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6.3 Forging the shoe

Preliminary thoughts

Before starting to make shoes it is necessary to have a pair of tongs that will hold the selected section of metal securely. As mentioned in Chapter 2, tongs can be right- or left-handed: *right*-handed tongs are held in the *left* hand and vice versa. It is useful, though not essential, to have a suitable pair of opposite-handed tongs for handling metal in the fire. If you are right-handed, the shoe will be turned (made) using the left hand to hold the shoe, but the metal will be worked in the fire using the right hand. The reason why tongs are 'handed' is so that the jaws, and therefore the metal, will always be held squarely. The thumb and forefinger hold the upper rein (lower jaw) whilst the other three fingers operate the lower rein (upper jaw). In the correct hand, a shoe that is held in the tongs will always lie flat on, or square to, the anvil face. The upper rein (lower jaw) will be held against the palm of the hand with the thumb. When the hand now closes naturally, a strong grip is applied by the fingers, with the jaws remaining square.

Holding the hammer with the thumb directly down the top of the shaft (Figure 6.4b) is extremely limiting to wrist movement, in fact it tends to lock the wrist, which in turn affects the ability to angle the face. It is far better to hold the hammer shaft as one would hold a bread knife (Figure 6.4a). This allows the hammer shaft to be held lightly between the thumb and first two fingers for very rapid, wristy blows (the arm is barely raised), yet allows the shaft to be grasped firmly with the little finger when strong, swinging blows are needed. The little finger allows for a powerful grip without locking the wrist. *Whilst we can explain how to hold the hammer for efficient and economic working, we cannot explain how tight to grasp it. This comes down to trial, error and experience.*

6.4 *above, left and right* Holding the turning hammer.

a. Gripped between finger and thumb. This allows for wristy movements with minimal arm movement.

b. Grasped with the thumb on the top of the hammer shaft. This locks the wrist, and means that blows will require movement of the whole arm.

Remember, a shoe is 'turned'. This means that it is the hand grasping the tongs which has the greater control of shoe shape. It is helpful at this stage to understand how metal will behave when struck with the hammer face, where it is struck to tighten a bend and where it is held and struck to open a bend (Figure 6.5a, b).

Always try to have the hammer shaft and the reins of the tongs as near to parallel as possible when turning a shoe. This way the hands will work in a coordinated fashion, and allow for a smoother and more regulated series of hammer blows.

6.5 *above, left and right* Opening and closing the heel.

a Opening the heel. The branch of the shoe is supported at two points on the beck, and is struck between these two points, to straighten the curve.

b. Closing the heel. The shoe is firmly held in the tongs, and supported on the beck. It is then struck on the far side to tighten the curve.

Shoes should be made in pairs, and we will start by describing forging a pair of fullered concave shoes for the forefeet. The following description is for a right-handed person.

Cutting the steel

After measuring the feet, it is good practice to cut the length of metal for the *pair* of shoes in one piece from the stock bar. This length is then balanced over a piece of triangular file or some similar material, marked at its midpoint, and cut. (If using a piece of file for this purpose, it is essential that it has been heated to remove the brittleness, without removing all the hardness otherwise, if struck to mark the shoe, it will shatter, and can cause injury to anyone close by – see Chapter 2 page 22). This gives two pieces of metal of exactly the same length and weight. These pieces are then balanced in turn over the piece of file and marked with a light blow to indicate the centre of the shoe. Mark the inner edge of the shoe to ensure that when drawing a clip at this point, the first blow of the hammer does not obliterate the mark.

The two pieces of metal are then placed side by side on the anvil, bevelled sides innermost. Both pieces are grasped in the tongs at one end and pushed together through the fire, so that their centre is in the hottest part of the fire. (It is important to ensure there is no clinker in the heart of the fire, as this will cause a cold spot within the fire). It is a matter of choice whether the concave surface is facing up or down. With the concavity facing up, the first piece of metal to get hot enough (that at the back of the fire) will be for the left, or near-side shoe. Some farriers prefer the concavity facing down, saying it prevents it being continually full of ash. However, with the concavity facing down it is more prone to getting scorched and therefore spoiling the shoe.

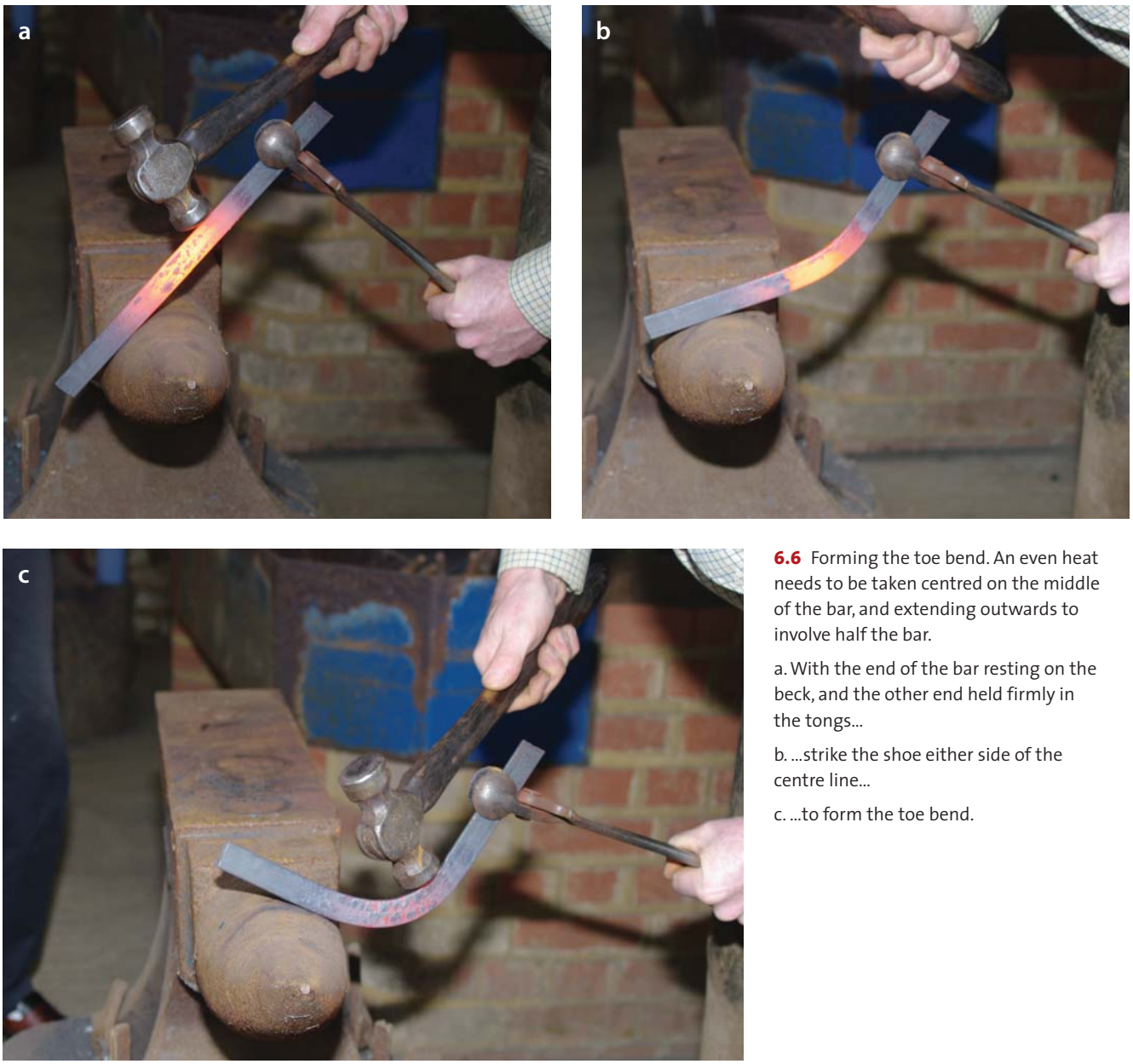
If placed concave surface downward, it will be necessary to place the metal in the forge with the bevelled sides outwards, in order to turn the left or near-side shoe first. (Normally the left shoe is turned first as this is usually the first shoe to be fitted. Most horses are used to being approached initially from the left side). Whichever way the steel is worked, try to make turning shoes a matter of habit, so that everything is done automatically, without having to think.

The first heat

The first heat and the first bend in the bar (the toe bend) is the most important. If this is right the shoe will almost make itself; if wrong it will be a struggle from here on. Even with machine-made shoes it is important to prepare the toe bend first, be it on an anvil or on a stall jack. Although heated in the middle, the heat should extend outwards to take in at least half the overall length of the bar. It must be a good, even heat so that it will bend in a smooth curve.

The toe bend has to be made slightly tighter than the actual radius required. When the quarters are turned, the toe bend will broaden slightly.

To obtain the toe bend, the bar is grasped as in Figure 6.6a, resting on the beck of the anvil, and a series of sharp, regulated blows are administered along the inner edge. The only reason for using the beck is that less scale is thrown over the face of the anvil, which needs to be kept as clean as possible at all times. These blows should be directed on the bar either side of the centre mark, using the hammer's rounded face. The centre will bend automatically to the radius being formed (Figure 6.6b, c). Always keep blows to a minimum. The more blows made, the more the metal will stretch. It is often at this point that the bar begins to buckle under the hammer blows. This is solely a consequence of the angle of the hammer face striking the bar. Level the bar on the anvil face



6.6 Forming the toe bend. An even heat needs to be taken centred on the middle of the bar, and extending outwards to involve half the bar.

a. With the end of the bar resting on the beck, and the other end held firmly in the tongs...

b. ...strike the shoe either side of the centre line...

c. ...to form the toe bend.

6.7 Level the shoe to remove any buckling, before proceeding.

6.8 Assess the toe bend to ensure it is symmetrical about the centre of the bar.

6.9 Smooth the toe bend to a symmetrical curve.

(i.e. flatten the bar to remove any buckling – Figure 6.7), and assess for accuracy of shape (Figure 6.8). Initially, for the beginner, it may be necessary to reheat the toe area of the bar, as a cold piece of bar isn't going to bend. With sufficient heat, the bar can now be reversed over the anvil beck and shaped to a smooth, symmetrical curve that will form the toe bend (Figure 6.9). Important points to remember are that the beck of the anvil does not have a symmetrical radius, but has a pronounced taper, and that the inner edge of the shoe is bevelled. It therefore means that the bar is subject to different radii on the same part of the beck, depending on which way the fuller is facing.

Trying to obtain a symmetrical toe bend can be very frustrating, but it is essential. It is general practice to work the bar at an angle on the beck. With the fullering facing away from the anvil face, a much tighter bend will be obtained than when the fullering is facing toward the anvil face, even though the bar is worked on exactly the same point of the beck. This is because of the bevel on the bar. To overcome this problem, simply hold the bar more squarely to the beck. How much difference of angle is necessary depends upon the size and shape of the beck. At this stage, the toe bend should be rather tight, more like the toe of a hind foot. Just away from the toe bend itself there is generally a pronounced kink, or shoulder (Figure 6.10). This can be corrected straight away, but it may be preferable to wait until after taking the next heat. It is very

6.10 At this point there is a marked kink, or shoulder, in the metal, just away from the toe bend (see pointer). This will need to be straightened, and in doing so the toe will open out slightly.

important that the kink is removed, and in doing so the shoe will open out, hence the reason for the tight initial toe bend. Once a satisfactory toe bend is obtained, we can progress towards completing the lateral branch of the shoe.

7.3 Trimming the foot

This is the most important aspect of shoeing. The application of the shoe prevents normal wear of the hoof wall and it is essential that the farrier trims the foot correctly to maintain normal hoof shape and correct limb flight. A shoe applied to an incorrectly trimmed foot can result in progressive distortion and injury to the hoof/limb.

Trimming the normal foot

When carrying out trimming on a 'normal' foot, e.g. when carrying out regular shoeing, it is normal to start at the toe. With the curved end of a drawing knife pointing towards the hoof wall, trim the sole at the white line, to ascertain how much of the wall at the toe can be removed (Figure 7.18). Once the white line is clearly demarcated, then it is normal to start trimming from one toe quarter, round the toe area. In this area the amount of wall that can be trimmed is limited by the thickness of the sole. The hoof wall in the toe region should be trimmed level or almost level with the sole. However, the exact amount of horn that is removed depends upon whether or not a hot shoe is to be applied. A minimal amount of horn has to be allowed for burning with a hot shoe.

Once the toe is trimmed (Figure 7.19a), work back to the heels, always trimming the higher side of the foot first (Figure 7.19b). Hopefully, there will be enough solid horn so that the heels can be trimmed to maintain a straight hoof/pastern axis. It may, however, be that the lower side will be in need of every bit of horn available to attain a correct medio-lateral balance. If the horn

7.18 Start trimming the foot by paring the sole at the toe of the foot to assess how much wall can be removed.

7.19 a. Trim the toe area and toe quarters.

b. Trim back to the *higher* heel maintaining a straight hoof/pastern axis if possible. It may be necessary to trim more horn than ideal if the foot has previously been over-lowered or the horn in the heel is weak.

is of poor quality, it may be necessary to trim the hoof at the heel back to sound horn, and either accept a slightly broken-back hoof/pastern axis, or a medio-lateral imbalance, or build up the heel(s) with artificial horn, or shoe with an egg-bar shoe or graded heel shoe (see Chapter 8 page 241).

Important aspects of trimming

1. The shod foot undergoes more wear at the heels, as these are free to move across the shoe with weight-bearing. When trimming, therefore, more horn must be removed from the toe than the heels.

2. The amount of horn removed from the heels should only be sufficient to maintain a straight hoof/pastern axis, or to get back to sound horn. In a 'normal' horse this will be a minimal amount. In very weak-footed animals, there may be little or no horn to trim from the heels.

3. Horn in the sole exfoliates naturally with the movements of the foot. However, flakes of horn should be removed from the surface of the sole at shoeing. If exfoliation does not occur a thick or double sole may build up and may require removing (this is commonly seen in dry conditions and overgrown feet, especially if working on soft surfaces).

4. Excessive growth or loose flaps of horn or infected areas of horn (black, soft horn) should be trimmed from the frog.

5. If the bars or heels grow across the sole, the excessive horn should be trimmed away. Any inward growth of horn at the heels is an indication that the heels themselves are beginning to collapse. This will also show as a slight curvature of the bars, and a distortion of the horn tubules. In this situation the distorted area of the tubules at the heels should be rasped back as far as possible to find solid horn. This may result in a broken-back hoof/pastern axis, but see Chapter 9 (page 310) regarding how to shoe feet with collapsed heels.

6. Any tendency for the walls to flare at the bearing surface, either laterally or medially, should be corrected by rasping the hoof wall from the outer surface, to straighten the wall. Any flaring of the hoof wall will tend to pull the heels forwards and inwards. (The one exception may be the medial toe quarter if you are trying to expand a medial contracted heel – see Chapter 9 page 306). The wall has to be left with sufficient thickness to enable nails to be driven safely, but do not pull back the toe and leave the toe quarters flared, as weakening of the toe horn alone encourages the quarters to flare more. Remember that when horn is severely rasped away, the softer exposed horn will dry out, and shrink. This possible shrinkage has to be taken into consideration if a shoe is being applied. This relates mainly to severely over-grown feet that have been radically remodelled.

7. The bearing surface of the foot (i.e. wall and white line) should be flat and level (Figure 7.20b). The bearing surface in the lateral to medial direction should be at right angles to the long axis of the cannon bone (assuming the leg to be reasonably straight).

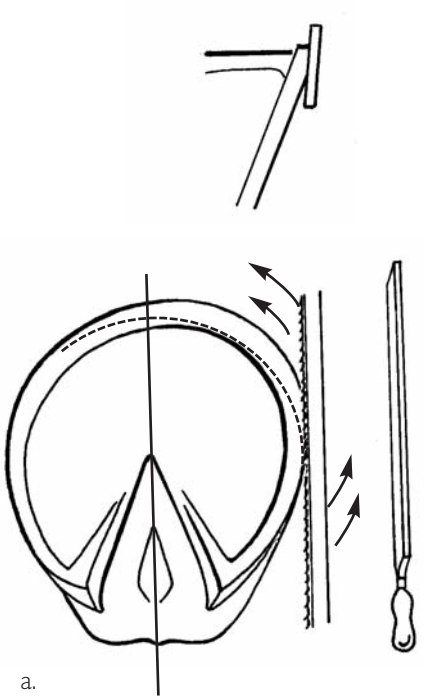
8. The bottom of the foot should be shaped as shown in Figure 6.3a page 180. If the foot appears wider than it is long, then further rasping of the quarters of the foot may be required.

Trimming the overgrown foot

Remedial shoeing is dealt with in detail in Chapter 9, but some brief comment on correct trimming of slightly abnormal feet is necessary here. Actual conformational defects aside, a horse will always try to place its foot in the most comfortable position. If it has a medial or lateral imbalance of the foot, or any type of problem that may cause discomfort when the foot is loaded, the animal will usually place its foot away from the natural line of flight of the limb, to a more comfortable position. In the process, the hoof capsule may be distorted and weakened. Initially, therefore, it may be helpful to roughly correct the medio-lateral balance in order that a better assessment of gait may be made.

Because the hoof wall grows from the coronary band, the peripheral length of horn cannot increase when it reaches the ground. As the toe of the foot is attached to the distal phalanx, it is held relatively rigid. If the foot is overgrown there is a tendency for the quarters to spread, and this results in the heels being pulled forward. If one thinks of a plastic cup it is easy to see how the mouth of this can be distorted, but never increased in size. Spread it one way, and it decreases in the other. The areas where the foot can alter are the quarters, which may spread, and the heels, which can only collapse forward.

Some reshaping of the dorsal wall may be required (Figure 7.20a), but it is important to maintain a symmetrical shape to the foot. Initially, lift the leg and sight down the cannon bone to determine if the bottom of the foot is central under the load-bearing line. If not, this can be corrected as the foot is trimmed to shape. It is simplest to start to trim the foot to the required shape from the ground surface (i.e. with the foot held between the knees). This can be done with the rasp, which is used at a 90-degree angle to the solar surface of the foot (Figure 7.20a). Once a correct shape has been formed, the foot can be taken forwards onto a foot stand, and any flare rasped down to the distal peripheral edge that you have just created. There is often little or no deviation in the horn tubules from the coronary band



7.20 *top of page* a. Some reshaping of the dorsal wall may be required, as it is important to maintain a symmetrical shape to the foot. See related text and Chapter 9 for further information.

b. *photo* Ensure that the surface is flat and level before fitting the shoe.

around the toe, but there may well be bending of the horn tubules at the quarters, which must be corrected. Finally, ensure that the foot is flat and level (Figure 7.20b).

Overgrown feet generally have a normal height of heel, and must be differentiated from feet with a dorso-palmar imbalance, which are dealt with in Chapter 9. With dorso-palmar imbalance, there is no height of heel and the collapsed heels may have forced the coronary band to adopt an unnatural angle to the hoof/pastern axis, causing the horn tubules to grow in a forward direction.

Trimming overgrown chronic laminitics

When laminitic feet are badly overgrown, as in Figure 9.32, the whole orientation of structures in the foot changes. The foot itself is healthy, but growing abnormally. The sole that we see is entirely different from normal, and thickened. The only area of natural exfoliation is in the angle at the back of the heel, between wall and bar. The healthy horn of the dorsal wall, and lack of tightly bunched grass rings under the coronary band, means that there has been no rotation of the distal phalanx in this case. This type of foot is not to be confused with feet that have suffered chronic laminitis.

9.32 Badly overgrown chronic laminitic feet (see also Figure 9.34).

Generally, chronic laminitics can be recognised by their gait. Rotation of the distal phalanx, or uneven horn growth, means they have a 'floppy' action with their forefeet, placing the foot heel-first. After an attack of laminitis, the heels will grow at up to twice the normal rate, but the dorsal wall at the toe grows slowly. The toe is often of poor-quality horn, and tends to grow forwards rather than following straight down to the ground. If the distal phalanx has rotated, it may be pressing down on a very weak sole (immediately in front of the point of the frog). To attempt to remove any sole in these circumstances would be disastrous.

The dorsal wall of the foot is likely to be running forwards at the ground surface, and will be slow growing. It will have pulled the white line forwards with it and also resulted in forward growth of the sole (see Figure 9.33). The frog corium, however, remains remarkably constant in its relationship to the distal

9.33 A cross-section of a chronic laminitic foot. The wall at the toe of the foot is curling away forward, and has separated from the sensitive laminae. The laminae remain attached to the dorsal wall of the distal phalanx, and have produced some amorphous horn from their surface to fill the space where the hoof wall has grown away. The white line is clearly seen growing from the bottom of the laminae. The sole is also distorted and pulled forwards, but the frog corium is still normally situated just behind the tip of the distal phalanx.

phalanx, and trimming the frog back to find where it arises from the sole can give a valuable insight as to how the sole has been distorted. As a general guide when trimming the dorsal wall, if sound horn isn't produced within 6 months, then it is extremely unlikely that it ever will be.

When remodelling misshapen feet, it may be found difficult to visualise a natural/normal hoof shape (Figure 9.34a). We suggest it is best to begin at the heels and work forwards. Assess what should be a normal height of heel for the animal, and trim the heels square to the load-bearing line of the limb. Next, trim forwards, gradually tapering off towards the toe quarters. The reason for this is that, although the heels are extremely high, the dorsal wall, in spite of its shape, is of a normal height. The white line will have been distended, and the dorsal wall forced forwards.

Once the foot has been satisfactorily levelled, it is now necessary to find the true point of the frog. Usually, when the foot has become elongated and the sole has thickened, the frog will also have grown forwards in a similar manner, although its attachment to the corium is relatively static in relation to the pedal bone. Careful paring of the point of the frog will eventually show where the natural point is. It will also give a much better indication of the thickness of the sole that has built up. Build-up of sole restricts flexibility of the hoof capsule as a whole, but is most noticeable in the inability of the sole to flex, and allow the foot to expand.

Begin by reforming the bars, then gradually ease away slivers of sole from along both sides of the frog. It may well be that small pockets of watery blood, dry blood, or even spongy patches of horn are encountered during this procedure. These are no cause for alarm, although they must be treated with caution. Carefully pare around the edges of any pocket found, and open fully, to make it possible to test that it is solid horn below. If the horn around the pocket is really solid, it is doubtful there will be any problem. Be aware of the depth of the sulci, as this is the best indication of the thickness of the sole that may be removed. *Always* keep testing the sole for flexibility during the removal of horn by pressing it with your thumb.

The sole should be shaped to be concave, and should not be weight-bearing, so further removal of horn from the ground surface of the wall is probably not necessary. In Figure 9.34c, it was possible to remove a considerable amount of horn from the dorsal aspect of the wall using curved hoof cutters, before completion with a rasp. In most in-stances, this procedure would be carried out on a foot stand, but remember dorso-palmar balance assessment (by grasping the cannon and viewing the dorsal wall relative to the hoof/pastern axis).

All overgrown feet will show an area following the natural direction of horn growth, immediately beneath the coronary band, on the dorsal wall. This can be as little as ⅜ inch (10mm) long, or as much as 1 inch (2.5cm). This is the line of growth that the dorsal wall *must* be trimmed to. With laminitics, this area may not be obvious. The grass rings may be tight together, close to the coronary band at the toe, and therefore misleading. When rasping the dorsal wall, it is

9.34 a. A chronically overgrown laminitic foot. The lines indicate how far back it can be trimmed. See also Figure 9.32.

b. View of the sole, showing the deep frog clefts, and apparently atrophied frog.

c. The heels are cut down to a little longer than their normal height, taking care to maintain the medio-lateral balance.

d. Trim back the frog and thin the sole, taking care to test the sole thickness continually. The sole must be left concave, and not weight-bearing.

e. The dorsal wall at the toe needs to be trimmed back, but often little or nothing can be taken from the ground surface at the toe.

important that the natural direction of growth is followed. Trauma, neglect, or foot imbalance can affect the downward growth of the hoof wall, especially at the toe, causing it to grow in a forward direction. Unless the horn at the toe is rasped to the correct line, the horn tubules will never be redirected to give normal growth. They will always follow the curve that they have adopted.

In many instances, removing horn from the toe of the foot will expose layers of necrotic laminae. This may look unsightly, and the laminae often contain pockets of fluid. Once exposed to air, however, it will quickly dry out, and there is seldom any danger of infection of the exposed laminae. Should it be necessary to apply a shoe after such trimming, no clips, or nails, should be near the exposed laminae. As the laminae dry out, they will also shrink.

Once the dorsal wall has re-grown, it will be found that the whole action of the animal may alter. Initially, the radical shortening of the toe may cause a slight stumbling effect, as the break-over point is considerably reduced. (Although stumbling is normally attributed to long toes, extremely short toes, particularly on large cob-type horses, can also be a cause.)