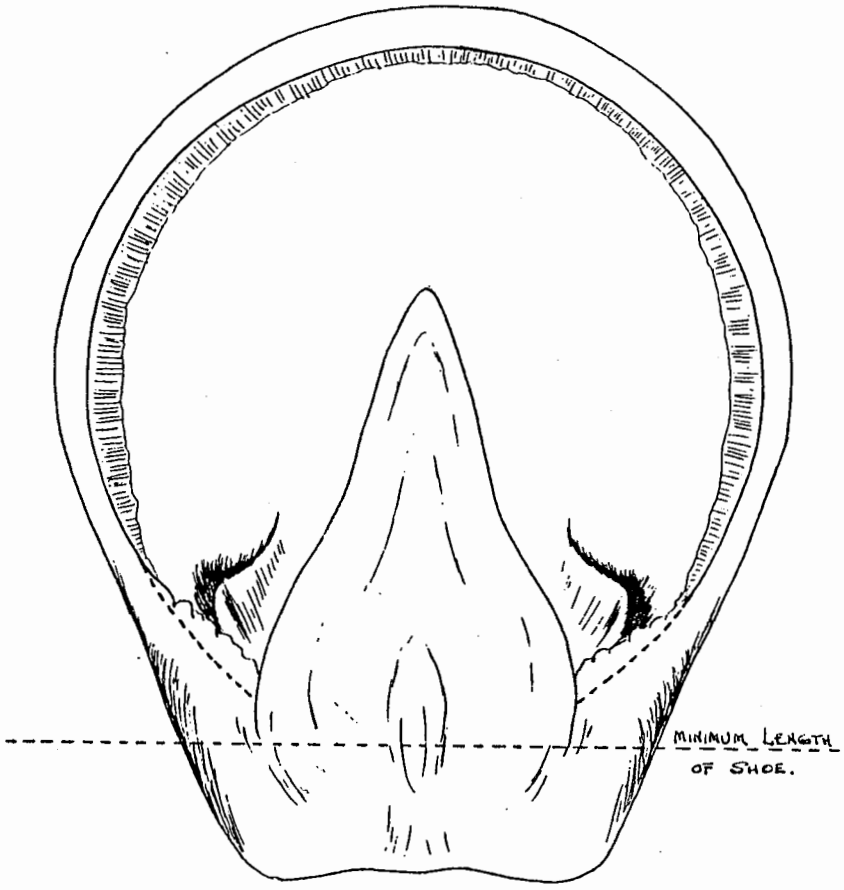


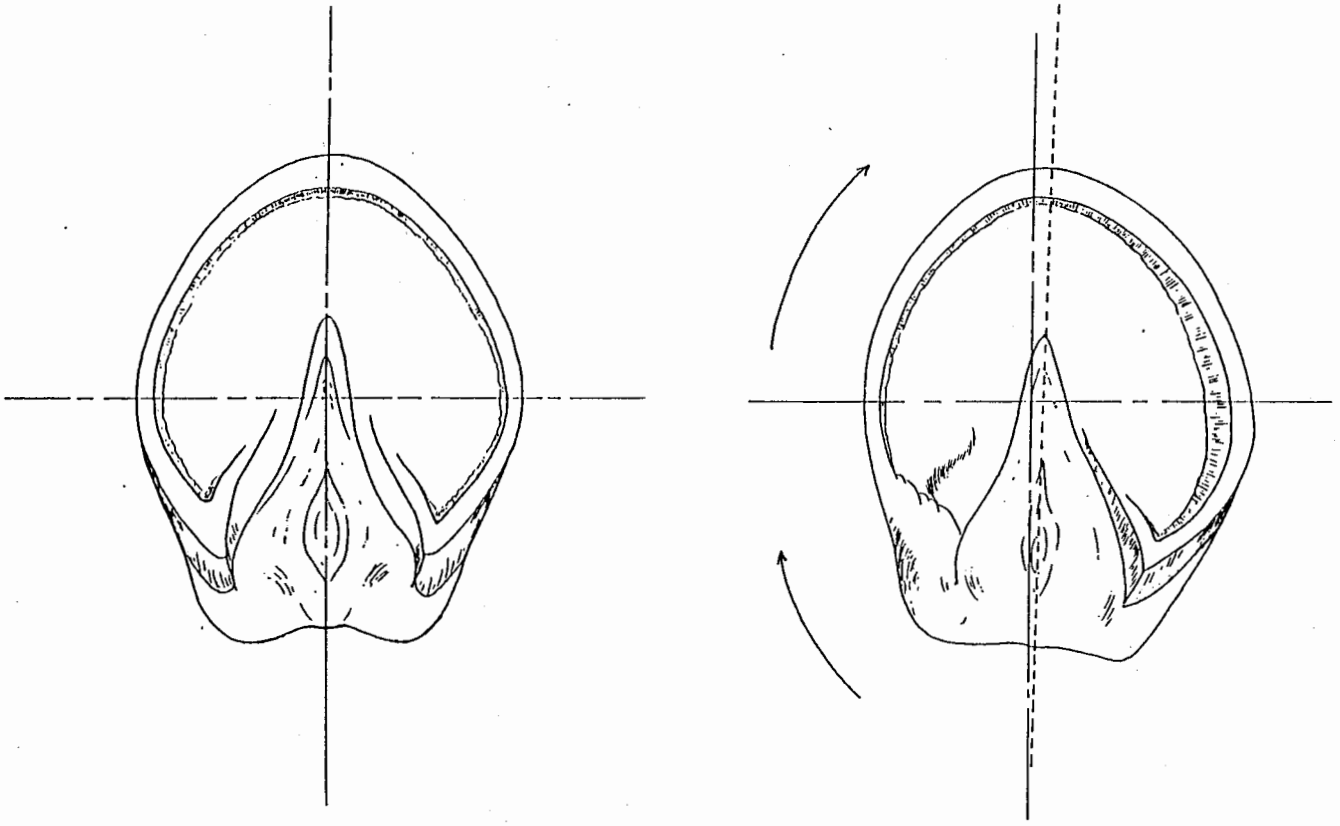
Figure 8

Forefoot, where wall has spread and heels have collapsed. Horn has curled under and inwards and bars have become deformed by excessive pressure.
Remove ingrown horn back to dotted line and fit with shoe, wide in cover over heels, to a minimum length of lateral clefts of frog.

Even on a deformed foot it would be extremely rare to find one of greater width than length.

Providing a flat sole is not caused by disease (laminitis), the majority of cases can be returned to a reasonable form of concavity simply by narrowing the foot to a more natural shape. A lot will depend on the strength of the bars and heels as to the time involved before success is achieved. The first indication of change is that the usually smooth texture of the flat sole will develop a small crumbly spot immediately at the point of the frog. Gradually this spot will increase in size as the sole adopts a more concave form.

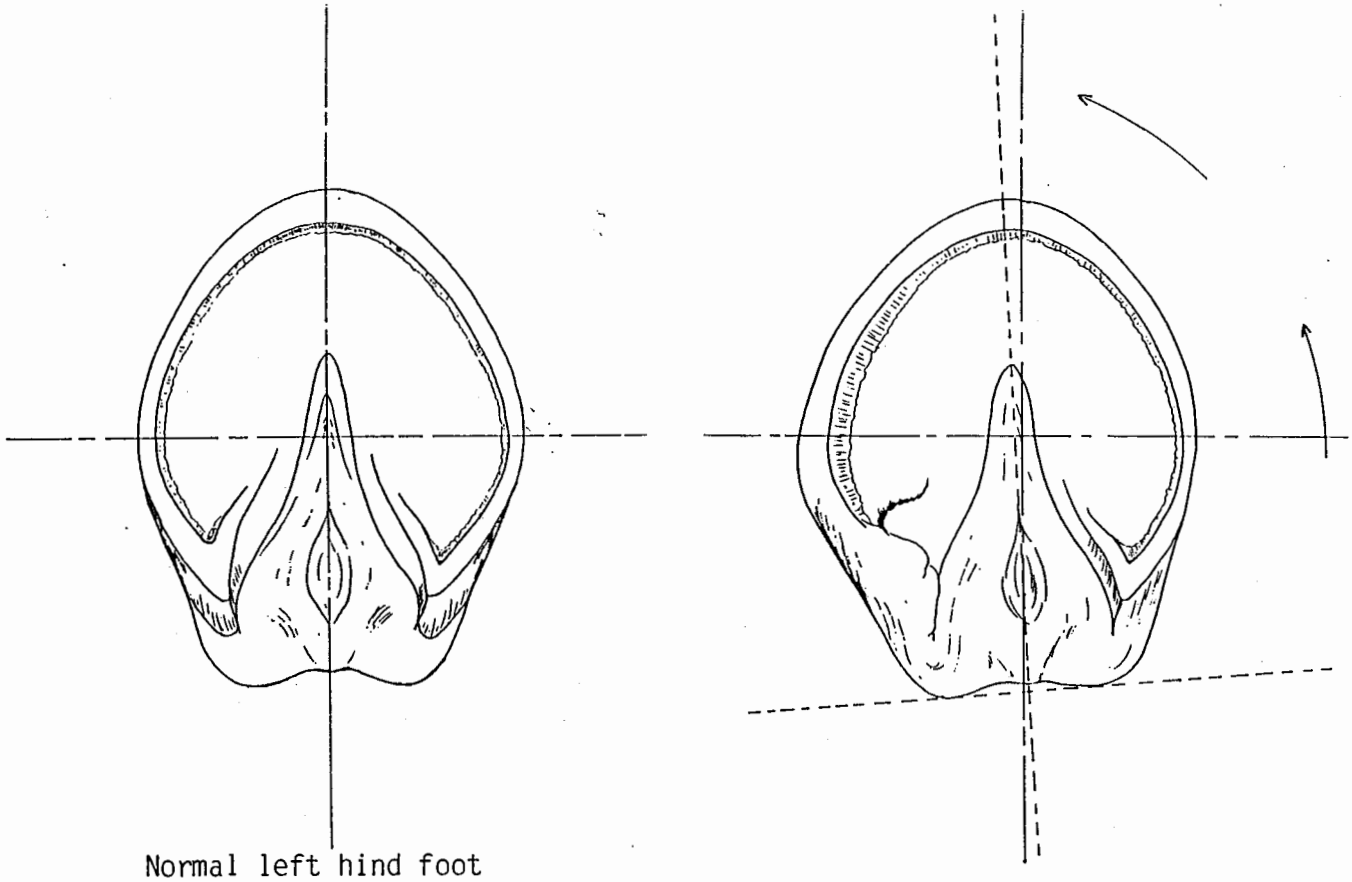
In the case of extremely collapsed heels it can be seen that the horn (at the heels) has actually curled under and inwards. Once the horn tubules have been deformed in this way, the inturned growth must be removed (Dollar, and Wheatley, 1898), (Fig. 8), otherwise weightbearing will result in horn continually growing in this direction, with further and greater weakening of the heels, making hope of correction increasingly difficult. Having removed the inturned horn, a flat shoe, wide in cover at the heels should be fitted. The fitting should be with the emphasis on setting the shoe to the position where one would like the horn to grow to, with the length of the shoe branch being almost to that of a perpendicular line down from the bulbs of the foot. In almost all cases of unbalanced feet, a cure can be attained using nothing other than a flat shoe. By flat this means no thickening or raised sections of the shoes thickness. The flat shoe, especially with extended heel bearing helps to distribute the animal's weight more evenly, and in doing so encourages the heels of the foot to form. In severe cases of collapsed heels, extending the branches into an "Egg-bar" shoe may be



Normal left hind foot

Figure 9

Left hind foot after prolonged shoeing with $\frac{3}{4}$ shoe. Heel under constant pressure collapses and foot progressively turns inwards on foot axis.



Normal left hind foot

Figure 9

Left hind foot after prolonged shoeing with one outside stud or caulkin fitted. Heel under constant pressure collapses but raised outer heel tips weight of limb towards opposite (inner) toe and foot progressively turns outwards on foot axis.

beneficial. The "Egg-bar" shoe as the name implies, is ovoid in shape, being broader at the heel than the toe. If correctly fitted this shoe should extend beyond the heels so that the inner border is putting no pressure on the frog. It gives approximately 25% more bearing surface, and it is certainly an excellent means of support giving greater stability to the limb, so that even less pressure is absorbed by the heels.

Where heels are collapsed and severely undergrown, frog pressure seems to have an almost adverse effect upon the expansion of the foot. When we talk of frog pressure and heel expansion, one automatically thinks in terms of an upward thrust of the frog from contact with the ground. My belief is that the downward thrust of the phalangeal bones plays a far more important part in heel expansion and the blood circulatory system, than the actual frog itself. It would appear that the frog plays a more important role as a shock absorbing wedge, allowing the hoof to expand, contract and flex without fear of fracture. This is in a way borne out by the fact that should plastic heel wedges be fitted where almost continual frog pressure is maintained, and the horn at the heels is even slightly undergrown, then not only does the frog begin to atrophy, but the heels appear to collapse even further.

Although I have up to now dealt solely with the forefeet, whilst on the subject of crushed heels, I would like to draw attention to the effect which threequarter shoes (Fig. 9), or shoes with only one heel stud or caulkin, have on the hoof to which they are fitted. In almost all cases, and certainly those of long standing, the heel that is under constant pressure is partly collapsed. The foot with a single stud also

has the sad tendency to throw the weight of the horse forward over the opposite (inside) toe quarter (Fig. 10). Over a prolonged period of time, the weight of the horse is progressively directed towards the inner wall, usually to the detriment of the coffin and/or pastern joint(s). This condition, in my view, is possibly one of the most difficult to correct with just a flat shoe. Although it is possible, in severe cases, it may be necessary to resort to the use of the "G shoe".

The shoe fitted with a single stud or caulkin, also acts as an example of how lower limb joints can be affected by an unlevel ground bearing surface. Any unlevelness of the medial/lateral aspect of the foot only succeeds in transferring the horses weight to the lower side of the hoof. It in no way has any effect on the general direction of the limb (Dollar & Wheatley). The practice of lowering one side of the foot, particularly on foals or other unshod horses, to correct a "toe in" or "toe out" abnormality, usually only results in misaligning a joint, or as is often the case, realigning a joint. Invariably when an owner insists his or her animal turns a foot, it is because the animals weight is not being carried immediately over the foot. In its normal state, the horse is slightly more upright on the inside wall and accordingly carries more weight on that branch, but I do think too much of a feature is made of this by many writers and in the process, encourages many farriers to practice this to excess.

I feel that if an equal amount of foot is kept either side of a vertical line, from the knee centrally down the front of the leg to the ground, then the slight variance, from what is supposedly a natural conformation, can cause no harm whatsoever to the well being and balance of the horse.

With shod horses, any imbalance can be observed by the amount of wear on the old shoe. This is often simpler than assessing how the hoof itself has worn in the unshod foot. In cases of extra wear seen on one branch of the shoe, it is then helpful to view the animal being walked away from you if a hindfoot, or if a forefoot, towards the observer. This will give a good indication as to the alignment of the ground bearing surface of the foot in relation to the coffin, pastern and fetlock joints. These joints should also be fully examined with the animal at rest, both taking its full weight, (with the other limb raised) and with the limb under scrutiny being raised and extended forwards. In this way it is possible to observe any deviation from the general line the fetlock and hoof should follow. Flexing the limb and only examining the hoof for correct balance can often be misleading, as if the bulbs of the heel are unlevel, they can seriously influence ones assessment. Consequently, it often happens that the exact opposite side of the foot is lowered than that required.

In certain cases, it has been noted that due to gross imbalance of the ground surface of the foot, where the medial branch of the hoof has been excessively lowered, the animal, to relieve the unnatural strain on the coffin/pastern joints, gradually places its foot in a line further away from its body. This has in turn produced strain on the entire upper limb, the result being that knee or even shoulder injury can be diagnosed. To a lesser degree, but nonetheless equally important, if the foot is only slightly unlevel in the medial/lateral direction, then it is but a short time before one of the lower limb joints comes under strain. This takes the form of compression of the articular cartilage on one side and a strain on the capsular and/or lateral ligaments on the

other. At best one can expect inflammation and swelling, at worst lameness with the possibility of bony growths, if the problem is ignored for any length of time. If the joint or joints in question have not been under undue strain for too long, then this imbalance is much easier to correct than the long toe low heel aspect. Quite simply it is a matter of putting the shoe where the actual foot should be, that is to have the cannon bone immediately over the centre of the shoe, regardless of where the hoof has grown. Obviously at an early stage, this is but a simple matter of shoeing one branch tight and the other full, but where this imbalance is of long standing, then the problem is not quite so simple. Firstly any changes made to correct the imbalance have to be gradual to avoid further damage to the joint by a harsh reversal of the changes. This must however be radical enough to promote improvement and a possible cure. This unfortunately is where there is no substitute for experience, and the help of a veterinarian in this situation can be priceless. One can only guess as to damage caused to articular cartilage or tissue, particularly where the coffin joint is affected, but the extra benefit of an x-ray and the Vet's ability to interpret the radiograph, is of enormous value.

My conclusions on hoof balance are, far better a crudely made shoe, well fitted to a balanced foot, than a beautiful piece of polished engineering, ill fitting an unbalanced foot.

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