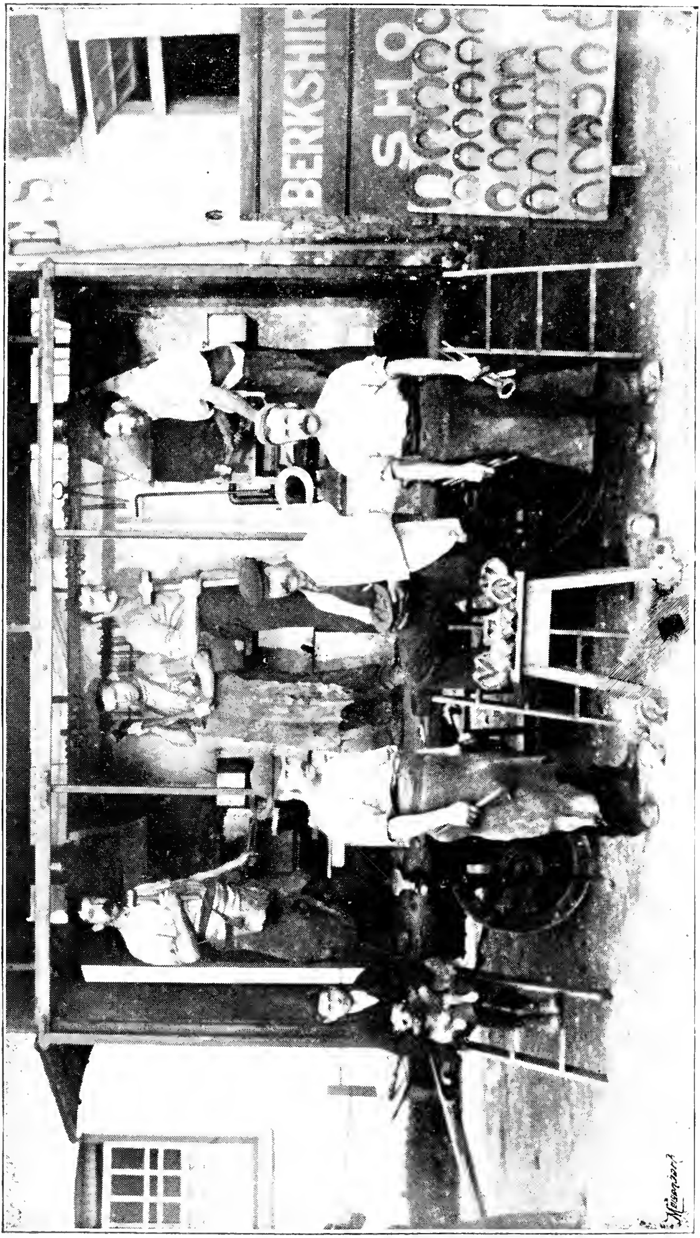
# HORSE-SHOEING




*Frontispiece.*]

# A HANDBOOK OF

# HORSE-SHOEING

WITH

INTRODUCTORY CHAPTERS

ON THE ANATOMY AND PHYSIOLOGY OF THE

# HORSE'S FOOT

BY

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NEW YORK:

WILLIAM R. JENKINS,

VETERINARY PUBLISHER AND BOOKSELLER,

851 AND 853 SIXTH AVENUE.

1898.

# PREFACE.

The friendly reception accorded to previous efforts encouraged the hope that a volume dealing with that less studied though scarcely less useful subject, Horse-shoeing, might find similar acceptance. To provide material, all the best known German, French, and Italian treatises have been ransacked, the leading English works referred to, and the information thus gained collated. Without any intention of disparaging the labors of other authors, the writer feels bound to confess that he has found no work of more practical and scientific value than Leisering-Hartmann's masterly Handbook, "Der Fuss des Pferdes;" which, though in a much modified form, and with the addition of a large amount of new matter, has been adopted as the model and substantial basis for the present volume. Other sources of information are indicated in the Bibliography hereto attached.

The first nineteen pages, on the history of Horse-shoeing, have been translated, with little alteration, from Leisering-Hartmann. In the section devoted to the Anatomy of the Foot, Professor Mettam has kindly contributed pages 61 to 65, and fig. 66 on page 106. The part dealing with practical Horse-shoeing has been almost entirely re-written, while many additions drawn from the writer's own experience or from Continental literature have been made in order to adapt the book to the requirements of English readers.

To Mr. Albert Wheatley is due one of the chief features of the book, viz., the large-sized blocks of horse-shoes printed on separate sheets, and the descriptions accompanying them.

The engraving of these has occupied considerably longer time than was at first anticipated, but the important character of the added matter fully compensates for any delay, and must be held as largely contributing to whatever degree of success the book may eventually attain. To the pains Mr. Wheatley has taken in superintending the preparation of both shoes and illustrations, the enthusiasm he has exhibited in the work now completed, and the personal kindness he has at all times shown, the writer cordially testifies.

Messrs. Schönefeld of Dresden have kindly permitted the use of the majority of the wood-cuts, and Messrs. Phipson & Warden, iron merchants, etc., Birmingham, have accorded a similar privilege in respect of the illustrations marked with an asterisk.

To Professor M'Queen, of the Royal Veterinary College, London, who rendered such valued service during the publication of the work on Veterinary Surgery, the writer has once more the sincere pleasure of tendering his thanks, and of gratefully acknowledging how much he owes to that gentleman's kindly encouragement and assistance in revising proof-sheets during the two years devoted to this later task.

JNO. A. W. DOLLAR.

LONDON, *October*, 1897.

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# INTRODUCTION

AND

# HISTORY OF HORSE-SHOEING.

## INTRODUCTION.

FROM the description of its structure and functions, hereafter given, the hoof will be seen to act as a protective covering to the sensitive structures of the foot. In the wild horse this protection is perfect. In proportion as the bearing surface of the hoof wears away, it is renewed from above; but immediately the horse is made to draw or carry on ordinary roads, the hoof wears more rapidly than it can be produced. Some artificial protection then becomes indispensable, and in almost all countries this takes the form of an iron strip or plate, fastened to the hoof with nails, and termed a 'shoe.' Everything relating to the preparation and application of such means of protection comes within the sphere of horse-shoeing, which therefore may claim to be both a science and an art. A science, because a knowledge of horse-shoeing presupposes an acquaintance with the principles and practice laid down by veterinary surgery for the maintenance of the hoof in a sound condition, for improving the faulty, and partially or completely restoring the function of the diseased. Horse-shoeing derives from anatomy a knowledge of the construction of the foot, from physiology relative guidance in treatment, and from surgery an acquaintance with the methods appropriate to the relief of diseases of the foot. Horse-shoeing is an art, because its exponents are handicraftsmen engaged not only in the making of shoes, but in fashioning them to the foot, the ground surface of which demands careful preparation to ensure a correct position of the limb, and therefore normal action, and to secure proper fitting of the shoe.

The object of shoeing is manifold. It serves to prevent excessive wear of the hoof, and in some measure to protect the sensitive structures which the hoof contains; to hinder slipping on smooth roads, on ice and snow, and on muddy streets; to improve in certain instances faulty action; and as an accessory in the treatment of diseased hoofs.

It can rarely be dispensed with, though horses doing light work in towns or on land are sometimes sufficiently protected by 'tips.' In most cases, however, the shoe should protect the entire ground edge of the wall. As growth is then uninterrupted, the normal relations of the hoof to the ground gradually change, and it becomes necessary, by occasional judicious trimming, to restore the hoof to proper shape. This is usually done at each shoeing, but is just as necessary in unshod horses which are resting.

Shoeing is by no means the simple affair it appears to the non-professional mind. The form of the shoe and the preparation of the foot demand endless variation, depending upon the shape of the hoof, the condition of the sole, the quality of the horn, the action of the horse, his work and his weight.

Only when shod, and well shod, can the horse exert his best powers; and any inattention or neglect is followed by injury to the hoof, if not by loss of the animal's services.

In addition to a knowledge of the structure and functions of the limb and foot, the farrier must possess bodily and mental endowments of an average order, besides experience and common-sense.

He must determine quickly and accurately the necessities of each case, and leave little to chance. The completed shoe should, in its form, thickness, breadth, length, stamping, and seating, bear a proper relation to the hoof, as well as to the animal's work and weight, and everything must be done with a careful eye to the end in view.

## HISTORY.

Though much debated, it is still uncertain to whom, or even to what race, we owe the invention of horse-shoeing. Accounts may be found in medical, veterinary, agricultural, military, archæological, and other publications; but having no intention to make this their chronicle, we shall give only a short sketch of the subject.

Whether the Romans or Greeks were acquainted with nailed-on shoes is undecided; for though they were aware of the insensibility and hardness of the horn, as shown by the writings of Homer, Virgil, and Horace, it is well known that the horses of Alexander's army suffered severely during marches through Asia in consequence of the wearing of their feet, and that vast numbers, becoming lame, had to be abandoned. Mithridates, King of Pontus (first century B.C.), while laying siege to Cycicus, sent his entire cavalry to Bithynia for treatment, on account of the manner in which the horses' feet had suffered from prolonged marching.

No Greek or Latin writer on military science, hippology, or agriculture mentions shoeing with nailed-on shoes. Vegetius Flavius certainly describes the forging of weapons and other instruments, but says nothing of either shoes or nails, as probably he would have done had they been used in his time.

Nor is there the barest indication of a horse-shoe on Trajan's Column, on the bas-reliefs of Castor and Pollux, the frieze of the Parthenon, on the mounted statues of Pompeii, nor in the mosaics representing the overthrow of Darius by Alexander, in the Naples Museum.

A further proof of unacquaintance with nailed-on shoes is given by numerous authors of this time, who describe methods to render the hoof resistant, and give directions for treating excessively abraded parts.

Xenophon, the general and author, for instance, states:—"To render the hoof as hard as possible, the horse should be kept on a stone pavement, both when in the stable and when in the court being cleaned." Columella recommends oak for the floor of the stall, which hardens the hoof in the same way as stone. In 1827 an ordinance of Diocletian (303 A.D.) was discovered, in which the prices of labour and the necessaries of life are fixed, and in which there are two instances of fees for the services of the veterinary surgeon (Mulomedicus), viz., for clipping the animal and paring the hoofs, 6 denars*; for grooming and cleaning the head, 20 denars. Had shoeing been known then, it would doubtless have been referred to in this edict.

In spite of the general agreement in selecting horses with

* Denar, a Roman coin, which in Diocletian's time equalled about 1s. 4¼d.

hard and rounded hoofs and concave soles, and the care taken to improve the quality of the horn, many grades were recognised, as shown by the terms *ungulæ*, *attritæ*, *detritæ*, *subtritæ*, etc., which continually recur in the writings of Absyrtus, Theomnestus, and Vegetius. For baggage horses, Xenophon recommends leather soles and shoes. Aristotle speaks of a kind of sock which was bound on the feet of camels used in war. The Greek veterinary surgeon Absyrtus clearly indicates the evils due to the straps by which the soles were affixed. Cato suggests that the under surface of draught animals' feet should be smeared with fluid pitch to make them more resistant. Columella, Theomnestus, and Vegetius describe protecting soles or shoes formed of woven broom, reeds, and bast (*soleæ sparteæ*), and fastened to the hoof by straps. Similar shoes are still used in Japan. The Romans also used metal shoes (*soleæ ferreæ*). Suetonius states that Nero took with him on a certain journey 1000 carriages drawn by mules shod with sandals or soles of silver. Pliny asserts that the mule of Popea (wife of Nero) was provided with gold soles. These soles, termed hipposandals, etc., are found all over Germany, France, and England, wherever the Romans settled. The richest discovery was made in 1851 and 1855, during the excavations at Dalheim in Luxembourg.

Hipposandals, though varying in form, usually consist of an oval metal plate, prolonged backwards on either side, and sometimes carrying a curved hook. In front and laterally are wings, provided with eyes and rings. Others are distinguished by the sides being bent upwards in front and behind, so that when seen from the side they resemble an ancient galley (fig. 1).

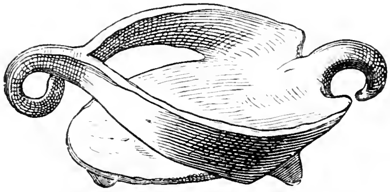


FIG. 1.—Iron hipposandal, found during the excavation of a Roman bath near Lazenhausen (Würtemberg).

Straps passed through these 'clips,' hooks, eyes, and rings, fastened the shoe to the foot. It would therefore appear that such shoes were only used for slow work, or for animals whose hoofs were already excessively worn. This view is confirmed by the rarity of such hipposandals, as compared with nailed-on shoes.

As for the instruments used to shorten over-long feet, we know, from the accounts given by Hippocrates, Absyrtus, and Vegetius, and by the remains found in Gastra Peregrina, Pompeii, and Masium, that they were almost precisely similar to the 'toeing-knife' of the present day.

In general, the horse-shoes of both these classical peoples were neither practical nor perfect.

The Celts, however, are credited, especially by French investigators, with having employed nailed-on shoes before the opening of the Christian era, and having extended their use throughout Gaul, Germany, and England. Though described by the Romans as barbaric, these people excelled in such occupations as agriculture, mining, shipbuilding and sailing, commerce and art. The Gauls and other Northern races of this period hoped to resume their work after death, and therefore buried weapons and other property, and even favourite horses, along with their dead. From such remains archæologists have been able to determine the habits and customs, and even the industries of these ancient races. Amongst articles discovered have been horse-shoes.

The French palæontologist Capstan, during excavations on the site of the ancient town of Alesia (in the Department of the Côte d'Or), found, in addition to wheel tyres and horses' bones, fragments of bronze horse-shoes, worn through at the toe, and a collection of nails, the heads of which resemble violin pegs. The same observer, in examining a Celtic barrow, found buried in a quantity of ashes the bones of men, horses, pigs, and bears, and beneath them a triangular file, a portion of a flat file, a chisel, masses of iron dross, a piece of bronze casting, an iron buckle, an iron hammer about five pounds in weight, an iron ring, and part of a small horse-shoe, with a nail attached. The remains were mixed with broken fragments of rude Celtic pottery.

Between the French towns of Langres and Dijon, where most probably the last battles which preceded the siege of Alesia (B.C. 52), and delivered Gallia into the hands of Cæsar, were fought, relatively large numbers of small fullered shoes have been found at a depth of 2 to 3 feet. Some carried nails resembling in form a Roman T, which were provided with clenches, showing how the shoes were fastened to the feet. Similar shoes have been found in Celtic monuments by the French palæontologist Foquet, the Swiss Troyon, and others. Quiquerez discovered some in the Bernese Jura, buried in an earthen mound along with horses' bones, and, from the evidence furnished by the superincumbent earth, referred them to the sixth century B.C.

All these shoes are characterised by six large roundish nail-holes, opposite each of which the border of the shoe is bulged outwards. There are shoes with and shoes without heels; but all are very small and weak (about $\frac{3}{16}$ inch thick, and $\frac{5}{8}$ to $\frac{11}{16}$ inch broad). They vary in weight from 3 to $3\frac{1}{2}$ ounces, and their shape is irregular and defective. The nail-heads are flat, and rounded off towards the side. The shanks are short, four-sided, tapering, and always pointed, showing that the nail was not cut and clenched after driving, but simply turned over and beaten flat on the horn. According to Veterinary-Surgeon Mathieu, however, other shoes of a more modern stamp exist. They have been found at Alesia, at Mont-Auxois, at Ancy le Franc, and in the valleys of La Brenne and L'Armençon. In 1871, on the occasion of erecting new buildings at the Sêvres porcelain factory, careful excavations were carried out, at the suggestion of Mathieu, who hoped to find similar shoes, it being known that the Gauls under the command of Camulogenus, who were defeated by Labienus, had fled towards Meudon, through the Sêvres valley. The search was successful, shoes being found at a depth of about 9 feet.

It is therefore clear that nailed-on shoes were in use before the Roman subjugation of Gaul, and that several forms of shoe were made; while it seems probable the art was known at more than one centre, and that if the Gauls were not the actual inventors of nailed-on shoes, they at least were the first to practise the art of horse-shoeing. At that time the very light, slender shoe was fastened without the use of clips, the hoof was not pared, and the nails were simply turned over. It is believed that the Druids made and fastened on the shoes for the Gallic warriors.

FIG. 2.—Celtic shoe (after Mégnin).

The period comprised between the Roman conquest of Gaul and the fall of the West Roman Empire in 476, termed by the French the Gallo-Roman period, affords however other examples of shoes. These are found in great numbers in the ruins of this period, associated with coins, weapons, and various other objects, and many are to be seen in the principal museums of Germany, France, Belgium, and England. They resemble those of the Celtic period, and have the same bulging opposite the nail-holes, but are larger and heavier (weighing from 6 to 9 ounces), and therefore appear destined for larger and heavier horses. This might seem to indicate that the breeds of horses were undergoing improvement. The nails had smaller heads, the shanks were always quadrangular, the point never cut, but folded over on the hoof, either in a straight line, or else in the form of a ring. The clenching was incomplete, and resembled that practised at the present day by certain *nomad* tribes and by the Eastern nations.

The shoes found in Switzerland, Germany, and Belgium usually show a distinct fullering, and six to eight nail-holes. The outer border is somewhat bulged, as in the plain shoes. The toe is wide. Many shoes have narrow thick heels, or even calkins. Occasionally there is a toepiece.

In the museum at Avignon is a bas-relief of the second century. It represents two horses drawing a carriage containing three persons—the driver with his whip, a man in Gallic costume, and a lictor provided with his staff of office. The shoes, and even the nails, on the fore-feet of one horse are quite clearly visible. In the Louvre Museum, Paris, there is a bas-relief of a carriage with horses, the first of which is shod on all four feet. The nails are clenched. The general appearance recalls the time of the first Emperor.

The horses of the Roman patricians were not invariably shod, in many cases the front-feet alone being so protected. According to French authors, some of the peoples, more especially those of German origin, included in the Roman Empire, possessed the art of shoeing. The references to shoeing during this period are obscure, and often repose on the evidence of fables and songs. According to one account, St George (who lived about the end of the third century), while in pursuit of a dragon, lost a shoe, and continued the chase until his horse's foot bled. This would indicate that shoeing was known about that time in Germany. A shoe, said to be the one in question, is still exhibited in the Nicolai Church in Leipzig.

The obscurity as to the origin of shoeing was somewhat dissipated by the discovery of shoes in the Roman fortress of Saalburg, near Homburg, in 1870. The castle was built by Drusus a few years before the birth of Christ, and remained more or less continuously in the hands of the Romans until the last quarter of the third century. The shoes there found exhibit calkins in some cases, and are provided with four to eight nail-holes. Whether these shoes belong to a Roman or a Germanic race of this period is still doubtful. The heels of those unprovided with calkins present a certain resemblance to the heels of interfering shoes,—that is, they are deep, and narrower at the ground than at the hoof surface. The shoe figured * is one quarter of the real size, shows no fullering, is from $\frac{5}{8}$ inch to $1\frac{1}{4}$ inch broad in the web, 4 to 5 inches long, and 3 to 4 inches broad over all,—that is, it is below medium size.

Many authors believe that certain tribes in Africa, Asia, and Eastern Europe were already acquainted with and practised horse-shoeing before the dwellers in the Roman Empire. Thus, in the East, the Mongols claim to have shod with iron since the earliest times. Their shoes resemble our bar shoe, save in being fastened by three clips instead of nails. The Arabian shoe is said to be merely a modification of this Asiatic pattern, with the single difference that it is fastened with nails. (Compare Bouley and Reynal, *Dictionnaire de Médecine Vétérin*, 6.)

Shoeing was more widely practised in the Middle Ages. The oldest shoe of the Merovingian time is that from the grave of Childeric, King of the Franks (died 481), which was found in 1653, together with other remains. It was, however, so injured by rust that on being grasped it fell to pieces,—the larger piece has been completed in the figure (fig. 3). Beckmann, and afterwards Rueff, doubted whether this had been a shoe. Rueff, who claimed that it was a portion of a saddle frame, supports his case as follows :—

" So many other portions of harness were present, such as bits and stirrups, that it seems possible the saddle was also interred. Is it not straining the point to believe that, in a grave

* Gohausen and Jacobi (Das Römercastell Saalburg).

where only a horse's head was found and no remains of feet, shoes should have been included as something of particular value?"

The view advanced by Rueff, that the shoes were added by the Alemanni, seems much more probable, because they were addicted to the consumption of horse-flesh, and therefore had better opportunities of discovering the formation of the different portions of the foot (?); and also because the horse being to them an indispensable means of transport in war, they would make it a special study, and seek for a more practical method of shoeing than the hipposandals of the Romans. The excavations of the battlefields of the Alemanni, near Ulm, support this view. Rueff continues:—

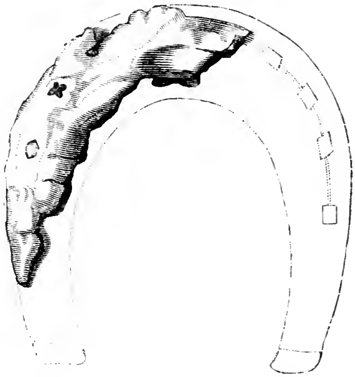


FIG. 3.—Shoe from the grave of Childeric, King of the Franks.

"Compared with other antique shoes, it is narrower at the toe, is unprovided with calkins and toepiece, and has six nail-holes, the punching of which has somewhat bent the outer border of the shoe.

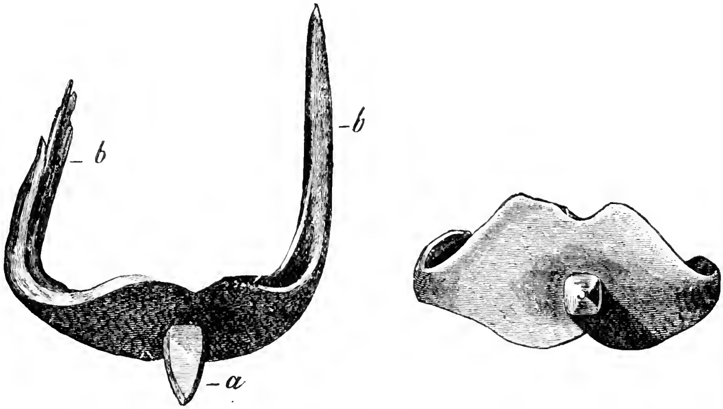
"In examining the graves of the pre-Christian Alemanni, Hassler found one containing the remains of weapons, and close to it a horse-shoe. This has some resemblance to other antique horse-shoes found in the same country; it is broad at the toe, has three nail-holes and quadrangular calkins. The graves date from the middle of the fourth to the end of the sixth century."

Next to this shoe must be placed one found, together with four smaller shoes, at a place of sacrifice near Cavannes, in Switzerland.

In the eighth and ninth centuries horse-shoeing was practised in the Scandinavian peninsula, although in quite a different manner. Professor Dr Olof Pehrson Bendz of Alnarp, South Sweden, states that these shoes, called broddar,* consisted of a kind of cramp with forward prolongations, the points of which

* Brodd. (Swed.) = Frost-nail; broddningen = to shoe.

were driven through the wall of the toe and clenched (figs. 4 and 5). This shoe was found in the so-called "Schwartzen Bodenart," 18 inches below the surface; also in different cairns




FIGS. 4 and 5.—The most ancient Northern shoe, seen from in front and from below. *a*, toe-piece or grip; *b*, points which were driven through the wall of the toe.

in Scandinavia, and in Christian graves, as well as in the Viking ship discovered in Sandefiord, Norway. The horse's skeleton which was excavated had a similar shoe on each foot. In certain parts of Finland these shoes are still used, under the name of Biskari.* So far as we can judge, this broddar shoe was intended more to prevent slipping than for general use.

The first written descriptions of shoeing are found in the Military Regulations of Emperor Leo IV. of Constantinople (ninth century), in which crescent-shaped shoes with nails are specially mentioned. French investigators believe that the farrier's art was introduced into the West Roman Empire at the time of the barbaric invasion by some Germanic race.

After the ninth century shoeing with nails became general, as is shown by precise references. According to Goyau and others, the old law-books like the *Code Venedotien*, *Sachsenspiegel*, and *Gottesfrieden* contain passages referring to horse-shoeing.

Duke Boniface of Tuscany, on his marriage in 1034, had his horse shod with silver shoes. In 1130 the horse of the

* Lungwitz refers to a very old Finnish shoe which was sent to him by Herr Grossman, teacher of farriery in Dorpat. It is only a semicircle, and seems to have been used for the outer half of the hoof. It has a low calkin at either end, and was fastened with nails.

Norwegian King Sigard the Crusader was shod with crescent-shaped golden shoes on his entry into Constantinople.

Father Daniel, however, states in his writings on horse-shoeing, that the hoof was only shod in frosty weather, or when exposed to special wear, as in travelling.

The history of Sicily shows that shoeing was known there in the eleventh century. At that time Sicily was held by the Saracens; and when they disagreed amongst themselves and went to war, the weaker party called in the aid of Grecian cavalry. The combined forces defeated their opponents, who in retreat threw behind them sharply-pointed spikes, in order to hinder the pursuers. But "the horses' feet were so shod that the spikes could not injure them, nor impede the pursuit."

William the Conqueror is said to have found horse-shoeing practised in England on his arrival in 1066, but others believe he introduced it. He commissioned one of his noblemen, Wakelin von Ferrariis, whom he promoted to be Count of Ferrers and Derby, to superintend and encourage the art of farriery. The shield of the Ferrers family carries six black shoes on a silver ground. Their castellan at Oakham, in the county of Rutland, has the privilege of demanding a horse-shoe as tribute from every nobleman or baron of the Kingdom on his first journey through the town. The shoes, together with the giver's name, are affixed to the door of the castle.*

In the year 1214 references are made to the art in French history. On the occasion of bringing Count Ferrand of Flanders to Paris as a prisoner, it is mentioned that "four well-shod horses" drew Ferrand's carriage, — a proof that shoeing was then known. After this time it is frequently referred to, as in the works of Rufo in 1492, of Laurentius Rusius, who in 1531 wrote a work on veterinary science, in which he devoted especial attention to shoeing, the treatment of deformed feet, and to injuries from nails; and especially of Cesare Fiaschi (first edition, 1539), and of Carlo Ruini in 1598.

Fiaschi describes and figures shoes for many varying purposes, his illustrations being the first in the literature of farriery. This author distinguishes not only between front and hind shoes, but between right and left, and between shoes with and without

* This right is still in existence, and was exercised as late as the present year (1897).—Jno. A. W. D.

heels and toepieces, hinged shoes and shoes with rounded toe. He already makes a clear difference between toe, quarter, and heel clips. He employs shoes with rings in the heels in order to give increased shoulder action. It, therefore, seems right to regard Italy as the country of origin of systematic horse-shoeing.

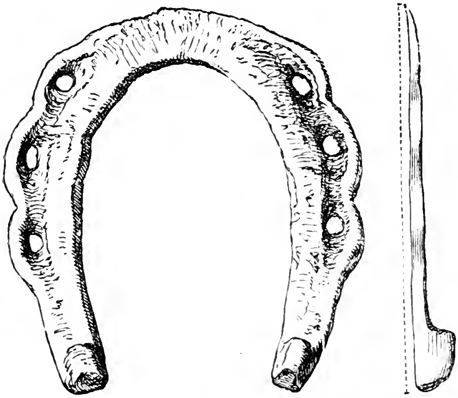


FIG. 6.

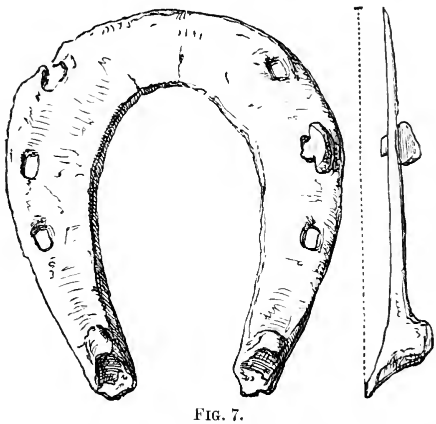


FIG. 7.

FIGS. 6 and 7.—Shoes of the Middle Ages (about the 13th century), found in excavating foundations for the Gymnasium at Borna in 1876.

In Germany the art attained prominence towards the end of the sixteenth century. Seuter of Augsburg in 1598 published a book on the medical care of animals, in which are described special shoes for the treatment of contracted feet.

Most of the ancient horse-shoes found in Germany resemble more or less those shown in figs. 6, 7, and 8. The broad shoes are often described as Swedish, though it is by no means proved that this form originated in Sweden. On the contrary, according to Schmid of Munich, broad shoes had been employed in Germany for a long time before the invasion from Sweden.

In France, in the seventeenth century, appeared Solleysel's *Parfait Maréchal*. This book was translated into many languages, but, according to Veterinary-Surgeon Mégnin, was only a paraphrase of Fiaschi's work. Solleysel's shoe is moderately broad, and provided with eight nail-holes, placed well forward. The author was the first to notice the slipper-shoe, with its bearing surface inclined outwards, named after De la Broue. In Germany, during this century, horse-shoeing was only slightly touched on in veterinary works,—the Thirty Years' War retarding the development and advance of science. With the institution of veterinary schools in the eighteenth century, the farrier's art once more rose to prominence, mainly owing to the discoveries in connection with the anatomy and physiology of the horse's hoof. Towards the close of the eighteenth century the literature of farriery received many important additions; and the improvement of horse-breeding, due to the introduction of Oriental blood, had an indirect though sensibly beneficial action in advancing the art.

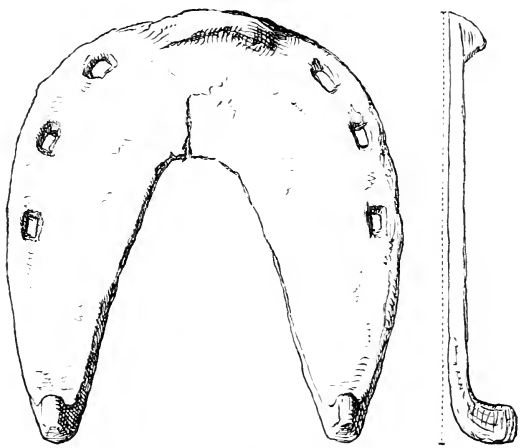


FIG. 8.

In France, during the course of the eighteenth century, a work on horse-shoeing was published by Lafosse the elder, in which was recommended a special shoe,—thick at the toe, thinner towards the heels, flat on the ground surface, and provided with eight nail-holes, equally distributed throughout its extent. Lafosse clearly recognised the advantage of allowing the frog to touch the ground. To minimise slipping on smooth pavement, he suggested a system of shoeing which presents a striking likeness to the Charlier method, introduced a hundred years later. In 1768 Bourgelat, the founder of the first veterinary school at Lyons, described with great exactness the proportions for fore-shoes, and the height of the heels and toepieces. His shoe is long and trough-shaped; and when seen from the side, presents a certain resemblance in outline to a boat. While the French owe to these two authors a large debt of gratitude for their efforts in perfecting horse-shoeing, other European nations have to thank English veterinarians of the end of the eighteenth and beginning of the nineteenth centuries for much of the improvement then observable. Up to the end of last century the farrier's craft depended upon very defective anatomical knowledge, while it had absolutely no physiological basis. Shoeing was done by rule of thumb.

J. Clark first drew attention to the elasticity of the hoof, and was followed by Osmer, Coleman, Moorcroft, and Goodwin, who invented shoes differing completely from those previously employed. Most of these were fashioned with a knowledge of the elasticity of the hoof, as is shown by their horizontal and seated-out foot surface ; Goodwin's is the only shoe concave on the ground surface, but like the others it shows a completely level bearing for the hoof and a rounded toe.

Goodwin was the first to use seven, instead of eight nail-holes, four being on the outer and three on the inner side, as shown in his illustrations.

The greatest impression, however, was produced by Bracy Clark's writings on the general anatomical formation of the foot and the elasticity of the horny box. This author advanced the theory of the expansion of the posterior portion of the hoof during movement, and the simultaneous sinking of the frog and flattening of the sole, from which originated many new views and experiments. On it he founded the use of a shoe hinged at the toe, by which he sought to allow of expansion and contraction when weight was placed on or removed from the foot. Although his shoe met with little acceptance, Clark rendered great service by drawing attention to the injurious contraction of the foot which followed the existent system of shoeing. He advocated turning out horses unshod in order to promote expansion of the foot, and made important contributions to the study of laminitis. His views on the changes of form produced in the hoof by pressure were adopted by the Germans and French, and provided a scientific basis for the practice of farriery.

Until the middle of the present century the German horse-shoe was almost always provided with calkins and usually exhibited eight nail-holes. It was very broad, and had open heels, the inner of which was about one-third thinner than the outer heel. In short, it was far from conforming to the shape of the hoof, and had many bad points. Well-formed shoes, like well-formed hoofs, were rare; and whilst in many parts of England great progress had been made, Germany continued in the old ways. Only Hanover, which for a long time had been under English influence, presented any exception. The hoof was prepared for the shoe to such a degree that the sole could be indented with the finger, and was excessively weakened. The toe was usually left too long in proportion to the heels, and heavy badly-shaped shoes which pinched the heels were applied. Even model shoes of this period exhibit many defects. In spite of a number of good books on farriery, such as those of Dieterich, Gros, and Straus, in which the functions and anatomy of the foot are described, the art of farriery was much neglected, and farriers, as a class, were wanting in the knowledge necessary to combine science with practice.

At the beginning of 1840 an attempt was made to introduce from France the method of hot fitting, and the use of Riquet's podometer, but although previously employed for many years in the French army, these were soon given up in Germany, because of their unpractical nature. Nor did Pauly's attempt to dispense with nails meet with any greater success.

In 1852 a further stimulus to the art was given by English influence in Miles's *brochure* on *The Horse's Hoof, and how to keep it Healthy*, the 7th edition of which was translated by Guitard. This book gradually produced an entire change of views. Miles was the first to show how the shoe should be fitted to the foot, and how it should be made in order to preserve the elasticity of the hoof when shod: he recommended six nail-holes, but used only five nails; and he suggested rounding the toe, so as to conform to the natural wear of the hoof. Although much of his teaching is erroneous, his writings have an enduring value. Even at the present day their influence can be distinctly seen in the shoeing system of the Austrian army.

In Saxony, Hartmann's attempts to break with old traditions are worthy of notice. Hartmann and Leisering's work on the horse's foot, published at Dresden in 1861, produced a marked impression, both on account of the excellent illustrations relating to the anatomy and physiology of the foot, and of the principles set forth in the second part for the practice of shoeing. Hartmann's shoe resembled the English in regard to its fullering and seating, but its fitting and bearing surfaces were more like the French pattern. This author maintained the importance of the frog bearing weight. Count von Einsiedel, a contemporary of Hartmann, took up the purely physiological position. The system of shoeing named after him is based on the views of the English authors Miles and Field. He recommended for front-feet a heelless shoe, of equal breadth throughout, the ground and bearing surfaces horizontal, well seated out, moderately rounded at the toe, and having somewhat finely punched nail-holes: for hind-feet the 'interfering' shoe. His exertions largely contributed to the improvement of shoeing in Saxony and Prussia.

Charlier's system, inaugurated in 1865, which consists in sinking the shoe in the wall of the hoof, thus surrounding the hoof like a ferrule, produces precisely the opposite effect to that desired. Instead of preserving the hoof it destroys it. Goodenough's method, published in 1869, was less injurious, but only suited to particular purposes. Its object was to promote the natural function of the horny sole and frog. The shoe has five prominences on its ground surface. In 1879 this method was revived, without, however, achieving any great success.

Dominik took up a purely theoretical standpoint in regard to shoeing. He believed that the wall of the hoof should always be supported at right angles by the upper surface of the shoe. The idea, however, is not practicable. Nevertheless, his observations on the action of animals before and after shoeing, and his demonstrations, proved of great service.

Since 1869 various methods of roughing have been introduced, and have proved almost indispensable in cold countries. The American, Judson, invented the round frost cog. Dominik made some, but preferred the quadrangular form, as being simpler to produce. Since that time both varieties have been successfully employed.

But no improvement in farriery can be of service until incorporated in the daily practice of the shoeing-smith; and, abroad, this has only been possible since the foundation, in the middle of the present century, of colleges for the instruction of farriers. Previous to this, only students attending the Veterinary Colleges had received instruction, but at the present time special institutes exist throughout Germany, having trained teachers and a thorough syllabus, in which theory and practice are united. The first School of Farriery was erected at Gottesaue, near Karlsruhe, in 1847. In Saxony the military authorities soon followed suit, and to provide capable shoeing-smiths for the army, military farriers were, in 1849, appointed to the position of teachers of horse-shoeing in the Veterinary School at Dresden. The same arrangement still exists. Since 1853 courses of instruction in horse-shoeing for civil farriers have been given in Hanover, and since 1857 in Dresden. From 1858 to 1869 the authorities in Saxony imposed an examination, that is to say, every person who wished to practise farriery was obliged to pass an examination in the Royal Veterinary School. In 1860 Count von Einsiedel's School of Farriery was appointed the Government School for Upper Lusatia. Since 1864 H. Behrens has conducted a teaching school in Rostock. Military schools of farriery were founded in Berlin in 1868, in Königsberg in 1874, in Breslau in 1875, in Hanover in 1886, and in Bockenheim, near Frankfort-on-the-Main, in 1890. In 1870 the school at Altona was opened, and in 1877 the Agricultural Union at Griefswald founded one in that town. In Bavaria the first military school arose in 1874. Schools for civilians existed in Munich and Würzburg in 1875. In Austria there are military institutions of this kind in Vienna, Brünn, Olmütz, Prague, Lemberg, Graz, Laibach, Buda-Pesth, Comorn, Temesvar, and Hermannstadt; schools for civilians in Vienna, Lemberg, Graz (1883), Klagenfurt, and Laibach. In addition, classes are occasionally held in different districts.

Similar institutions exist in Denmark, Sweden, Russia, and the Balkan Peninsula. They teach shoeing, promote and encourage exhibitions of farriery, carry out competitions, etc., and their objects are set forth in special publications, such as *Der Hufschmied.* The great importance attached to good shoeing by the German Government is shown by the fact that the Imperial law of 1883 allows the allied States to make it incumbent on all persons engaged in the practice of farriery to possess a certificate of examination. In consequence, all the countries included in the German Empire have passed similar laws and have instituted schools.

In regard to horse-shoeing, Saxony has again attained the position which it occupied before 1869. Since the political renaissance of Germany, and especially since the foundation of an Imperial Patent Office in Berlin, the farrier's art has been the subject of a great number of discoveries and inventions. In every department novelties have been introduced. Iron is no longer considered sufficient for shoeing: organic materials, such as leather, cloth, oakum, rubber, gutta-percha, felt, wool, straw, horn, cork, wood, and so on, have been used, either alone or in combination with iron, and inventions continue to be produced.

The efforts to prevent the many evils inherent in our methods of shoeing are well indicated by these devices, which aim at minimising strains, slips, and injuries to the limbs. Patents are exceedingly numerous. Many refer to movable toepieces and heels and to nailless shoes. There are also shoes to be applied with cement, shoes with special nails, and shoes to insure regular distribution of weight, etc.

The methods of shoeing have thus become so numerous that the ordinary farrier, and even the veterinary surgeon, can scarcely keep himself informed as to what is or is not of value, the more so as no critical treatise has yet appeared on the subject. Many of these discoveries are absolutely worthless; many more are exceedingly questionable. Very few are really valuable or of great promise, but machine-made nails, various forms of rubber pads, and, especially, machine-made shoes mark undoubted advances. The reason so few of these inventions are of real worth is the difficulty of exactly fitting them to the foot. The majority of inventors have incorrect impressions of horse-shoeing, and especially of the formation of the foot, otherwise they would certainly have spared themselves the pains, time, and money which they have expended.

It is much to be regretted that the only body in England claiming to be representative of farriery, viz., the Worshipful Company of Farriers of London, when in 1890–91 carrying into operation a scheme for the registration of shoeing-smiths, omitted to put into operation the most promising clauses of their published programme, and instead of assisting practical teaching or apprenticeship, or founding one or more teaching schools, substituted a short theoretical examination under which hundreds of farriers (*sic*) were enrolled. The attention of the public was drawn to the matter, and a reorganisation attempted, but unfortunately not until confidence in the value of the Company's certificate had been lost. This is the more unfortunate, as it must, for many years to come, have a most prejudicial effect on any effort made to improve the farrier's art in England.

Considering the scope and difficulties of the art of shoeing, it is desirable that the efforts made during the last fifteen years by the Royal Agricultural Society and other bodies to produce good practical and theoretical farriers should be still further extended, so that the workman may fit and apply the shoe with knowledge of the effect it will produce on the foot and limb. Without awarding the preference to any particular system of shoeing, it may be said that that most deserves it which least alters the condition and form of the hoof, which is simplest, and which adapts itself most readily to varying requirements.

# PART I.

# THE STRUCTURE AND FUNCTIONS OF THE FOOT.

## SECTION I.

## THE STRUCTURE OF THE FOOT.

### GENERAL REMARKS ON THE HORSE'S FOOT.

THE lower portion of the horse's limb is called the foot. As the horse is of little value to man except as a beast of draught or burden, and as the lower portions of the limbs are chiefly concerned in movement, the foot is one of the most important parts of the horse's anatomy. The reason the horse's foot is subject to so many diseases is to be sought in the strains and many injurious influences to which it is exposed both when the animal is at rest and when moving, and also in the injury done by defective shoeing and ignorant attempts at treatment. Many diseases could be avoided if the foot were regarded not as a dead mass but as a living and highly organised portion of the limb, which would not lightly bear interference and unnatural treatment, while many more would be more easily and rapidly cured if the structure and functions of the parts were clearly kept in view.

It is, therefore, very desirable that owners and attendants should have some knowledge of this portion of the animal's anatomy, while to the shoeing-smith, whose duty it is to keep sound feet healthy, and to the veterinary surgeon, who has to convert diseased into sound feet, a thorough acquaintance with it is an absolute necessity.

The parts of the limb to be included under the term "foot" depend on the purpose with which the expression is employed. Some persons regard "foot" as including only the portion of the limb enclosed in the horny capsule. Others, again, extend the term to those structures in the horse which correspond to the foot of man, that is, the metatarsus or metacarpus and all below it, though, according to this view, the horse's fore-foot should include the knee, and the hind-foot the hock

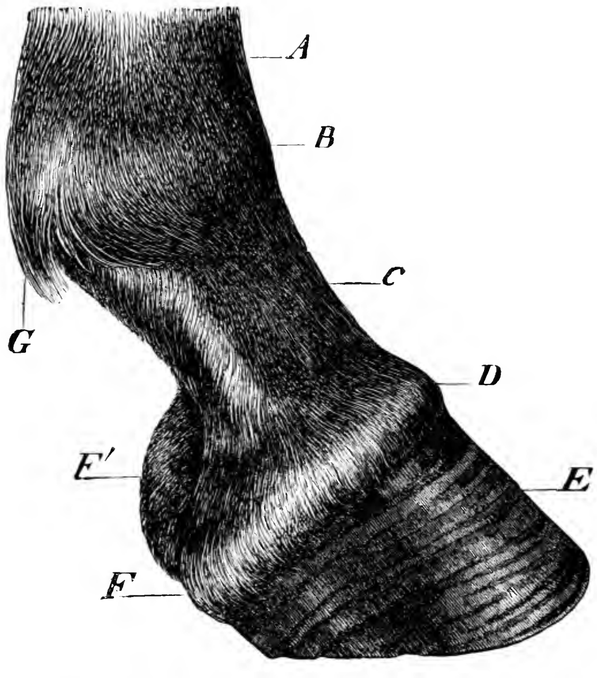



FIG. 9.—Postero-lateral view of right fore-foot. *A*, lower end of metacarpus; *B*, fetlock joint; *C*, suffraginis or pastern bone; *D*, coronet; *E*, hoof; *F* and *F′*, outer and inner bulb of the heel; *G*, small corneal growth at back of fetlock.

joint. Leisering's definition, which is here followed, covers more than the portions surrounded by the horny capsule, though holding it unnecessary to take into consideration the entire limb from the knee or hock. It includes the fetlock joint and parts of the limb below, *i.e.*, the structures corresponding to the finger or toe of man.

These parts are represented in fig. 9.

Externally we distinguish the lower end of the metacarpus (*A*): the fetlock joint (*B*); the suffraginis (*C*); the coronet (*D*): the hoof and parts included therein (*E*): and the bulbs of the heels (*F*).

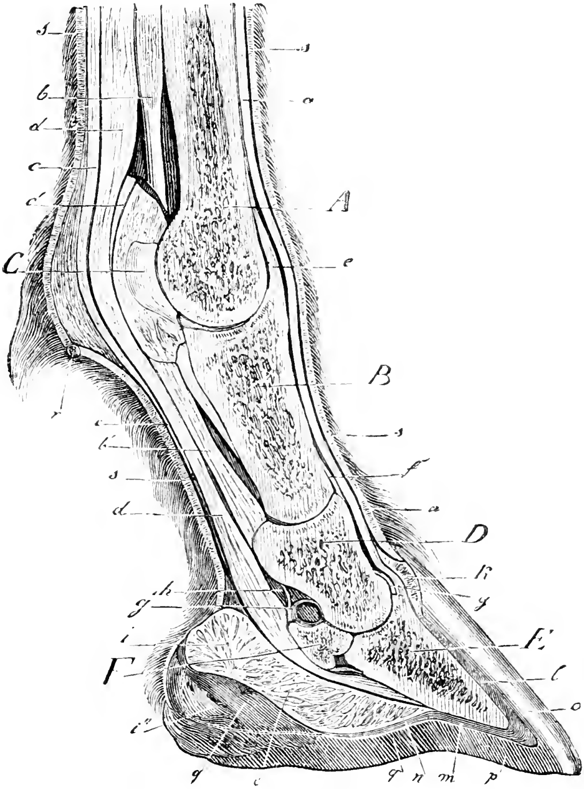



FIG. 10.—Perpendicular mesial section of right fore-foot (the position of the lower bones is shown rather too upright). *A*, lower end of great metacarpus: *B*, suffraginis or pastern bone: *C*, inner sesamoid bone (to render the bone visible, a portion of the intersesamoidean ligament has been removed); *D*, coronet bone; *E*, pedal bone: *F*, navicular bone: *a*, extensor pedis tendon; *b*, superior sesamoidean or suspensory ligament; *b′*, inferior sesamoidean ligament: *c*, flexor pedis perforatus tendon; *c′*, great sesamoid sheath: *d*, flexor pedis perforans tendon: *e*, capsular ligament of the fetlock joint; *f*, capsular ligament of pastern joint: *g* and *g′*, capsular ligament of coffin joint; *h*, bursa of flexor pedis perforans: *i*, plantar cushion; *i′*, portion of plantar cushion forming the bulbs of the heel: *k*, coronary band: *l*, sensitive wall; *m*, sensitive sole: *n*, sensitive frog; *o*, horny wall; *p*, horny sole: *q*, horny frog; *r*, ergot at base of fetlock; *s*, skin.

At the first glance the horse's foot, as represented in fig. 9, might appear to one who had not studied its construction to be exceedingly simple. By making a perpendicular mesial

LOWER SURFACE OF HORSE'S HOOF.
FORE FOOT.

section of the foot, however, as shown in fig. 10, the erroneous character of such a conclusion is evident, and yet this section exhibits only a few of the structures constituting the foot. In order to become acquainted with the form and functions of the foot, one must study each part separately and in a certain order.

Many writers on the horse's foot begin with the external parts and gradually proceed to the deeper seated. With some care all the anatomical structures can thus be demonstrated on one foot, but much then remains doubtful which would certainly be clear by observing the opposite process; for this reason we commence our description of the foot with the bones.

# CHAPTER I.

## THE BONES OF THE FOOT.

We have agreed to consider the horse's foot as beginning at the fetlock joint, and have, therefore, to study (1) the lower end of the great metacarpus; (2) the suffraginis bone; (3) the two sesamoid bones; (4) the coronet bone; (5) the pedal bone; and (6) the navicular bone. The relations of these bones are shown in fig. 11, and those of the bones to surrounding parts in fig. 10.

### 1. The Lower End of the Great Metacarpus. (Figs. 10 and 11, *A*.)

The metacarpus or cannon is the long bone which begins at the knee, and is continued downwards in an almost perpendicular direction to the fetlock joint. Its lower end presents an articular surface extending from side to side, covered with articular cartilage and rendered irregular by three prominences and two depressions. The middle prominence or ridge extends furthest forward, and is the highest both in front and behind. The lateral prominences are broader, and are separated from the middle prominence by two shallow depressions. At the sides of the lower end of the metacarpus are two rough grooves for the attachment of ligaments. The articular surface is in contact with that of the os suffraginis both in front and below, while behind and below the joint is completed by the anterior surfaces of the sesamoid bones.

### 2. The Suffraginis Bone or First Phalanx (Figs. 10 and 11, *B*; Figs. 12 and 13, *A*)

Extends between the great metacarpus and coronet bone or second phalanx in an oblique direction downwards and forwards, and forms with the metacarpus an angle of about 130 to 140 degrees. In the hind-limbs this angle is greater than in the fore, being usually about 150 degrees. The suffraginis bone is, roughly, one-third the length of the metacarpus, though a slight difference exists in this respect between the fore and hind limbs, the metacarpus being somewhat shorter than the metatarsus. The suffraginis bone is divided into an upper, middle, and a lower portion.

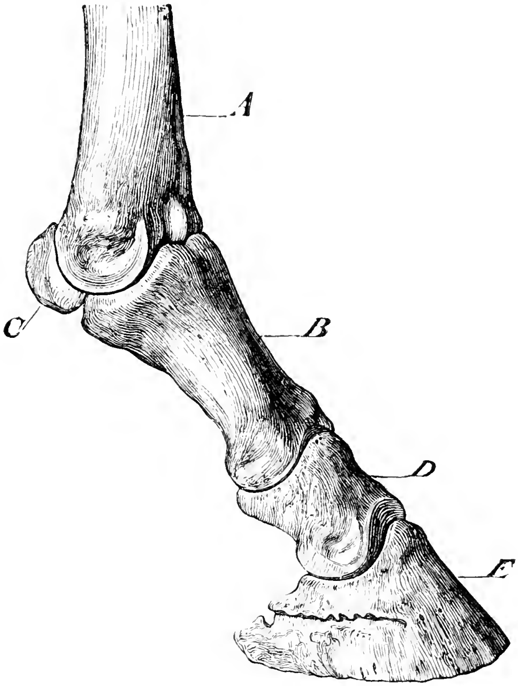


FIG. 11.—Antero-lateral view of bones of foot. *A*, lower end of metacarpus; *B*, pastern; *C*, outer sesamoid; *D*, coronet; *E*, pedal bone.

The upper portion is the strongest, and presents an articular surface (fig. 12, *a*), which is surrounded by a somewhat prominent border. It responds exactly to the anterior half of the lower extremity of the metacarpus or metatarsus. The centre of its articular surface presents a marked depression for the middle prominence of the metacarpus or shin bone, and on either side two shallow depressions for the lateral prominences of the shin bone. The mass of bony tissue forming the upper part terminates on either side in a prominence directed backwards and outwards, to which the ligaments of the joint are attached.

The middle portion possesses an anterior, a posterior, and two lateral surfaces. The anterior is slightly rounded and fairly smooth; the posterior is flatter, and exhibits a well-marked roughened triangle (fig. 13, *a*). This runs from each of the lateral prominences already mentioned in a downward direction almost as far as the lower end of the bone. The triangular surface thus formed is rough for the insertion of ligaments. The lateral surfaces of the bone are rounded and very rough towards the base.

The lower end of the bone is smooth and covered with carti-

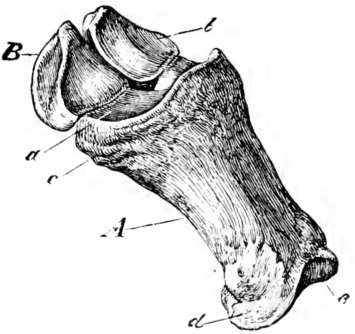



FIG. 12.—Pastern and sesamoideal bones seen from same point as fig. 10. *A*, pastern; *B*, sesamoid bones; *a*, upper articular surface of pastern; *b*, do. of sesamoids; *c* and *d*, rough surfaces for insertion of ligaments; *e*, lower articular surface.

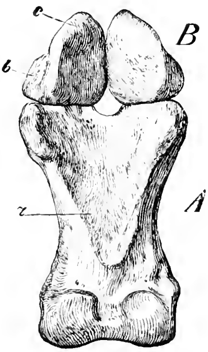



FIG. 13.—Posterior view of pastern and sesamoid bones. *A*, pastern; *B*, sesamoids; *a*, rough triangle for ligamentous insertion; *b*, surface for insertion of superior sesamoidean ligament; *c*, surface covered (in life) by intersesamoidean ligament.

lage. Its centre presents a slight depression (fig. 12, *e*), and on either side a prominence, the inner being somewhat larger than the outer and projecting rather further backwards. Above these prominences are rough surfaces for the insertion of ligaments (fig. 12, *d*).

## 3. The two Sesamoid Bones
### (Figs. 10 and 11, *C*; Figs. 12 and 13, *B*)

Are small rounded pyramidal bones lying at the back of the lower portion of the great metacarpus. They appear to continue the suffraginis bone. Each has three surfaces, a summit and a base. The anterior surface (fig. 12, *b*) is slightly concave, almost triangular, and covered with articular cartilage. The opposed borders of the two bones are so rounded off that when in position they enclose a groove corresponding to and continuing the central groove on the upper end of the suffraginis bone. The two sesamoids, combined with the suffraginis bone, form a surface which responds to that of the great metacarpus, with which they are in contact. The outer surface of the external sesamoid and the inner surface of the internal are very rough, and show marked depressions for the insertion of ligaments. The two remaining surfaces of the bones (fig. 13, *c*) are convex and smooth; in front they are in contact, posteriorly they recede more and more from each other, and when in position form a groove filled with cartilage in the living animal, over which the flexor tendons play.

The upper end or apex is pointed and formed by the convergence of all three surfaces. The lower end or base is rounded off.

### 4. The Coronet Bone or Second Phalanx (Figs. 10 and 11, *D*; Figs. 14 and 15)

Lies below the suffraginis but above the pedal and navicular bones. It is approximately one-half the size of the suffraginis. In form it resembles a cube, slightly compressed from before to

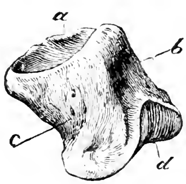



Fig. 14.—Antero-lateral view of coronet bone. *a*, upper articular surface; *b*, anterior surface; *c*, lateral surface; *d*, lower articular surface.

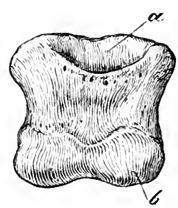



Fig. 15.—Posterior view of coronet bone. *a*, smooth facet, over which the flexor pedis perforans tendon glides: *b*, lower articular surface.

behind. It, therefore, presents six surfaces. The upper and lower are for articulation; the upper shows two lateral depressions and a very slight central prominence; the lower (figs. 14 and 15, *b*) in this respect resembling the lower end of the suffraginis bone, two lateral prominences and a central depression. The anterior edge of the upper articular surface exhibits a broad, low projection. Towards the sides this edge is sharp, behind strong and rounded; powerful ligaments are attached to it. Behind is a smooth area (fig. 15, *a*), which serves as a gliding surface for the flexor pedis perforans tendon. The anterior and posterior surfaces (figs. 14, *b*, and 15) are, when healthy, tolerably smooth, and are perforated with a multitude of little holes. The lateral surfaces (fig. 14, *c*), on the other hand, are always rough.

### 5. The Pedal Bone or Third Phalanx (Figs. 10 and 11, *E*: Figs. 16, 17, 18)

Is the lowest bone of the foot, and is entirely surrounded by the hoof and by soft tissues. It presents three surfaces, three prominences, and three borders. The anterior surface responds to the wall of the hoof (fig. 16, *a*, and fig. 17). In general, it takes the same form as the hoof, that is, it is convex from side to side, is crescent-shaped, and runs obliquely downwards and forwards or outwards. The anterior part of the upper border shows a marked prominence, which has been called the coronoid process, but has been more correctly described as the pyramidal process of anatomists. The backward continuation of the outer surface forms on either side a process, termed the wing of the pedal bone (fig. 16, *c.c*).

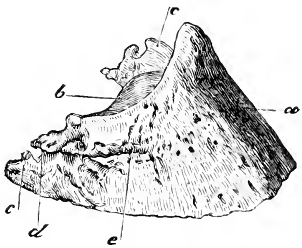
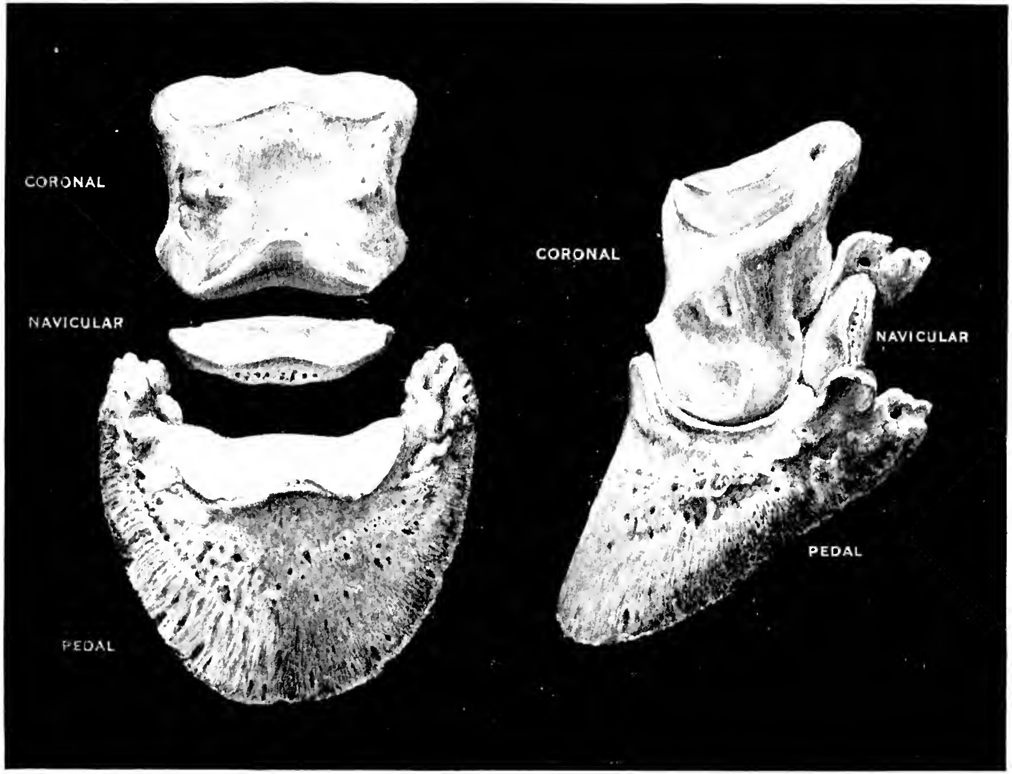


Fig. 16.—Antero-lateral view of pedal bone. *a*, anterior surface, which is prolonged upwards to form the pyramidal process; *b*, upper or articular surface; *c*, outer wing of pedal bone; *d*, notch, which in cases of "sidebone" is often converted into a foramen. The portion of the wing above this is termed the basilar, that below the retrossal process; *e*, preplantar groove.

The coronoid or pyramidal process is the highest point of the pedal bone; from it the borders gradually descend backwards towards the wings. Each of the wings is marked by a deep depression, the preplantar groove, which extends forwards to about the centre of the quarter, where it disappears. This surface is pierced by a large number of holes and fine grooves giving the bone an appearance somewhat resembling pumice-stone.

The *upper surface* (fig. 16, *b*, and fig. 17) is for articulation with the coronet bone, but being too small to engage with the whole articular surface of that bone, it is completed behind by the navicular bone. As a whole, this upper surface is crescent-shaped, and falls rapidly away in a backward and downward direction. The centre shows a slight prominence, the sides




*THE BONES OF THE FOOT.*

*To face p.* 28.]

shallow depressions. On the posterior edge of this surface is a narrow elongated facet, to which the navicular bone is applied (fig. 24). The lower or plantar surface (fig. 18) is slightly concave, so that when the bone is resting on a plane only the external margin actually touches it. This surface presents two half-moon-shaped portions, of which the posterior is smaller and thrust into the anterior. The anterior (fig. 18, *a*) is covered by the sensitive sole and is fairly smooth; at the back, however, where the body of the bone becomes continuous with the wings (fig. 18, *b*), it is rough and full of holes. The posterior, and smaller, portion appears as though cut out of the anterior; and the border (fig. 18, *c*) which divides it from the anterior part is rough for the insertion of the flexor pedis perforans tendon. In the centre, close behind this border, is a protuberance consisting of firm, bony substance, and serving for the insertion of a ligament.

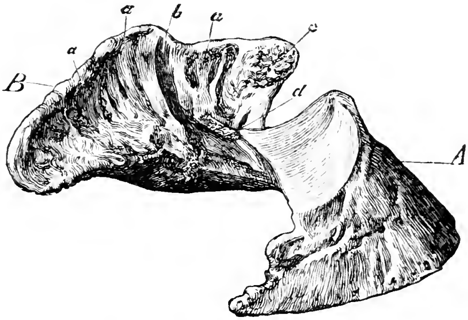



FIG. 17.—Postero-lateral view of pedal bone; in this figure the entire upper surface is not visible. *B*, inner lateral cartilage.

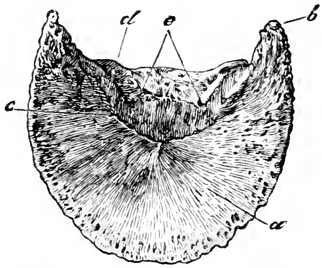



FIG. 18.—Inferior surface of pedal bone. *a*, anterior portion covered in life by sensitive sole; *b*, wing of pedal bone: the part shown is retrossal process; *c*, rough crescent-shaped portion for insertion of flexor pedis perforans; *d*, plantar groove leading to *e*, plantar foramen.

On either side of this protuberance is the mouth of a canal (fig. 16, *d*), the plantar foramen, from which a groove, termed the plantar groove, runs. These canals are continued into the interior of the pedal bone and meet, forming a semicircle, from which are given off in various directions numerous small secondary canals. The grooves, holes, and canals permit of the passage of blood-vessels and nerves (compare fig. 38).

The coronoid or pyramidal process, already mentioned, serves for the insertion of the extensor pedis tendon. The two wings of the bone are most widely separated at the back (fig. 16, *d*). Each wing is divided by a notch, continuous with the preplantar groove, into an upper and lower portion, though in old horses the two parts may be united by exostoses, and instead of a notch a hole alone exists. To the wings are attached the lateral cartilages (fig. 17, *B*), which we shall afterwards describe more fully. It not unfrequently occurs that these cartilages become ossified, especially at their point of origin, causing the wings of the bone to appear much larger than they really are.

The three borders of the pedal bone are: an upper, a lower, and a posterior. The upper border runs from one wing to the other, first in a forward and upward, then in a downward and backward, direction, and divides the articular from the anterior surface. It is continued over the pyramidal process, and is somewhat excavated and rough on either side for the insertion of ligaments.

The lower border divides the anterior from the plantar surface, and is sharp and well-defined. Its centre point often shows a slight notch. As the os pedis is somewhat inclined in the normal position of the hoof, as shown by the section (fig. 10), the anterior part of this border is the lowest portion of bone in the limb. Just above the border are a number of large holes for the passage of arteries.

The posterior border divides the articular from the plantar surface, and runs obliquely from one wing of the os pedis to the other. Posteriorly, it is in contact with the navicular bone.

## 6. The Navicular Bone.

(Fig. 10, *F*, and Figs. 19 and 20.)

This is a short, transversely elongated bone placed between the wings of the pedal bone, articulating with the posterior edge of its upper surface, and assisting to form the cavity for the reception of the lower end of the coronet bone. It possesses an anterior and a posterior surface, an upper and a lower edge, and an inner and an outer extremity.

The anterior surface is also directed slightly upwards, and is covered with articular cartilage. A vertical ridge divides the surface into two unequal portions, the inner of which is the larger; both are concave, and with the ridge continue posteriorly the conformation of the articular surface of the pedal bone. The posterior surface is more extensive than the anterior, and it looks downwards as well as backwards. Generally it resembles the anterior, but is not so smooth. Over this surface the flexor pedis perforans tendon plays. Of the two edges the upper is less extensive, rough and porous in appearance, and receives the insertion of the postero-lateral ligaments of the coffin joint. (To be afterwards described.) The lower edge is divided into two portions—one, the anterior, carries a narrow, elongated smooth area for articulation with the pedal bone, the other, or posterior portion, is rough, showing the openings of numerous small canals, and provided for the insertion of the interosseous ligament that binds the navicular to the pedal bone. The two extremities of the bone, inner and outer, are bluntly rounded and tapering, and show nothing worthy of note.

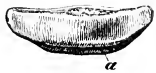



Fig. 19. — Antero-superior surface of navicular bone.

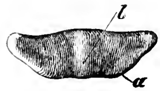



Fig. 20.—Postero-inferior surface of navicular bone. a, anterior border; b, tendinous surface.

The foregoing remarks on the bones of the foot apply equally to the fore and hind extremities. It need only be remarked that the bones of the hind foot are somewhat longer and more slender than those of the fore. The posterior os pedis, being laterally compressed, has a more upright appearance, while its plantar surface is more concave than that of the fore-limb.

# CHAPTER II.

## THE LIGAMENTOUS STRUCTURES OF THE FOOT.

The tissues connecting the bones of the foot are termed ligaments. The capsular ligaments surround all the bony elements of the joint like a sheath or capsule, and consist of two superposed layers.

The external layer is firm and fibrous, and in certain of the joints is exceptionally developed. It may be regarded as a prolongation of a portion of the periosteum from one bone to another.

The inner or synovial layer is a soft, delicate, and vascular tissue, which clothes the interior of the outer sheath, and is intimately connected with it. This sheath, however, is not continued on to the articular surface of the bone, as was formerly supposed, and, therefore, does not form in itself a closed sack. Its function is to secrete the fluid which lubricates the joint and facilitates movement. This fluid is mucoid and sticky, closely resembling egg-albumen, is of a yellowish-white or yellowish-red colour, and is termed synovia or joint oil.

The lateral and other ligaments consist of whitish, glistening, fibrous material, and form strong bonds of union, varying in thickness and length, between one bone and another. They possess enormous strength, so that they rarely rupture, the bones into which they are inserted usually breaking more readily than the ligaments. Their points of attachment on the bones are usually rough and uneven.

The joints we have been considering are known as ginglymoid or hinge-like, and only permit of flexion and extension. Movement is certainly considerable, but only occurs in one plane. Lateral displacement is either impossible or only practicable in a very slight degree. Such articulations may be compared to those of a pocket-knife or of a door. In a ginglymoid joint a convex surface glides upon a concave surface (the two surfaces being more or less adapted one for the other).

To facilitate this backward and forward movement it is necessary that the surfaces be smooth, and that they be lubricated. Both requirements have been provided for in the most complete manner. The articular surfaces are covered by cartilage, which, whilst very smooth, possesses a certain elasticity. The lubricating fluid is supplied by a peculiar secreting membrane, which we shall consider later.

The horse's foot presents the following joints :—(1) the fetlock joint; (2) the coronet joint; (3) the pedal joint. The ligaments are shown in figs. 21 to 23, to which the under-mentioned letters refer.

## 1. The Fetlock Joint.

In this joint the lower end of the metacarpus forms the upper articular surface. The upper end of the suffraginis bone and the anterior surfaces of the sesamoid bones are so combined that the articular surface of the suffraginis forms the anterior, the sesamoid bones the posterior, portion of the lower articular surface. To attain the necessary strength, this joint is provided with numerous strong ligaments.

(*a*) All the bones which contribute to the formation of the fetlock joint are enclosed by a synovial membrane (fig. 10, *e*). This surrounds the lower end of the great metacarpus and the upper end of the suffraginis bone throughout their entire extent, but in the case of the sesamoid bones is only inserted around the articular borders. Behind, a portion extends between the great metacarpus and the superior sesamoidean ligament: its walls are very thin. Anteriorly, however, between the metacarpus and suffraginis bones the walls are thick, and are attached at either side to the lateral ligaments. Another part of this capsule closely surrounds the flexor tendons.

(*b*) The great metacarpus and suffraginis bones are connected by an inner and an outer lateral ligament. Each of these consists of a comparatively weak, superficial layer, which arises from the lateral surface of the lower end of the metacarpus and extends to the middle of the suffraginis bone, and of a deeper, short but very strong, layer, which arises from the depression at the lower end of the metacarpus, and becomes attached to the rough spot on the side of the upper end of the suffraginis bone, and partly also to the excentric surface of the sesamoid.

(*c*) The connections between the sesamoid bones are much more complicated than those of the bones hitherto regarded.

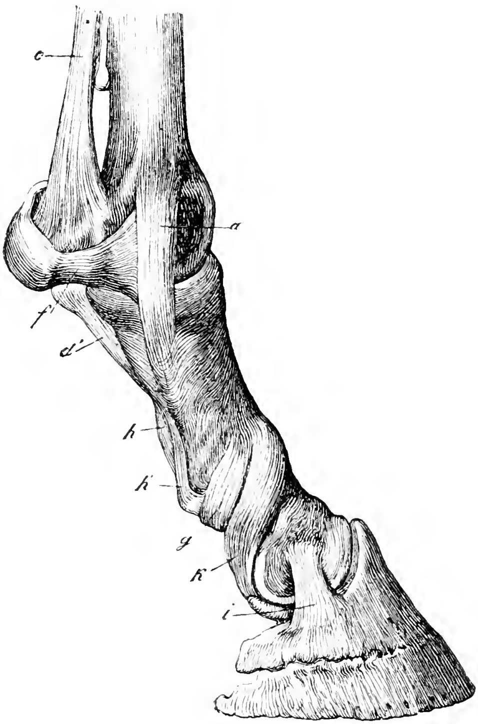



FIG. 21.

Fig. 21 shows the bones of the foot and their ligaments viewed from the side, figs. 22 and 23 viewed from behind. The letters indicate same parts in each figure. *a*, external lateral ligament of pastern joint; *b*, intersesamoidean ligament; *c*, superior sesamoidean ligament; *d*, middle limb of inferior sesamoidean ligament; *d'*, lateral limb of do.; *e*, cruciate ligament; *f*, lateral sesamoidean ligament; *g*, outer lateral ligament of the pastern joint; *h* and *h'*, posterior corono-suffraginal ligaments; *i*, outer lateral ligament of pedal joint; *k*, postero-lateral ligaments of navicular bone; *l*, fibrous sheath of synovial membrane of coffin joint.

(1) The sesamoid bones are connected with one another by means of an inter-sesamoidean ligament (*b*). This connection is so strong as almost to convert the two sesamoids into one mass, and to render movement between them out of the question.

The inter-sesamoidean ligament consists of very strong, fibrous tissue (with an admixture of white fibro-cartilage), the fibres of which run obliquely between the opposing surfaces and completely fill the space which would otherwise exist between the bones. This tissue is prolonged upwards above the sesamoids, forming an oval mass which posteriorly is somewhat concave and markedly exceeds in size the sesamoid bones themselves. The posterior surface is very smooth and permits of the tendon of the flexor pedis perforans and of the encircling fibres which the flexor pedis perforatus gives to the perforans at this point, gliding freely over it.

(2) Above, the sesamoid bones are attached, or perhaps we should say slung, through the medium of the superior sesamoidean or suspensory ligament (*c*, and fig. 10, *b*, and fig. 25, *b*). This is a very strong tendinous cord, the substance of which

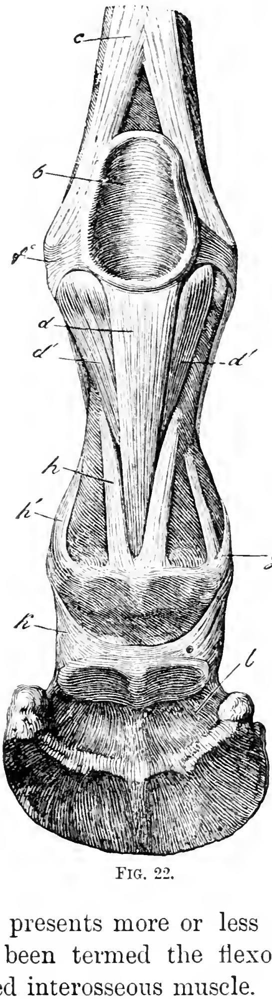



Fig. 22.

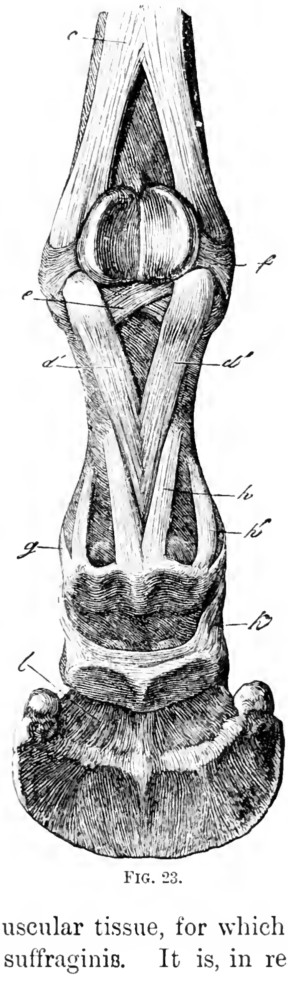



Fig. 23.

always presents more or less muscular tissue, for which reason it has been termed the flexor suffraginis. It is, in reality, a modified interosseous muscle.

Its upper end is attached, in the fore-limb, behind the knee, in the hind-limb, behind the hock, and becomes continuous with the other ligaments covering the posterior surfaces of these joints. From this point it runs downwards immediately in contact with the posterior surface of the metacarpus, lying between the two small metacarpals. At the lower third of the metacarpus it divides into two portions, which become attached to the corresponding surfaces of the sesamoids. From this point each division gives off a considerable reinforcing band, which runs in an oblique direction downwards and forwards, to become continuous with the extensor pedis tendon at the front of the suffraginis bone. This is the "ligamentum extensorum" of Percivall.

(3) The sesamoid bones are attached below by two ligaments, the inferior sesamoidean ligament and the cruciate ligament. The inferior sesamoidean ligament (*d* and *d′*, and fig. 10, *b′*) is a strong band, in which three parts may be distinguished. The middle portion (*d*) (superficial inferior sesamoidean ligament of M'Fadyean) is the most superficial; it arises at the lower end of the two sesamoid bones and runs, more or less covering the two lateral portions, with which it is connected by a few fibres, in a downward direction to be inserted into the strong posterior margin of the upper surface of the coronet bone. Here it becomes intimately united with the two limbs of the flexor pedis perforatus tendon, forming one mass.

The two lateral limbs (*d′*) (middle inferior sesamoidean ligament) arise from the lower part of the sesamoid bones, run downwards and inwards, converging at an acute angle. They become attached to the posterior surface of the centre of the suffraginis bone, and extend downwards to near its lower end, covering the already described rough triangle on the posterior surface of that bone.

The cruciate ligament (*e*) (deep inferior sesamoidean ligament), formed of flat crossed fibres, closely applied to one another, is covered by the lateral limbs of the inferior sesamoidean ligament. The fibres themselves arise from the upper part of the posterior surface of the suffraginis bone, and, after crossing, end at the lower part of the sesamoid bones.

(4) Towards the sides the sesamoid bones are attached by the two lateral sesamoidean ligaments (*f*). These arise from the lower part of the corresponding surface of the sesamoid bones, and divide into two portions, the upper becoming attached

in the ligamentous pit of the lower end of the metacarpus, the lower to the side of the upper end of the suffraginis bone.*

## 2. The Pastern Joint,

Consisting of only two articular surfaces, the lower end of the suffraginis and the upper end of the coronet bones, is the simplest joint of the foot. The suffraginis bone possesses a convexity, the coronet bone a corresponding concavity, which is completed at the back by tendinous and ligamentous structures.

The ligaments of the coronet joint are:—

(1) A capsular ligament, or rather, a synovial membrane (fig. 10, *f*), attached to the borders of the respective articular surfaces. Its outer sheath is anteriorly and laterally fairly strong, in front it is attached to the extensor tendon of the foot, and laterally to the lateral ligament; posteriorly to the cartilaginous mass formed by the tendons and ligaments there inserted, at which point it is very thin and lax.

(2) An inner and an outer lateral ligament (*g*). These are short, but fairly strong, bands, arising from the sides of the lower end of the suffraginis bone, and being attached to the lateral surfaces of the upper part of the coronet bone. They are continued downwards and backwards as the postero-lateral ligaments of the coffin joint, and each eventually is inserted into the end of the navicular bone of its own side, and into the wing of the os pedis.

(3) The posterior corono-suffraginal ligaments are four in number. The two central (*h*) arise from the sides of the rough triangle at the posterior surface of the suffraginis bone about its centre; between them lies the lower part of the central limb of the inferior sesamoidean ligament (superficial inferior sesamoidean ligament). The lateral (*h'*) arise from the sides of the suffraginis bone, about its lower third, and are in contact, on either side, with the terminal branches of the flexor pedis perforatus tendon. They are weaker than the central, and are

* Prof. Mettam considers it is doubtful if the lateral sesamoidean ligament divides into two portions. He prefers rather to look upon that directed upwards, as here related, as a portion of the lateral ligament of the fetlock joint, and the lower portion inserted into the sesamoid as the true lateral sesamoid ligament.—[Jno. A. W. D.]

covered by strands of tissue that act as a check ligament to the flexor pedis perforans, with which they are usually so intimately united that they might be regarded as belonging to that ligament.

As already indicated, these ligaments at their insertion into the posterior part of the coronet bone combine intimately with the central limb of the inferior sesamoidean ligament and with the terminal portions of the flexor pedis perforatus, so as to form a single mass and to permit only of artificial separation.

### 3. The Pedal or Coffin Joint

Is formed by the union of the articular surfaces of three bones. The convexity is formed by the lower articular surface of the coronet bone, the concavity by the upper surface of the os pedis and by the navicular bone.

(*a*) All three bones are united by a synovial membrane (fig. 10, *g*), which, as in other joints, surrounds the articular surfaces of the joint. The outer sheath is strong in front, where it is firmly united to the extensor tendon. Behind, the capsule is distended so as to form a kind of blind sac (fig. 10, *g′*), which extends upwards behind the coronet bone. At this point its outer sheath is very thin, but between the navicular and pedal bones it is strengthened by fibres which run from before backwards, and which are so well-marked as to present the appearance of a special ligament, which has been described as the inferior navicular ligament or interosseous ligament.

(*b*) The coronet and pedal bones are connected by an inner and an outer lateral ligament (*i*) (antero-lateral ligaments, M‘Fadyean). These ligaments are excessively strong; they arise from the ligamentous furrow at the sides of the coronet bone, run somewhat obliquely backwards and downwards to end in special pits on the upper border of the pedal bone, flanking on either side the pyramidal process. Posteriorly, they are bounded by the lateral cartilages, in the tissues of which they are lost.

(*c*) The navicular bone is connected with the suffraginis and pedal bones and with the lateral cartilages.

With the suffraginis bone by means of the postero-lateral ligaments or suspensory ligaments of the navicular bone (*k*, and fig. 24, *b*). These arise in common from the posterior border of the navicular bone, which is completely occupied by them, extend upwards on either side in an oblique direction over the lateral surfaces of the coronet bone, to which they are partly attached; and end on the anterior part of the lower extremity of the suffraginis bone, becoming united with the lateral ligaments of this and of the coronet bones. These ligaments sustain the navicular bone in position. The navicular bone is further connected with the pedal bone, and especially with the lateral cartilages, by what German anatomists term lateral ligaments (fig. 24, *c*). These consist of short but strong masses of ligamentous tissue, which run obliquely from the ends of the navicular bone to the lateral cartilage of either side, to which and to the wings of the pedal bone they become attached. They are really but extensions of the postero-lateral ligaments, and the most important connecting ligament between the pedal and navicular bones is undoubtedly the interosseous. The pedal joint permits of slight lateral movements.

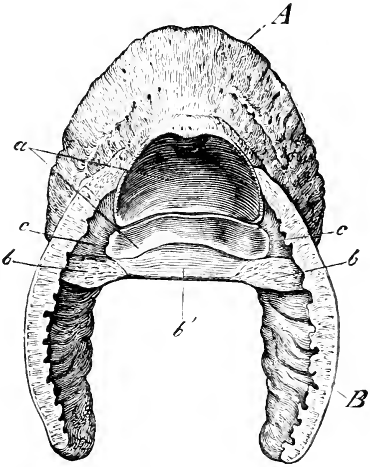



FIG. 24.—*A*, pedal bone; *B*, lateral cartilage cut through horizontally at the level of the pedal joint; *a*, surface, formed by pedal and navicular bones, for articulation with coronet bone; *b*, postero-lateral ligaments of navicular bone cut through; *b*′, portion of above which are attached to back of navicular bone; *c*, the lateral ligament of navicular bone of the German anatomists.

## CHAPTER III.

### THE LOCOMOTOR APPARATUS OF THE FOOT.

THE extremity of the horse's limb possesses no muscular tissues, and the structures which move the bones of the foot act through the medium of long, powerful tendons. In the front limb the muscles themselves are situated above the knee and around the forearm, in the hind above the hock and around the leg or, as it is sometimes called, second thigh. In construction and in the arrangement of their tendons, which, for our purpose, alone demand consideration, there is no essential difference between the fore and hind limbs. The movements of the bones of the foot occur in two directions. Movement forwards we term extension, movement backwards, flexion. The extensor tendons lie in front of, the flexor behind, the bones of the limb.

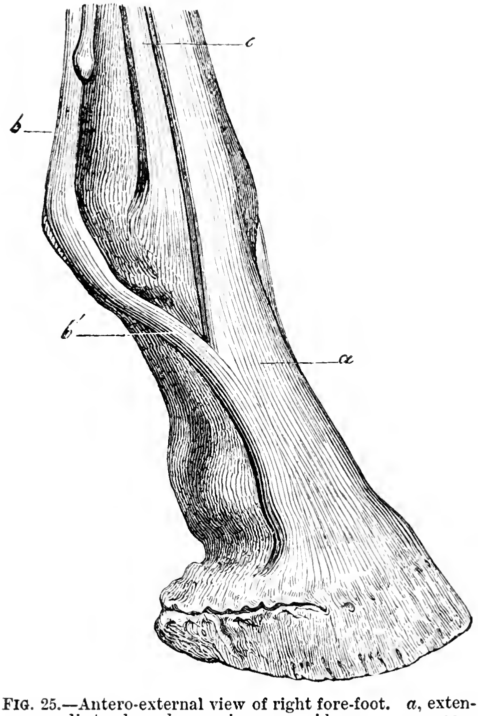



FIG. 25.—Antero-external view of right fore-foot. *a*, extensor pedis tendon; *b*, superior sesamoidean or suspensory ligament; *b′*, prolongation of sup.-sesamoidean lig. (*lig. extensorum*); *c*, extensor suffraginis tendon.

## 1. The Extensor Pedis Tendon.
(Fig. 25, *a*.)

The suffraginis, coronet, and pedal bones have one common extensor tendon. In the fore-limb the suffraginis bone also receives a special tendon, the extensor suffraginis, which lies alongside the extensor pedis tendon on the outer face of the limb, and is inserted into the upper part of the suffraginis.

The extensor pedis tendon runs downwards over the front of the great metacarpal bone and of the fetlock joint towards the lower end of the os suffraginis, where it receives on either side an important reinforcement from the superior sesamoidean ligament (fig. 25, *b′*), which increases its width to $1\frac{1}{2}$ or 2 inches. It then passes over the pastern joint, the coronet bone and coffin joint, and is inserted into the pyramidal process of the os pedis. It is attached to all the bones of the foot, with the exception of the navicular, and to the anterior surfaces of their capsular ligaments, while it is held in position both by the reinforcing bands received from the superior sesamoidean ligament and by the band-like ligaments which run to it from the lower end of the suffraginis bone.

The masses of muscle of which the extensor pedis tendon is a continuation are termed the extensor pedis muscle.

## 2. The Flexor Pedis Perforatus Tendon
(Figs. 26, *b*, and 27, *a*)

Courses down the posterior surface of the great metacarpus, and covers the other flexor tendon. At the point where the two sesamoid bones form a gliding surface (fig. 26, *f*), the tendon becomes broader and flatter, somewhat concave on its anterior surface, and some of its fibres form a ring (fig. 26, *b′*), by which it is attached to the flexor pedis perforans (*a‴*), which lies immediately in front of it. It then passes behind the suffraginis bone, still covering the perforans tendon, and somewhat below the middle of this bone divides into two limbs (figs. 26, *b″*, and 27, *b*), permitting the passage of the perforans tendon, and becomes attached on either side to the lateral surface of the coronet bone. At this point it is difficult to divide the tendon from the ligaments, with which it forms a most intimate connection. A smaller portion extends to the lateral surface of the suffraginis bone just above its lower end. The tendon, therefore, acts not only on the coronet, but also on the suffraginis bone.

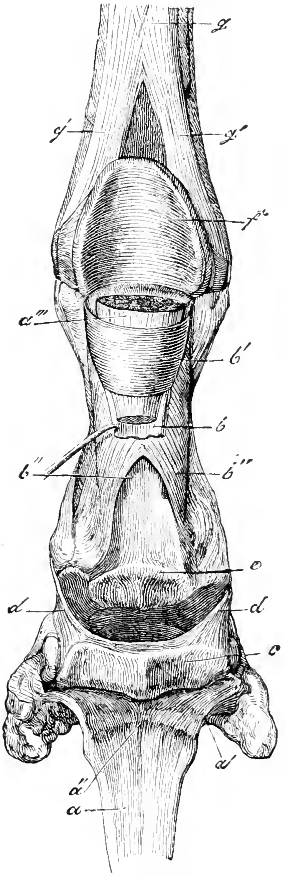



FIG. 26.—Posterior view of right fore-foot. *a*, lower end of flexor pedis perforans tendon cut through and drawn downwards; *a'*, expanded portion which becomes attached to pedal bone; *a''*, depression for reception of the rounded prominence of the navicular bone; *a'''*, isolated section of flexor pedis perforans tendon surrounded by tendinous ring *b'*; *b*, flexor pedis perforatus tendon; *b'*, its fibrous ring; *b''*, its terminal limbs, between which passes the flexor p. perforans tendon; *c*, navicular bone; *d*, its postero-lateral ligaments; *e*, posterior face of coronet bone, over which glides the perforans tendon; *f*, gliding surface formed by intersesamoidean ligament; *g*, superior sesamoidean or suspensory ligament; *g'*, its insertions into the sesamoid bones.

### 3. The Flexor Pedis Perforans Tendon
(Figs. 26, *a*, 27, *e*)

Is described by German anatomists as arising in the fore-limb from five, and in the hind-limb from three masses of muscle. During its course behind the metacarpus, it is rounded and lies between the perforatus tendon and superior sesamoidean ligament. It passes through the ring formed by the perforatus tendon (fig. 26, *b'*), glides over the articular surface of the sesamoid bones, here losing its rounded shape, and becoming broad and double-edged, next makes its way through the opening formed by the division of the perforatus tendon (fig. 27), here being in contact with the smooth surface formed by the fibrous mass clothing the posterior surface of the coronet bone (fig. 26, *e*), and being marked on its anterior surface by a crescent-shaped prominence (fig. 26, *a''*), to which the synovial sheath is attached; it then proceeds as a broad fan-shaped tendon (fig. 26, *a'*) over the navicular bone (*c*), as over a pulley, completely covering the bone. At this point it exhibits a deep furrow, corresponding to the prominence on the lower surface of the navicular bone. Finally, it is inserted into the entire surface bounded by the half-moon-shaped space already described on the lower surface of the pedal bone. The lower part of its posterior surface rests in a special space (fig. 27, *c*), on the plantar cushion.

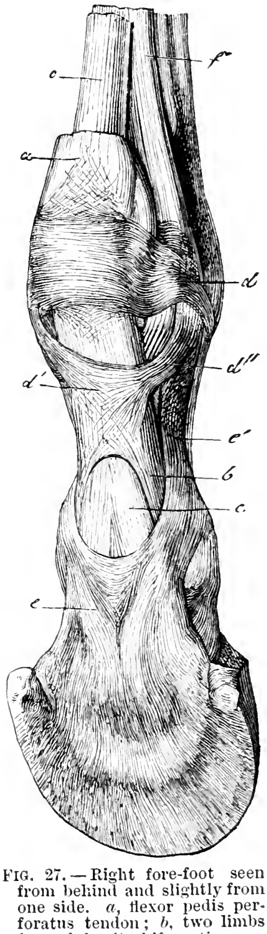



FIG. 27.—Right fore-foot seen from behind and slightly from one side. *a*, flexor pedis perforatus tendon; *b*, two limbs formed by its bifurcation; *c*, flexor pedis perforans tendon; *d*, fibrous reinforcing band of great sesamoid sheath; *d'*, fibrous supporting sheath inserted into suffraginis bone by four heads; *d''*, upper insertions (the lower not visible in figure); *e*, fibro-elastic plate covering the lower surface of flexor p. perforans and inserted into suffraginis bone at *e'*; *f*, suspensory ligament.

The flexor tendons, like the extensors, are held in place from behind by special check ligaments, which fasten them to the bones of the foot. These consist—

(1) Of a broad, strong, annular ligament, which arises from the sides of the sesamoid bones and surrounds the perforatus (fig. 27, *d*, and fig. 31, *f*).

(2) Of a mass of fibrous tissue attached to the skin, which embraces the perforatus tendon below the fetlock joint like a girdle (fig. 27, *d'*). It is attached by its two upper and stronger limbs (fig. 27, *d''*) to either side of the upper end of the os suffraginis behind the lateral ligament; its two lower, weaker limbs are inserted on the sides of the lower third of the suffraginis bone. Above, this fibrous mass unites with the annular ligament, and its central portion is, in general, very intimately connected with the flexor pedis perforatus tendon.

(3) Of a more elastic ligamentous apparatus embedded in the skin (fig. 27, *e*), which covers the lower end of the perforans tendon, and is closely connected with it. Two strong, elongated, and somewhat elastic bands (fig. 27, *e'*) arise from the pedal bone at the point of insertion of the perforans tendon, and pass in an upward direction, covering the points of insertion of the perforatus tendon, and becoming inserted into the lateral aspects

of the suffraginis bone at about its centre. They sustain the lower part of the perforans tendon like a sling. As the divisions of the perforatus tendon in passing downwards, and of this elastic ligament in passing upwards, diverge from one another, they enclose an oval or diamond-shaped space, which is closed from without by a thin membrane connected with the synovial sheath of the perforans tendon.

# CHAPTER IV.

## THE ELASTIC TISSUES OF THE FOOT.

To those portions of the horse's foot just described must be added other structures, which prolong and complete the former: the two lateral cartilages and the plantar cushion. These are peculiar to the horse, and do not occur in the same form in the foot of any other animal. They, therefore, differentiate the equine foot from all others, and, on account of their structure, form, and functions, deserve our closest attention. The fact of physical peculiarities rendering them of such great importance, leads us to very shortly describe the two commonest forms: cartilage and elastic tissue.

Cartilages are, in simple language, close-grained, firm tissues, which, when fresh, present a whitish, when dried, a brown colour. They are moderately firm in texture, exceedingly tough, insensitive, and almost non-vascular. In addition to toughness they show a high degree of flexibility and elasticity, especially when in moderately-thin plates or when mixed with other fibrous or tendinous tissue, as in "fibro-cartilage." In the animal body, cartilage not only forms a component of joints, in which we have already found it occurring as articular cartilage, but enters into the composition of many parts, which, while possessing a distinct form, are also distinctly flexible.

Elastic tissue is widely distributed throughout the animal organism, and is found associated with connective or cellular tissue, of which it is a variety. The parts in which elastic tissue predominates are distinguished by a yellow colour. Microscopical examination shows this tissue to consist of fine fibres uniting with one another and forming a kind of net. The smallest accumulations of such fibres are associated to form bundles, smaller and larger cords, bands, or entire tissues. The ends of the fine threads, when ruptured, curl up; and the larger, when pulled lengthwise, return to their original position with a jerk, reminding one closely of india-rubber. This tissue, like cartilage, is insensitive, and almost non-vascular.

## 1. The Lateral Cartilages

Are attached to the wings of the pedal bone, which they prolong in a backward and upward direction. Each cartilage consists of an approximately lozenge-shaped plate, extending upwards above the middle of the coronet bone. In front, it is in contact with the extensor tendon; behind, it projects beyond the pedal bone. The free ends of the cartilages tend to approach each other, and thus to surround the plantar cushion and flexor perforans tendon.

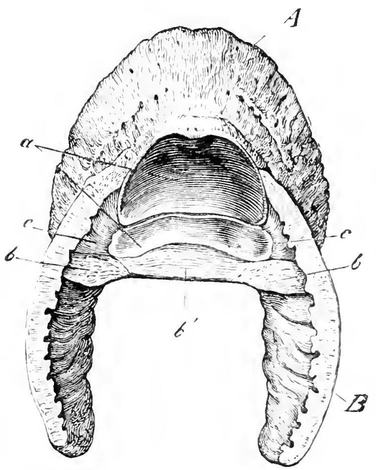



Fig. 28.—*A*, pedal bone; *B*, lateral cartilage cut through horizontally at the height of the coffin joint; *c*, postero-lateral ligaments.

Each cartilage has two surfaces, four borders, and four angles. The outer surface (fig. 29, *C*) is convex, and covered by numerous blood-vessels, mostly veins. Its anterior and upper parts are fairly smooth, but the posterior and under portion show numerous apertures of varying size, permitting the passage of blood-vessels. The anterior portion of the inner surface (fig. 30, *B*) covers the side of the coronet bone. It is concave, and from its upper border arise numerous strong, cord-like tendons, which run in various directions. Be-

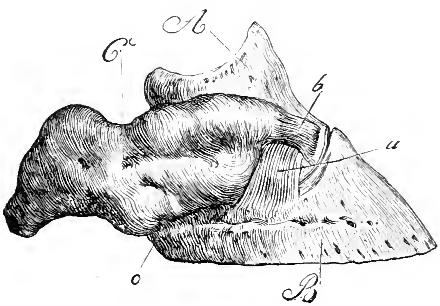



Fig. 29.—Right fore-foot. *A*, coronet bone; *B*, pedal bone; *C*, outer lateral cartilage; *a*, outer lateral ligament of pedal joint; *b*, ligament connecting lateral cartilage to coronet bone; *c*, ligament connecting lateral cartilage to pedal bone.

tween these are channels for a rich venous network. About the centre of the inner surface, or rather nearer its anterior margin, can usually be found a well-marked furrow (*b*) running from above downwards and forwards towards the plantar groove. In this lies the large vessel which supplies the pedal bone. Close to the lower and anterior angle are attached the postero-lateral ligaments of the coffin joint (*d*). From here runs a strong, fibrous cord, the ligament connecting the lateral cartilage and bulbs of the frog to the lateral surface of the pastern bone (figs. 31, *c*, and 33, *d*). The upper border is thin, and usually inclined inwards, but this does not obtain in every foot; in some it is upright, in others more or less turned outwards. The lower border is the thickest portion of the cartilage. In front it is united with the wing of the os pedis, in part directly, in part by the ligaments attached in common to it and to the pedal or navicular bones (fig. 29, *c*). The notch in the wing of the pedal bone is closed by a mass of cartilage, save for a small foramen, which permits of vessels passing to the sensitive structures. The site of this foramen is where ossification of the lateral cartilage usually begins. The posterior part of the lower border inclines inwards (fig. 28), but from this point, in an upward direction, the usual trend is outwards. The tissue is here in such close union with the plantar cushion, partly through cartilaginous, partly through fibrous connections, that the two form a common mass, in which no distinct boundary can be detected (fig. 35). The anterior border runs obliquely from above downwards and backwards, and is closely connected with the lateral ligaments of the pedal joint (fig. 29, *a*), with which it to some extent unites. The posterior border runs in the

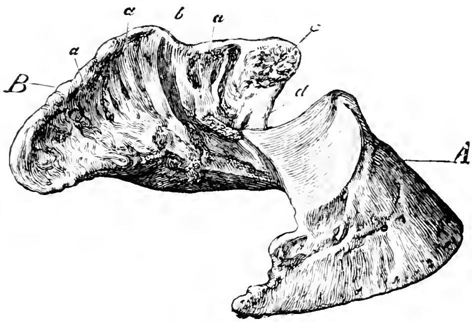



FIG. 30.—Postero-lateral view of pedal bone and inner lateral cartilage. *A*, pedal bone; *B*, inner surface of lateral cartilage; *a*, insertions of the various ligaments attached to lateral cartilage; *b*, furrow leading to plantar foramen; *c*, point of insertion of ligament connecting the coronet bone and lateral cartilage; *d*, point of insertion of lateral ligament of navicular bone (postero-lateral ligament).

same direction as the anterior, is sharp, and exhibits a number of depressions, through which vessels pass. The antero-superior angle is formed by the meeting of the anterior and upper borders. It is attached to the lateral surfaces of the coronet bone by strong ligaments (figs. 29, *b*, and 30, *c*). The antero-inferior angle is connected with the wing of the os pedis. The postero-superior angle, formed by the meeting of the upper and posterior borders, is somewhat rounded off. The postero-inferior angle is connected with the plantar cushion.

A short note on ossification of the lateral cartilage may perhaps be permissible. Lungwitz's experiments showed that of 1251 animals examined, 11·5 per cent. had well-marked ossification. Lungwitz states that side-bone is commonest in heavy, coarse-bred horses (our common experience); the fore-feet are most frequently affected—the left foot more commonly than the right, and the outer cartilage oftener than the inner. Ossification may occur early in life, especially at the time when animals are first put to work. Well-bred animals seldom suffer.

## 2. The Plantar Cushion.

The fibro-fatty frog or plantar cushion (figs. 31, *a*, and 10, *i*), although sometimes described as consisting of two different parts, the sensitive bulbs and sensitive frog, must practically be regarded as one and indivisible. It is difficult to find an object which precisely simulates it in form; but it may be compared to a wedge whose sides all converge to one point, or to a four-sided pyramid, one surface of which is slightly convex, the opposite concave.

The convex, thicker end of the plantar cushion, is turned towards the rear, and is surrounded by the posterior part of the lateral cartilage. Thence it converges to a point corresponding in position to the border between the anterior and middle thirds of the lower surface of the pedal bone. Consequently, it covers the centre of the two posterior thirds of the sensitive foot.

The postero-superior part (figs. 31, *a'*, 32, *a*, 33, *a*, and 34, *b*) is convex, rounded, and rises on either side above the neighbouring portions. Its centre is marked by a slight depression, dividing it into two distinct halves, which, as they serve as bases to the so-called bulbs of the foot, and for the most part are only covered by skin, have received the name of the sensitive bulbs.

The cellular bulbs consist principally of yellow, elastic or fibrous tissue, combined to form elastic membranes, elastic cords of varying thickness, bundles, or spherical masses. The bulbs contain little white fibrous tissue, and are, therefore, the softest part of the entire plantar cushion. From them, on either side, runs a strong elastic cord in a forward and upward direction towards the lower end of the suffraginis bone, accompanying a similar elastic cord, which arises more from the anterior part of the plantar cushion and inner surface of the lateral cartilage. As this elastic cord serves to suspend the bulbs from the fetlock, it has been termed the suspensory ligament of the bulbs (figs. 31, *b*, and 33, *c*).

Similar, but smaller ligaments arise from the bulbs, and become attached to the posterior border of the lateral cartilage (fig. 31, *b′*). At the same point is inserted a tendon, originating in the skin close to the horny skin under the fetlock (fig. 31, *d*).

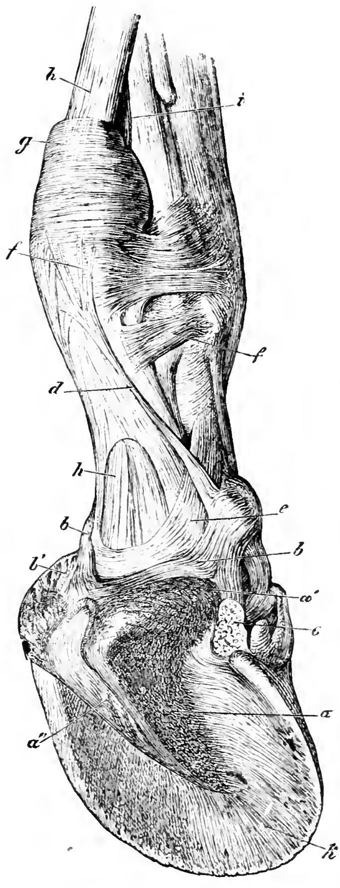



**Fig. 31.**—Infero-posterior view of right fore-foot, showing the position of the plantar cushion. The outer lateral cartilage and the tissues covering the lower surface of the pedal bone (sensitive frog and sensitive sole) have been removed. *a*, plantar cushion; *a′*, bulbar portion of plantar cushion; *a″*, cleft of the frog in which rests the "frog stay"; *b*, origin of the so-called "suspensory ligament of the bulbs"; *b′*, small elastic band passing towards the lateral cartilage; *c*, elastic band arising from lateral cartilage and becoming inserted into pastern bone; it unites with *b*; *d*, small tendon which arises from the skin and becomes attached, in common with *b* and *c*, to the pastern bone; *e*, fibro-elastic supporting sheath of flexor p. perforans; *f*, fibro-elastic supporting sheath of flexor ped. perforatus; *g*, flexor p. perforatus tendon; *h*, flexor p. perforans tendon; *i*, suspensory ligament; *k*, lower surface of pedal bone, to which the flexor p. perforans tendon is attached.

This, however, is not elastic, but of a fibrous nature. The sides of the expanded portion of the bulbs cover the lower parts of

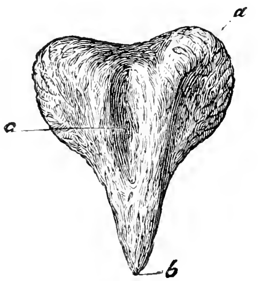



FIG. 32.—Plantar cushion, seen from below. *a*, base; *b*, point; *c*, groove for receiving frog-stay.

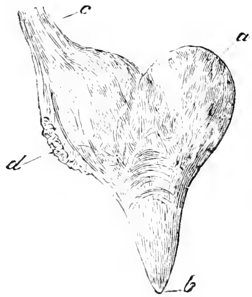



FIG. 33.—Plantar cushion seen from above. *a*, base; *b*, point; *c*, origin of the "suspensory ligament of bulbs"; *d*, spot where the elastic ligament running to the lateral cartilage becomes attached.

the plantar cushion, and are, as already stated, so intimately connected with the posterior part of the lateral cartilage that no sharp boundary can be traced between the two, the cartilaginous material penetrating the elastic, and the elastic the cartilaginous (fig. 35). Anteriorly, the bulbs are continued obliquely downwards and forwards over the superior surface of the plantar cushion (figs. 33 and 34). From this surface a number of broad elastic bands run to the elastic reinforcing band of the perforans tendon, to which part they become attached; other portions may be traced in an upward direction. The under surface of the bulbs and the under and both lateral surfaces of the plantar cushion are clothed by a vascular membrane, from which the horny frog is secreted; for this reason all the central part of the plantar cushion has been termed the


FIG. 34.—Vertical mesial section of plantar cushion. *a*, surface of section; *b*, bulbs of frog; *c*, groove for frog-stay.

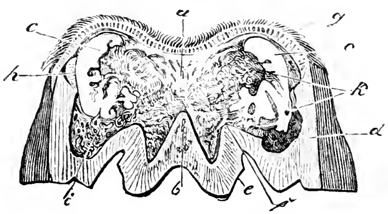



FIG. 35.—Vertical section of foot from side to side, at a point corresponding to the centre of the frog's greatest length. *a*, posterior part of plantar cushion; *b*, frog-stay; *cc*, lateral cartilages. Note the prolongations into the substance of the plantar cushion. *d*, wall; *e*, lateral aspect of frog; *f*, junction of frog and bar; *g*, skin; *h*. coronary band; *i*, modified corium covered with blood-vessels; *k*, foramina in lateral cartilage for passage of blood-vessels.

secreting or sensitive frog. The sensitive frog is much firmer than the sensitive bulbs; the elastic tissue being slight, the tendinous or fibrous abundant in quantity.

The inferior surface of the base of the bulbs and the postero-inferior surface of the sensitive frog are divided by a cleft of varying depth into two similar parts (figs. 32, *c*, and 34, *c*). Above, this conformation is continued in the bulbs (fig. 32, *a*). Anteriorly, the two parts unite to form a level, pointed surface. The two lateral surfaces are flat, and marginate the limbs on either side. They run towards the middle line of the foot, and meet at the point of the plantar cushion (figs. 32 and 33, *b*).

The cushion itself is fixed in position partly through the medium of the elastic cords and tissues enumerated, partly through its intimate connection with the lateral cartilages, but chiefly by the fibrous material which most intimately unites the sensitive frog with the lower surface of the pedal bone.

# CHAPTER V.

## THE BLOOD-VESSELS AND NERVES OF THE FOOT.

Between the bones, ligaments, tendons, and elastic tissues on the one side, and the protective structures of the foot on the other, lie a number of organs, which, though not perhaps of the same importance in a mechanical sense as those already reviewed, nevertheless exercise a paramount influence in the play of such phenomena as growth, nourishment and sensation. These organs are the blood-vessels and nerves.

### A. BLOOD-VESSELS.

The blood-vessels are a system of membranous tubes which convey the blood from the centre of circulation to all parts of the body, and return it thence to the heart. As the blood, on which the growth and nourishment of the entire animal body depends, is continually moving, it is clear that the same tubes which conduct it from the heart cannot return it there. For this reason two varieties of blood-vessels are distinguished—those coming from the heart, termed the arteries, and those going to it, the veins.

With few exceptions, the arteries can be distinguished from the veins in the dead as well as in the living subject. They have thicker walls, are of less calibre, and fewer in number than the veins. In the dead body they seldom contain blood, while the veins are more or less filled. Before Harvey's discovery they were supposed to carry air; hence their name. If, in a living animal, a large artery be pressed on with the finger, a regularly-repeated light beat (the pulse) can be felt. If such a vessel be opened, bright red blood issues in a jerking stream. The veins exhibit no pulsation; their blood is dark red, and escapes from the severed vessel in a steady flow.

In addition to the blood-vessels are other tubes, which contain a yellow or yellowish-red fluid. These have very thin walls, are small, and usually accompany veins, into which they finally pour their contents. The fluid is termed lymph, and the vessels themselves lymph-vessels. Such vessels can be found in the foot, but are so attenuated as scarcely to be visible. A lengthened description would be inappropriate here. A few remarks on the blood-vessels must suffice.

At their origin from the heart the arteries are large and thick-walled, but, as they recede from this point, they continuously divide, and their walls become thinner. Large stems branch off into smaller; from these twigs originate in all directions until, finally, all trace of them appears to be lost in the surrounding tissues. The arrangement can best be compared to a tree, the trunk of which divides into main stems, the stems into branches, and the branches into innumerable twigs. The splitting up of the vessels which provide blood for the organs of the body ultimately produces a net-work, which can no longer be distinguished with the naked eye. The minute vessels of this net-work are termed capillaries. The capillaries, after a short course, re-unite in the same fashion as they had arisen from the arteries,—that is, by their union they gradually form larger and larger vessels, termed veins, which at last empty into the heart. The veins, more especially those of the limbs, have valves which support the column of blood ascending against the action of gravity. The course of the veins is precisely comparable to that of the arteries, though in them the blood flows in an opposite direction.

The arteries and veins being the conductors of blood to and from the various organs are of great importance, but the capillaries are equally indispensable to nutrition and secretion. Passing through their thin walls the fluid portions of the bright red arterial blood bathe the tissues of the different organs, bringing to each the material necessary for its existence and function.

All parts of the foot are provided with blood-vessels and contain more or less blood, with the single exception of the horny tissues. The parts, however, concerned in producing horn, receive a large supply, and are the most vascular parts of the entire foot.

## 1. The Arteries.

Before the blood from the heart can reach the foot it must traverse a large number of arteries, which are variously named. At the metacarpus the principal vessel is termed the metacarpal artery, a name which it retains down to the region of the fetlock joint. An inch or two above the fetlock joint and in front of the flexor tendons this vessel divides into two branches of similar size, which then pass downwards on either side of

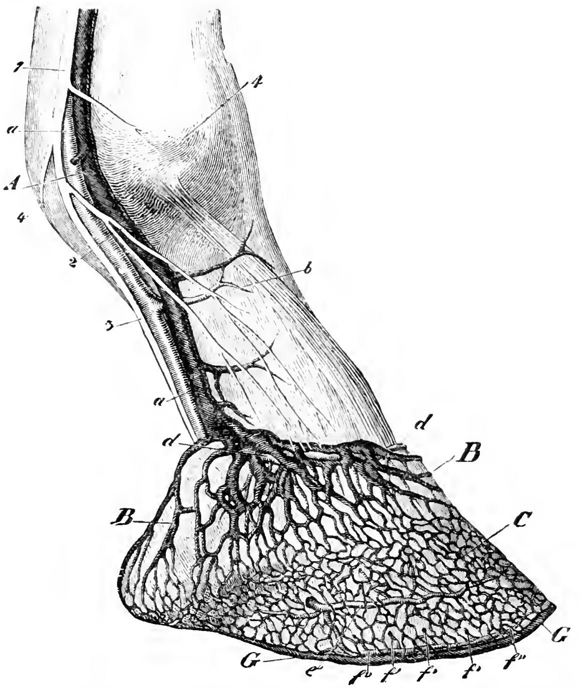



FIG. 36.—Lateral view of fore-foot, with prepared vessels and nerves. *a*, digital artery; *b*, perpendicular artery; *e'*, preplantar artery; *f'*. twigs from the plantar artery which escape through the foramina, just above the lower margin of the os pedis, and by their anastomosis form *f''*, the circumflex artery of the toe; *A*, digital vein; *B*, coronary venous plexus; *C*, laminal plexus; *G*, circumflex vein; 1, digital nerve; 2, anterior terminal branches of digital nerve; 3, posterior terminal branches of digital nerve; 4, cutaneous branches.

the limb as far as the pedal bone, being known as the digital arteries. At the pedal bone each digital divides to form the preplantar (fig. 36, *e'*) and plantar artery (fig. 38, *f*).

Examining the vessels more closely, one notices, (1) that each digital artery (*a*) is a fairly-large vessel, lying at the side of the flexor tendons, to which, or to the check ligament of which, it is fastened by connective tissue. In front is placed the vein of the same name; behind it the digital nerve. About the middle of the os suffraginis it gives off:—

(*a*) The suffraginal artery. This is a very short vessel, which runs at right angles to the digital artery, and almost immediately divides into two twigs.

(*aa*) The perpendicular artery (the German term means anterior suffraginal artery) (fig. 36, *b*) runs forward, and divides into a short and a long twig; the former running upwards, the latter downwards. Both anastomose freely with the similar artery of the opposite side. They are distributed to the extensor tendon, the skin and the fetlock joint. The lower twig assists in supplying blood to the perioplic and coronary bands.

(*bb*) The posterior suffraginal artery. This is one of Bouley's *rameaux échelonnés* (fig. 38, *b*), passes backward and supplies the flexor tendons and their synovial sheaths, the inferior sesamoidean ligament, the suffraginis bone, etc., and anastomoses with its fellow of the opposite side.

(*b*) The artery of the plantar cushion (figs. 37 and 38, *c*) arises at about the lower end of the os suffraginis, runs backwards and downwards below the centre line of the foot, and gives off numerous branches in the plantar cushion, and especially in the sensitive frog. In addition, it sends twigs to the sensitive bars.

(*c*) About the middle of the coronet bone there arise from the digital artery, sometimes together, sometimes separately—

(*aa*) The anterior coronary artery, or anterior artery of the coronary band (fig. 36, *d*). This is the larger branch of the two, and chiefly supplies the coronary band. It anastomoses with its fellow of the other side, forming a very complete net-work termed the coronary circle.

(*bb*) The posterior artery of the coronet bone (fig. 38, *d*), or posterior artery of the coronary circle, which passes backwards, unites with its fellow of the opposite side, forming a net-work, and supplies the synovial membrane of the coronary and pedal joints, the coronet bone, flexor tendons, ligaments, and skin.*

* Professor Mettam regards the arteries to the coronary band as derived in front from the coronary circle and behind from the artery to the plantar cushion. The arteries from the coronary circle are two descending on either side of the extensor pedis tendon. They divide, right and left branches uniting, and the efferents from the artery to the plantar cushion doing the same, and uniting with branches from the others, a circumflex artery of the band is formed.—[Jno. A. W. D.]

Finally, the digital artery arrives at a point between the navicular bone and the wing of the pedal bone, where it divides into two branches, of which one runs outwards over the surface of the os pedis, the other into the substance of the bone. The former is termed—

(2) The preplantar artery, or artery of the wall (figs. 36, *c′*, and 38, *e*). Before passing outward this vessel gives off a twig, which is distributed to the plantar cushion and sensitive sole. It then passes through the foramen, between the wing of the os pedis and the lateral cartilage, and at once divides into three branches. The most important (fig. 36, *c′*) runs in a forward direction in the preplantar groove, and is chiefly distributed to the sensitive laminæ. The branch running backward supplies the outer surface of the posterior part of the lateral cartilage and the tissues adjoining with blood; that running downwards has connections with the artery next mentioned.

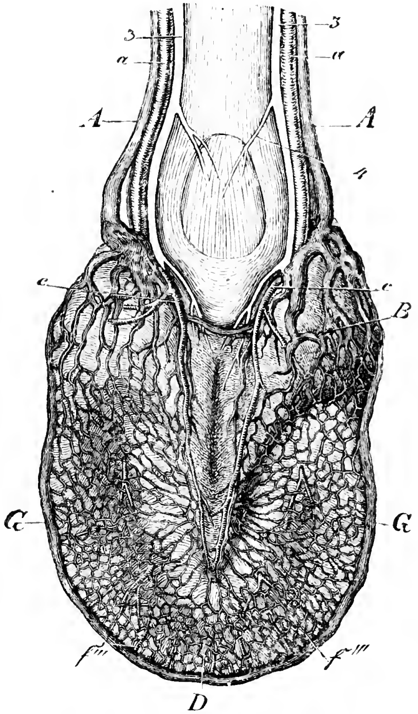



FIG. 37.—Foot, seen from below and behind. *a*, digital artery; *c*, artery of the plantar cushion; *f′′′*, twigs of the plantar artery, which divide to form the solar plexus; *A*, digital vein; *B*, lateral portion of coronary plexus; *D*, solar plexus; *G*, circumflex vein of toe; 3, posterior division of digital nerve; 4, cutaneous branches of digital nerve.

(3) The plantar artery, inner pedal artery, or artery of the sensitive sole (fig. 38, *f*) is a direct continuation of the digital. After giving off some twigs to the pedal joint (fig. 38, *g*), it passes, lying in the plantar groove towards the plantar foramen, through which it enters the interior of the pedal bone, where it anastomoses with its fellow of the opposite side, forming a net-work, the plantar-arch or semilunar anastomosis, from which small arteries are given off in all directions (fig. 38, *f′*). These

minister to the nutrition of the pedal bone, but a number, termed the anterior laminal arteries, escape from the bone by the numerous foramina piercing its anterior surface, and supply the sensitive laminæ.

Others again, known as the inferior communicating, pass outwards through the eight to twelve or more little channels opening on the external surface of the os pedis, just above its inferior margin (fig. 36, *f′*), run chiefly downwards, and unite with twigs given off by the preplantar artery, forming a more or less well-marked vessel, which encircles the lower border of the pedal bone, and is termed the circumflex artery of the toe (fig. 36, *f″*). From this twigs pass backwards over the lower surface of the foot, supplying chiefly the sensitive sole (fig. 37, *f‴*).

## 2. The Veins.

After the blood has traversed the capillaries, which in the horn-secreting structures are somewhat large, it is collected into another series of vessels, which form several superimposed net-works, and are so intimately connected one with another that its return by one path, if for any reason impeded, can always be effected by numerous alternative channels. The blood brought to the foot by the arteries finally arrives in a large vein, which runs parallel with the digital artery, and is termed the digital vein (figs. 36 and 37, *A*). This vein is formed by—

(1) The solar plexus (fig. 37, *D*), the net-work of small veins which closely cover the under surface of the foot, aided by those from the plantar cushion and sensitive bars. It discharges partly through the net-work formed by the veins of the plantar cushion (solar plexus) (fig. 37, *B*), partly through that formed by the deep coronary vein which collects the blood from the inner face of the lateral cartilage (fig. 38, *E*), and possibly through the coronary plexus, with all of which it is in direct communication.

(2) The laminal plexus (fig. 36, *C*) resembles, in most respects, that of the sole. The blood which it contains is either discharged into the coronary plexus, or makes its return by the circumflex vein of the sole.

The venous net-work of the sensitive sole (solar plexus) and that of the sensitive laminæ (laminal plexus) are connected by—

(3) The circumflex vein of the toe (figs. 36 and 37, *G*). This is not perhaps a true vein, but might rather be regarded as a sinus, being formed of several thin-walled tubes or sacs of varying length, which encircle the lower border of the os pedis, and are of much greater calibre than the veins of the solar and laminal plexuses with which they are connected.

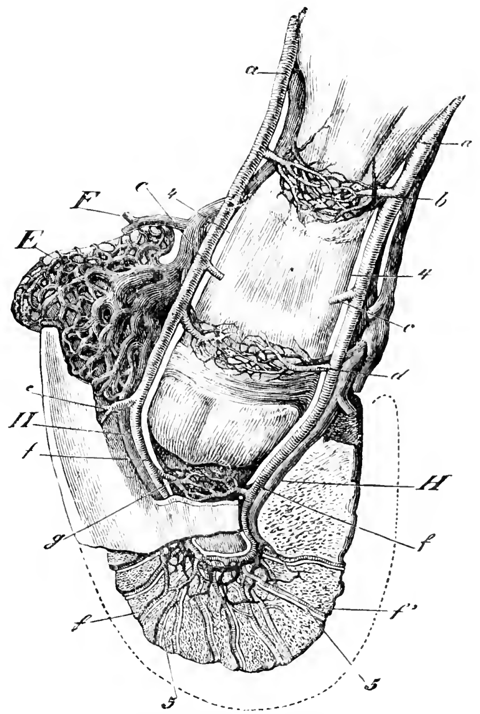



FIG. 38.—Right fore-foot, seen from below, behind, and somewhat from one side. The outer lateral cartilage is removed, together with sufficient of the pedal bone to render visible the vessels, etc., in its interior. The nerves accompanying arteries *f* are shown too thick; they should be less than half as broad as figured. *a*, digital artery; *b*, posterior suffraginal artery; *c*, artery of plantar cushion (cut through); *d*, posterior artery of coronary circle; *f*, plantar artery, which anastomoses with its fellow within the pedal bone, and gives off twigs *f'*, which pass to the anterior surface of the pedal bone, just above its lower edge; *g*, twigs of plantar artery supplying coffin joint; *E*, deep lateral layer of coronary plexus, clothing inner surface of lateral cartilage; *F*, divided ends of superficial part of coronary plexus. From these arise the digital vein (not shown); *H*, plantar vein; 4, posterior branch of digital nerve accompanying vessels into pedal bone; 5, twigs of posterior branch passing towards sensitive laminæ.

(4) The coronary plexus encircles the entire coronet with the exception of the anterior part, covering both the outer and inner surfaces of the lateral cartilage, by which it is divided into a superficial and a deep portion.

(*a*) The superficial plexus (fig. 36, *B*) covers the outer surface of the lateral cartilage, and is formed by vessels from the sensitive laminæ. Its veins are larger, and the meshes of the net-work wider than those in the sensitive laminæ. At the upper border and postero-superior angle of the lateral cartilage a number of large veins unite, and, in combination with those of the deep coronary plexus and of the plexus of the plantar cushion, form the digital vein.

(*b*) The deep plexus (fig. 38, *E*) lies embedded in the depressions of the inner surface of the lateral cartilage, which we have already noticed. It likewise is formed by somewhat large vessels intimately connected with the superficial plexus by means of apertures in the lateral cartilage. As a rule, this plexus receives—

(5) The plantar vein (fig. 38, *H*), which issues from the foramen in the pedal bone, and is to be found lying in the plantar groove along with the plantar artery. It is formed by intraosseous branches, which collect and carry off the blood after its circulation in the pedal bone, but it has nothing to do with the removal of blood supplied to the horn-secreting structures. During its course it often receives veins from the pedal articulation, though, in other cases, these open separately into the deep coronary plexus.

(6) The venous plexus of the plantar cushion (fig. 37, *B*) is really nothing more than an extension backwards and upwards over the bulbs of the heel of a part of the solar plexus, the meshes of the net-work becoming wider, the veins larger; afterwards they unite to form large vessels, which, as already noted, assist in the construction of the digital veins. During its course upwards the digital vein of the foot (*A*) lies in front of its artery at the side of the flexor tendons, receiving, in addition to some innominate cutaneous veins, the suffraginal and perpendicular veins. After the digital veins pass the fetlock joint, they unite in front of the flexor tendons and form a plexus, from which the metacarpal veins (3) arise. Their contained blood, however, has yet to traverse a large number of other vessels before it reaches the heart.

## B. THE NERVES.

The nerves are white, rounded cords of varying thickness, which arise from the brain and spinal cord, and, in their course, usually accompany the arteries. Like the latter, they divide into stems and branches, and are finally lost in the tissues which they supply. Whilst the blood-vessels carry to and fro material for the nutrition of the tissues, the nerves preside over, and, in a certain sense, regulate the nutritive and secretive processes, thus exercising a most important influence on growth, in addition to serving as channels for the conveyance of impulses which result in motion or sensation. The extra-vascular portions of the foot, *i.e.*, the horny tissues, are destitute of nerves, so that cutting the horn of the hoof and the hairs above it causes the animal no pain ; but the skin and the horn-secreting structures, on the other hand, are freely supplied. For this reason most diseases of the foot cause lively pain, whether they result from bruising, pricks in shoeing, inflammation, contraction of the foot, or any one of the many other possible forms of injury.

The nerves which supply the foot arise from the spinal cord, and in the lower part of the limb, where they accompany the digital artery and vein, are termed the digital nerves.

Each digital nerve (fig. 36, *1*) divides at the fetlock into two twigs. The anterior (fig. 36, *2*) passes obliquely downwards and forwards over the digital artery and vein, and splits into a great number of small branches, which are distributed in the skin, the coronary band, and the sensitive laminæ.

The posterior branch (figs. 36, 37, *3*, and 38, *4*) is the larger, and lies behind the artery, which it accompanies as far as the point where the latter forms the net-work in the pedal bone. On its way to the plantar foramen it gives off a few twigs for the skin (figs. 36 and 37, *4*), for the joints, and especially for the sensitive frog and sensitive sole. The portion which accompanies the plantar artery into the pedal bone divides into very fine branches, which run side by side with the small arterioles, make their way out of the pedal bone, and are finally lost in the laminæ (fig. 38, *5*).

A third (middle) branch of the plantar nerve can sometimes be distinguished running down immediately behind the vein and supplying the coronet and sensitive laminæ. In the horn-secreting tissue, especially in the sensitive frog, peculiar structures have been found connected with the nerves, which are known under the names of Pacinian or Vater's corpuscles.

# CHAPTER VI.

## THE PROTECTIVE STRUCTURES OF THE FOOT.

THE portions of the limb which have, up to the present, been studied, are, like all other portions of the body, covered and protected from injury by the skin. The covering of the foot, however, differs from that of all other parts of the body.

*The Skin.*—The skin or common integument is divided into a superficial epidermis and a deeper corium or true skin. The epidermis or scarf skin is composed of a multitude of cells united together so as to form a layer that covers the entire body. From it are derived certain structures, such as hairs, horns, and hoofs, which have important functions to perform, and so to render parts of the body more fit for the purposes to which they are put. In animals that have coloured skins, or skins provided with a thick hairy covering, the epidermis is found to be divided into two portions,—one the rete mucosum or stratum malpighii; the other, and one that is constantly shed as scurf, the

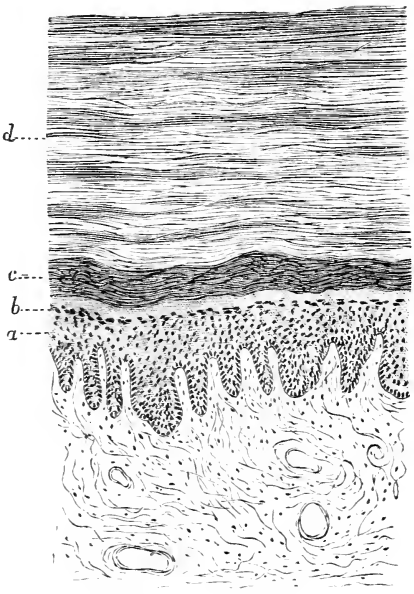



FIG. 39.—Vertical section through the human nail and nail-bed. *a*, stratum malpighii of nail-bed; *b*, stratum granulosum of nail-bed; *c*, the deep layers of the nail substance; *d*, the superficial layers of same. (From Klein's *Histology*.)

stratum corneum. The deepest layer of the stratum malpighii, that lying next to the corium, is a very active layer, the elements are capable of dividing and giving origin to others that go to take the place of those constantly being shed. Moreover, from this layer any loss of epidermis, as in a wound, is made good. Further, from the cells of this layer all the epidermal appendages are derived, as we shall presently explain.

During the passage of the cells, derived from the actively growing cells of the stratum malpighii, to the surface, various changes occur in them. Their substance is converted into a horny material, they apparently lose their nuclei, they become flattened and more or less dissociated. Eventually, they are lost as scurf. The epidermis of the domestic animals generally is not so thick as that of man, nor can it be shown to consist of so many well-marked layers; this masking is due to the amount of pigment contained in the epithelial cells, and the finer differentiating details are thereby lost.

The corium is composed of a felted mass of connective tissue (both white and yellow varieties are present, the former in greater amount), and it contains blood-vessels, nerves, lymphatics, etc. A certain amount of fat, too, is present, occupying the interstices of the connective tissue and mostly near the blood-vessels, but fat is not abundant in the corium proper; it is below the corium in the subcutaneous tissues that the great mass of adipose tissue seen in some animals, as the ass, is deposited. Here it forms the panniculus adiposus.

The corium, from its structure, is elastic; the suppleness and the power of accommodation possessed by the skin is due entirely to this feature. The blood-vessels are very numerous, and the capillaries in the superficial parts of the corium are extremely close set and complicated. Much blood is required in this position owing to the non-vascularity of the epidermis, which must draw its nourishment indirectly from the blood-vessels of the corium. When we consider the rapidity of growth of the epidermis, as evidenced by the constant call upon it for the renewal of the hair, the renovation of the hoof, and the amount of scurf lost daily, we must conclude that the supply of nourishment required is great. Again, the corium possesses nerves, and many of the nerves end here in special structures termed end-organs; some of the nerves may even penetrate the epidermis to terminate there. So the corium is a highly-sensitive structure, and forms the seat of the sense of touch. In the corium certain glands are present, such as the sweat glands, which are long, tubular, highly-convoluted glands, opening upon the surface of the epidermis, either alone or with a hair. These glands are lined by an epithelium that is directly continuous with the stratum malpighii of the epidermis. Imbedded in the corium are the roots of the hairs. If a hair, its sheath, and the papilla, as the small conical elevation of the corium at the bottom of the pit is called, be examined, it will be found that cells also derived from the stratum malpighii cover this papilla, and from the proliferation of these cells the hair is formed, moving from off the papilla like a cast. As the cells continue to grow and multiply, more additions are made to the newly-formed hair below, so that eventually it projects from the level of the epidermis. It continues to increase in length for a time, but soon growth ceases and the hair dies, but provision is made for a new hair in the same sheath by a process of budding and the formation of a new papilla by the corium, which continues the function of the first one. The cells lining the hair sheath and covering the papilla are continuous with the stratum malpighii, and thus hair is as truly a derivative of epidermis as scurf. Growing out, also, from the cells lining the hair-sheath and into the corium at several points, we have masses of cells arranged to form glands, which provide an oily secretion that is poured into the root sheath of the hair. These glands are the sebaceous glands, are mostly associated with hairs, and provide the secretion that renders the skin unctuous, smooth and silky to the touch, and less liable to crack.

*The hoof derived from the epidermis.*—The epidermis covering the corium of the foot provides the horn that forms the hoof. The epidermis covering all the corium below the line where the hair terminates has this function. In other words, from the epidermis covering the corium of the perioplic ring, the coronary band, the sensitive laminæ, sensitive frog, and sensitive sole horn grows, and hoof is developed.

The corium is not smooth: if the epidermis is removed it will be found to be covered with minute projections sticking apparently into the epidermis. In certain regions, *e.g.*, the perioplic ring and coronary band, these papillæ are very long. The corium, however, had not always this papillated appearance; in the early stages of developmental life the surface was quite plane, covered by the epidermis. During the tenth week of fœtal life the epidermis covering the part where the hoof is to appear begins to grow into the corium and dissect it up; this ingrowth occurs at regular intervals, and proceeds throughout the whole depth of the foot. Furthermore, a similar ingrowth takes place along the sides and at the inflections of the walls known as the bars. The epithelial invasions continue to advance into the corium, and after a time to form on either face secondary invading points, which behave in a similar fashion, though not to the same extent, as the original ingrowths. In this way the corium is split up into a great number of plates running parallel to each other, and these form the sensitive or fleshy laminæ. But the epithelial cells of the epidermis become eventually converted into horn scales: such also is the fate of the epithelial cells that invade the corium, and hence we find that occupying the axis of any ingrowth is a horny plate that has resulted from the proliferation and alteration of the cells of the epidermis. No difference, therefore, is to be noted in the fate of the daughter cells, save that they have cohered to form a horny plate after the same fashion as their relatives, the cells producing a hair. This horny plate becomes a horny lamina, and hence the horny lamina comes to occupy the space between two sensitive laminæ. A sensitive lamina results, therefore, from two incursions of the epidermis taking place into the corium, and its depth from free edge towards its attached border represents the depth of the corium of the foot. The epithelial cells covering the corium give rise to the horn lining the horny capsule, whether it belongs to the horny laminæ or to the horn cementing these to the remainder of the hoof. As one proof of their horn-forming function, it is to be noted that the horn of the interior of the capsule is uncoloured, despite the colour of the hoof, and this is to be explained by the absence of pigment from the epithelial cells covering the corium in this region. Again, if the hoof be partly stripped off, the epithelial cells covering the soft structures speedily produce a new horny pellicle. On the surface of the hoof the horn thus formed shows itself as the white line uniting wall and bars to the sole.

The greater portion of the wall is formed from the cells covering the coronet. The corium of this region carries numerous papillæ of varying length; those placed low down are usually longer than those above. The papillæ act as moulds, upon which the horn tubes are cast, and from them the tubes grow like the hairs from the papillæ sunk in the corium of other regions, as noted above. The epithelial cells covering the depressions between the papillæ form horn in a fashion precisely similar to those forming the horny laminæ, and hence the horn tubes or fibres are cemented together by a horny matrix, as may be ascertained by consulting any good illustration of a section through the wall. Occupying the horn tubes may be found a material that has been named intratubular material; this is derived from the cells covering the extreme tips of the papillæ on the coronet, and hence the different portions of the horn forming the wall are named tubular, intertubular, and intratubular, according to their origin from the cells covering the sides of the papillæ, the depressions between, or the summits of the papillæ.

The horn of the frog is developed partly from the cells covering the numerous papillæ of the sensitive frog or from the depressions between. The peculiarity of the frog may partly be accounted for by the mass derived from the non-papillated regions, and partly by the secretion formed by the sudoriparous glands found in the frog. Close and attentive examination of these glands show that they are not true sweat glands, secreting sweat as it is usually understood. The material formed, as observed in the ducts of the gland tubes, resembles ear wax rather than true sweat, and such a secretion would keep the frog in the condition we find it, better than a watery secretion subject to rapid evaporation. Moreover, the ragged nature of the frog may be explained by the hypothesis that the horn of purely cellular, as distinct from a moulded and papillated origin, is present in greater abundance than in the wall, and, as we shall observe later, such an explanation may be offered as to the structure of the horny sole, but here no glands are present. The cellular horn of the frog, as distinct from the tubular horn, has a remarkable appearance on close examination with the microscope. The cells are disposed in two alternating directions, and passing through these alternating strata and at right angles to them are the horn fibres. Such an arrangement must consolidate the whole structure and resist traction when brought to bear in any direction, and that the toughness of the horn of the frog is surprising anyone will admit who has attempted to pull a piece away.

The horny sole also is developed from cells covering the papillæ of the sensitive sole, and from those covering the surface of the corium between them. The papillæ, however, are short, and the amount of horn derived from other than a papillary origin is relatively abundant. The two factors taken in conjunction, the short tubes and the cellular horn, explain the lack of coherence and the rapid exfoliation. Further, there is no natural secretion provided to keep the horn from rapidly desiccating and crumbling, as in other regions, where, if no secretion is provided, as in the frog, yet a thin protecting pellicle descends over the nascent horn, prevents it from cracking until it is sufficiently hard to withstand the usages to which it is put. The absence of secretion, or of periople, together with alternations of excessive dryness or of moisture to which the sole is subjected, accounts for the crumbling and breaking down of the horny sole; and, beyond this, it should be mentioned that certain structures, as hairs, tend to break off and disintegrate when they have reached a certain length, or, in other words, have passed beyond the sphere of influence of the tissues from which they have been derived.

The perioplic horn is derived from the cells covering the perioplic ring. Here, again, as in other regions, there are present papillæ. The horn developed passes over and becomes superficial to the horn derived from the coronary band, and its relation to the latter part of the hoof wall is like that of a varnish. It has been termed, not inaptly, an epithelial varnish, and as such it acts. The newly-formed horn from the coronary band when submitted, as it sometimes unwittingly is, to desiccation, cracks; and, according to the extent of the crack, a lesion serious or not may arise, but fissures in the horny capsule are rarely seen, unless of traumatic or of violent origin, if the periople is still intact; and, doubtless, many cases of so-called brittle feet are due to a deficiency of secretion from the perioplic ring. The periople passes down over the wall as a thin pellicle of horn, and may be traced as far as the clenches, where it commences to break down, and is removed as flakes.*

The corium consists of interlacing bundles of white fibrous tissue, with a varying quantity of elastic fibres. Its surface is papillated, *i.e.*, it is broken up by innumerable conical prominences, which, though of small size in most situations, attain a relatively enormous development in others, such as the coronary band, sensitive sole, frog, etc.

## A. THE HORN-SECRETING STRUCTURES.

In the foot, stripped of its horny covering, five great divisions of the horn-secreting corium may be recognised. In front and at the sides, the perioplic ring, coronary band, and sensitive laminæ; below, the sensitive sole and the sensitive frog. To prepare a specimen for study, the foot may be macerated in water for a few days. In from four to eight days, according to the prevailing temperature, the hoof can be detached from the vascular structures it covers. To preserve its form the hoof, when removed, may be filled with liquid plaster of paris: otherwise it loses its characteristic form on drying.

### 1. The Perioplic Ring.

(Figs. 40 and 41, *b*.)

The perioplic ring forms a band about one-sixth to one-quarter of an inch broad, lying between the hair-bearing skin and the coronary band, and extending completely round the foot to the bulbs of the heel. In front it is somewhat broader than at the sides, but its greatest breadth is attained close to the bulbs, over which it extends to blend imperceptibly with the frog. The perioplic ring, though somewhat deeper seated than the hair-bearing corium, cannot be sharply differentiated from it. On careful examination under water, it will be noted, however, that between the last hairs are little papillæ belonging to the perioplic ring. The division between the coronary band and perioplic ring is indicated by a well-marked, sharply-defined linear depression, the coronary groove (*Kronenfalz* of Möller).

The outer surface of the perioplic ring bears numerous, closely-arranged, fine papillæ, from one to two twenty-fourths of

* I am indebted to Professor Mettam for kindly supplying the foregoing passages (pp. 61–67) on the skin.—[Jno. A. W. D.]

an inch in length, which, from their close apposition, give to this part of a freshly-stripped foot a shining appearance, especially when the surface is rubbed with the finger or with any hard body, thus at once distinguishing the perioplic ring from the hair-bearing cutis above, which has a finely-punctated appearance, and from the coronary band, which has a rougher look. The perioplic ring produces the soft horn of the periople and the superficial layer of the wall. The periople has been regarded as a portion of the coronary band; but, as the horn which it secretes differs in many respects from that of the coronary band, it has been thought well to distinguish it from that structure, and to regard it as a separate portion of the horn-secreting corium.

To show that this superficial layer of horn is not merely a layer of epidermis, which it was long thought to be, a foot should be sawed through in a circle about an inch below the coronet until the sensitive structures are reached, and macerated for a few days. The portion thus divided may then be separated from the other parts of the hoof, and, with the exercise of some care, may slowly be detached from the foot. During the act it will be seen that the fine papillæ of the perioplic ring, described by Leisering, are drawn out of their horny sheaths, just as the papillæ of the coronary band are drawn from the depressions in which they lie in the horn of the coronet.

## 2. The Coronary Band.

(Figs. 40 and 41, *c.*)

The coronary band is a rounded structure about $\frac{3}{4}$ of an inch wide, which encircles the foot from the region of one bulb to that of the other, and is situated between the perioplic ring and the upper extremities of the sensitive laminæ. It is divided from the perioplic ring by the above-mentioned "coronary groove," and is so related to the underlying parts that, at the front of the foot, its upper border extends above the highest part of the pyramidal process of the pedal bone, and lies in front of the lower third of the coronet bone, where it covers the extensor pedis tendon. Its sides stretch obliquely backwards and downwards, covering the lateral surfaces of the coronet bone and the supero-anterior part of the lateral cartilage. Its posterior portions, however, are overtopped by the lateral cartilage, and by the perioplic ring (compare fig. 41). The coronary band is convex on its anterior surface, and is broadest and strongest above the toe. Towards the sides it somewhat diminishes in size and becomes less prominent, until, in the region of the bulbs, it almost altogether loses its convex shape, becoming nearly flat.

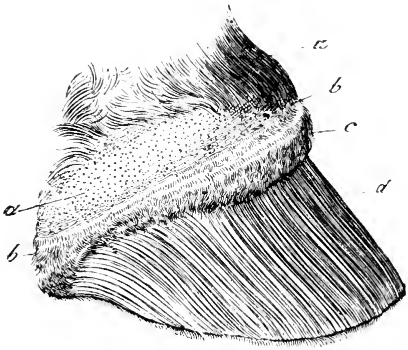



FIG. 40. —Foot deprived of horny capsule. *a*, corium, bearing hairs; towards the left the hairs have been removed by gentle stroking. *b*, perioplic ring; *c*, coronary band; *d*, sensitive wall; at the base of the laminæ can be seen papillæ.

The coronary band exhibits numerous papillæ, which, though they vary greatly in length and thickness, are, as a whole, much longer and stronger than those of the perioplic ring. They are best marked in the lower third of the band, where the strongest of them are to be found, as can easily be seen by examining the upper part of the hoof after removal. The length of these papillæ varies in general from $\frac{1}{6}$ to $\frac{1}{4}$ inch, though Leisering has seen some as short as $\frac{1}{12}$ inch and others as long as $\frac{1}{3}$ inch. These papillæ, however, do not cease at the junction of the coronary band and plantar cushion, but are reflected in the form of two converging rows, about $\frac{1}{4}$ to $\frac{1}{2}$ an inch in breadth, over the postero-inferior parts of the foot, between the margins of the sensitive laminæ and of the

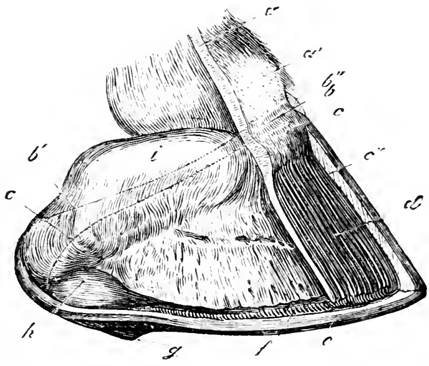



FIG. 41. - Foot from which the outer portion of the horn wall and the greater part of the sensitive structures have been removed, so as to show their relations to the lateral cartilage. *a*, divided surface of the hair-bearing corium; the cut is continued perpendicularly downwards through the sensitive wall, showing that the latter is only a continuation of the former; *a'*, hairless portion of hair-bearing corium: *b*, perioplic ring; *b'*, line indicating its upper border; *b''*, section of perioplic horn; *c*, coronary band; *c* (to the left), line indicating the upper border of the coronary band; *c''*, section of wall at toe; *d*, sensitive wall; *e*, horny sole; *f*, white line; *g*, horny frog; *h*, plantar cushion; *i*, lateral cartilage.

sensitive frog. Immediately in front of the point of the sensitive frog they mingle with and are lost amongst the similarly-formed papillæ of the sensitive sole. It is these rows of papillæ on the inferior surface of the foot which produce the bars. From their union with the papillæ of the sole (compare fig. 43) it will be clear that the bars and sole are structurally continuous, a point to which we shall later refer. The convex form of the coronary band depends partly on a considerable thickening of the cutis (see fig. 41, *c*, section of the corium), which, at this point, is very firm in texture, indeed of almost cartilaginous consistency; partly, however, from the richness of this region in blood-vessels (see fig. 36, *B*). The coronary band produces the central portion of the horny wall.

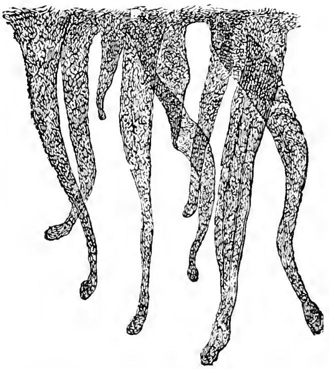


FIG. 42.—Horn-secreting papillæ from the coronary band; magnified.

### 3. THE SENSITIVE LAMINÆ.

(Figs. 40, 41, *d*, and 43, *a*.)

The corium below the coronary band presents a very different structure from that above. Certain portions become thinner (compare with section in fig. 41), and the tissue shows, instead of papillæ, a large number of parallel closely-packed leaves, which extend in straight lines from above downwards and forwards. These leaves are termed the sensitive laminæ. The portions of the cutis bearing such leaves may be collectively termed the sensitive wall.

The sensitive wall covers the anterior surface of the pedal bone and the lower portion of the lateral cartilages. Towards the back of the foot the two sides approach the middle line, forming an acute angle, and are inclined towards each other from above downwards. At the heels the sensitive wall of either side is sharply reflected forwards at an acute angle with its former course, and lying between the papillæ of the sensitive sole and those of the reflected coronary band (already described), forms a strip about 1 to $1\frac{1}{4}$ inches wide, which secretes the second (laminal) constituent of the bars. We, therefore, see that the bars are compound in origin, and may theoretically be divided into a "coronary" and a "laminal" portion.

Although, when the hoof is removed, the isolated sensitive laminæ appear to lie closely packed together, they are really divided by deep furrows, which, in life, accommodate the horny laminæ of the wall. The sensitive laminæ may be compared to the leaves of a book,—that is, they are fastened by their posterior margin to the corium covering the pedal bone and vessels, whilst their anterior margin and lateral surfaces are free. The isolated laminæ are very narrow above, just below the coronary band, and become broader as they descend, attaining their greatest breadth at the centre, which breadth they preserve as far as the ground, decreasing, however, in thickness, so that at the base they are markedly thinner. They terminate in papillæ resembling those of the sensitive sole. The "toe" of the foot presents the broadest and most numerous laminæ. Towards the sides and quarters they become narrower and more widely spaced. In the bars they are most slender and widest apart. In a similar way the laminæ of the toe are the longest; those of the quarters become shorter and shorter, until they gradually cease. Their breadth varies from $\frac{1}{25}$ to $\frac{1}{8}$ of an inch, their length from $\frac{1}{12}$ at the bars to 2 or 3 inches at the toe, depending on the size of the foot. The number of laminæ is not always the same. As a rule, there are about 25 to a centimetre at the toe,* 21 to 22 at the quarters, 15 to 17 at the heels, and at the bars only about 10, so that the entire number may be estimated as between 550 and 600, depending on the size of the foot.

To the naked eye the laminæ appear quite flat, but under the microscope they are seen to present a number of small projections which have been called secondary laminæ, running more or less in the same direction as the laminæ; in fact, each lamina reproduces the same structure in miniature as the entire sensitive wall. The sensitive laminæ produce the laminal portion of the wall, and serve especially to connect the corium and the horny wall. The strength of this elastic connection is greatly increased by the enormous surface presented by the secondary laminæ (compare with fig. 50).

* Two and a half centimetres equal nearly one inch.

Möller distinguishes in the sensitive wall three layers, viz., (1) the periosteal layer (stratum-periostale); (2) the vascular layer (stratum-vasculosum); and (3) the real laminal layer (stratum-phyllodes), corresponding to the corium of other parts of the body. Möller estimates that at the junction of the upper and middle thirds of the toe primary laminæ are from $\frac{1}{240}$ to $\frac{1}{120}$ inch, and the secondary laminæ from $\frac{1}{600}$ to $\frac{1}{300}$ of an inch in thickness. At the lower end of the wall the primary laminæ are about $\frac{1}{480}$ inch, the secondary about $\frac{1}{1200}$ to $\frac{1}{480}$ inch. At the centre of the toe, in many cases, a small depression may be found, which extends on to the wall, and contains papillæ corresponding in position with the little rounded prominence to be found at the toe of the horny capsule.

## 4. The Sensitive Sole.
(Fig. 43, *b*.)

The corium, after clothing the wall, is reflected over the lower border of the pedal bone to the sole, and then loses its laminal character, except at the bars, exhibiting instead papillæ which partly resemble those of the perioplic ring, partly those of the coronary band. The portion of the under surface of the foot covered by long, thick papillæ, like those of the coronet, is termed the sensitive sole (fig. 43, *b*). This, often flecked with black colouring material, or irregularly tinted, includes the entire anterior third of the under surface, and is divided into two parts by the sensitive frog, between which and the sensitive sole, however, intervene the bars. The sensitive sole is connected, as already remarked, with the coronary band by a number of rows of large papillæ insinuated between the "laminal" portion of the bars (secreted by a continuation of the sensitive laminæ) and the sensitive frog. The sensitive

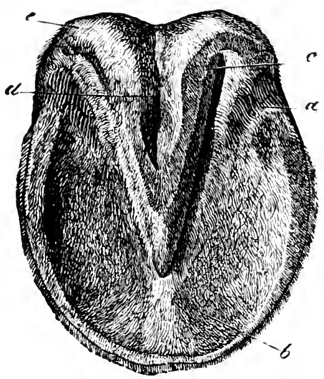



FIG. 43.—Lower surface of foot denuded of horny capsule. *a*, sensitive bars; *b*, sensitive sole; *c*, sensitive frog; *d*, furrow of the frog into which the "frog-stay" fits; *e*, bulbar expansion of perioplic ring, which is seen to be continuous with the sensitive frog.

sole carries a very well-marked venous plexus, and produces the horn of the sole.

### 5. The Sensitive Frog.
(Fig. 43, *c*.)

The sensitive frog is that portion of the corium which covers the plantar cushion. It clothes the groove of the frog (*d*), and insensibly unites in the neighbourhood of the balbs (*e*) with the perioplic ring, so that no distinct boundary can be drawn between them. In general, the sensitive frog is not so well supplied with vessels as the sensitive sole, and, therefore, presents a lighter colour. The papillæ on the lower surface are somewhat longer than those at the sides and base. The sensitive frog produces the horny frog.

Under the term sensitive frog is often included the plantar cushion, together with its horn-secreting covering. This, however, is anatomically incorrect. The sensitive frog clothes the plantar cushion in the same way as the sensitive sole clothes the under surface of the os pedis, and the sensitive wall the laminal surface of this bone. The plantar cushion and the horn-secreting surface are entirely different structures. The former is not a mere thickening of the latter, but a tissue, formed of elastic and fibrous components, which fulfils a special physiological function.

## B. THE HORNY STRUCTURES.

The collective masses of horn produced by the active epithelium of the foot are termed the hoof (fig. 44). This presents the appearance of a capsule enclosing the lower end of the limb, and comports itself towards the latter much as a shoe to the human foot. The connection between the horny capsule and the corium is so intimate that in the healthy tissues the two can never be dissected apart. Only in certain diseases of the foot do the sensitive and insensitive parts of the foot become more or less disunited. Occasionally, and in very severe cases, the hoof may, however, part from the corium, but after death decomposition very soon loosens the connection, the line of separation occurring along the row of cells from which the inner portion of the horny capsule is developed.

The hoof may be divided into three different parts, which, however, though differing from one another in essential particulars, must, on account of their position and function, be looked on as three parts of one and the same structure. No one of these portions can be removed without injury to all and without weakening all. Their indivisibility and mutual interdependence are best understood by carefully regarding the interior of a hoof after removal. At no point can sharp divisions be recognised; each part unites and becomes continuous with the other. The three parts of the hoof are wall, sole, and frog.

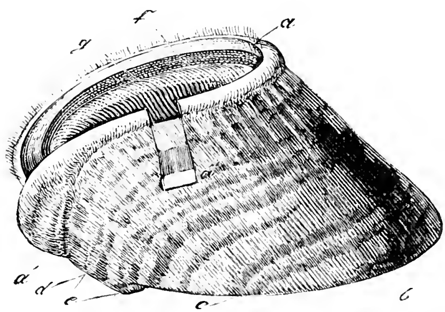



FIG. 44.—Hoof with vascular structures removed. *a*, periople; owing to maceration in water this is swollen and prominent; the outer border exhibits adherent hairs, the inner fine punctations. Towards the heels (*a*′) the periople is seen to broaden out and become continuous with the horny bulbs. At *a*″ a portion of horn has been removed. From the point to *b* constitutes the toe, from *b* to *c* the quarter, and from *c* to *d* the heel of the foot; *e*, projecting portion of frog; *f*, coronary furrow or cutigeral groove, showing numerous punctations; *g*, laminal sheath of wall.

## 1. The Horny Wall

Is that part of the hoof which is visible when the horse is standing (fig. 44), and which protects the foot in front and on either side. If we compare the foot with a man's shoe, the wall represents the upper, though, with this difference, that it extends down to the ground and embraces the sole.

The horny wall exactly responds both in position, course, and direction, as well as in the combination of its various parts, to the sensitive structures that produce it. It extends obliquely downwards from the border of the skin, decreasing in length (or height) towards the back. At the heels it bends inwards at either side (compare figs. 45, 46, and 47), runs for a short distance in a forward direction, and gradually becomes lost in the sole. The horny wall, therefore, does not surround the foot like a ring, but its extremities are infolded and inclined towards each other, forming three angles, the middle posterior angle being open at the back for the reception of the frog, the two lateral facing forwards and grasping the posterior prolongations of the sole.

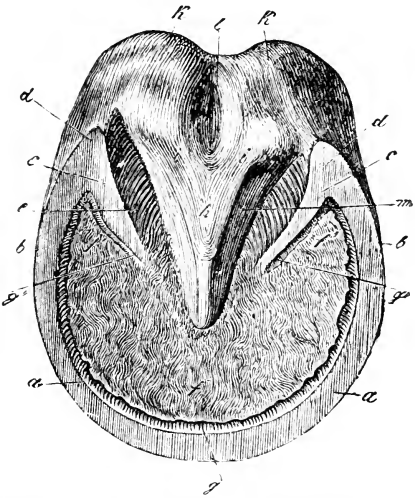



FIG. 45.—Under surface of right fore-foot. *a*, *a*, bearing surface of toe; *a*. *b*. of quarters; *b*, *e*. of heels; *d*, commencement of bars; *e*, lateral aspect of bars; *f*, sole; *f′*. seat of corn; *g*, white line, which is seen to be reflected forwards between sole and bars at *g′*; *h*, horny frog; *i*, bulb or glome of frog; *k*, bulb of heel; *l*, median lacuna or cleft of frog; *m*, lateral lacunæ of frog.

The horny wall presents an outer (anterior) smooth, slightly ribbed, or undulating surface, convex from side to side (fig. 44), and an inner (posterior) and correspondingly concave surface (figs. 47 and 48): an upper border in contact with the cutis, and a lower which marginates the sole. The upper (fig. 44, *a*) is generally known as the coronary border, whilst the lower (figs. 45 and 46, *a*) is termed the plantar or bearing border.

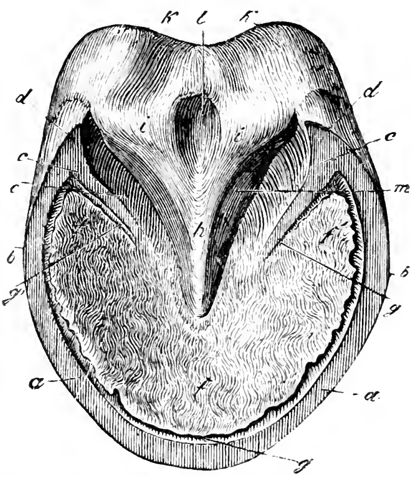



FIG. 46. Under surface of right hind-foot. The lettering is as in fig. 45.

For convenience of description the wall may be divided by imaginary vertical lines; thus, one drawn through the centre of the hoof will divide the wall into an inner and an outer half (inner and outer walls), or four lines may be so drawn as to divide the wall into five equal parts, termed respectively the toe, the inner and outer quarters, and the inner and outer heels.

(*a*) The anterior portion or toe (fig. 44 from the point of the toe to *b*, and figs. 45 and 46 from *a* to *a*) extends on either side of the middle line for a distance equal to about one-tenth of the entire circumference of the foot; it, therefore, comprises about one-fifth of the whole extent of the wall.

(*b*) The quarter (fig. 44, *b* to *c*, and figs. 45 and 46, *a* to *b*) extends backwards from the boundary of the toe, on either side, for a like distance.

(*c*) The heel (fig. 44, *c*, *c*, and figs. 44 and 45, *b*, *d*) includes the parts between the boundary of the quarter and the inflection of the bars.

(*d*) The inflection of the bars (figs. 45 and 46, *d*, 47, *a*, *b*) is the spot where the wall turns in a forward direction, forming an angle.

(*e*) The continuation of the wall in a forward direction between the sole and horny frog is named the bars (figs. 45 and 46, *e*, and fig. 47, *e*).

The direction, length, and thickness of the wall at the toe, quarters, and heels respectively, vary not only in the fore and hind feet of the same horse, but even in the two halves of the same hoof.

In the normal hoof the wall of the toe has the greatest inclination to the ground surface, forming in fore-feet an angle of 45° to 50°, in hind-feet of 50° to 55°. This inclination is less at the quarters and heels, where the wall becomes nearly perpendicular. It may, indeed, surpass a right angle, the wall in such cases running from above downwards and inwards. The angle between the quarter and the ground surface is always greater in the outer portion of the wall, the reason being that the outer wall describes a larger circle than the inner (compare figs. 45 and 46).

The fact that the wall slopes outwards renders it evident that the circumference of the foot must be greater at the bearing than at the coronary margin (compare fig. 44).

The height of the wall decreases from the toe to the inflection of the bars, and to a greater proportionate extent in fore than in hind feet. No exact measurements can be given, as so much depends on the race, age, use, conformation, etc., of the animal, and great differences may exist without necessarily rendering the hoof abnormal. The length of the toe, as compared with that of the quarters and heels, depends on the angle of the foot, and is about in the proportion of 3 : 2 : 1, as $2\frac{1}{2} : 2 : 1$ or as $2 : 1\frac{1}{2} : 1$.

The thickness of the wall varies greatly; from the toe to the heels it gradually diminishes, and more markedly in fore than in hind feet, the exact rate, however, depending on the size and form of the hoof and the breed of the animal. The larger and the more oblique the hoof the thicker its walls; the more nearly vertical the wall the less its thickness. Coarse-bred horses, as a rule, have thicker walls than finer breeds. According to Mayer, careful measurements gave the following results, which are indicated in millimetres:—

| | Toe. | Outer and Inner Quarters measured at Junction with Heel. | |
|---|---|---|---|
| Fore-foot of pure Arab. . . . | 9 | 7 | 5 |
| Hind-foot of pure Arab, . . . | 8·5 | 7 | 6 |
| Medium-sized fore-foot of well-bred horse. . | 13 | 8 | 7 |
| Hind-foot of well-bred horse, . . . | 11 | 8 | 7·5 |
| Large fore-foot of coarse-bred horse, . . | 16 | 11 | 10 |
| Hind-foot of coarse-bred horse, . . | 13 | 10 | 9 |
| Small upright fore-foot, . . . | 10·5 | 8·5 | 5 |
| Small upright hind-foot of the same horse, . | 10 | 6 | 5·5 |
| Average thickness, . . | 11·37 | 8·18 | 6·87 |

These figures, which in general agree with many measurements made by Leisering, show that the toe of the fore-foot is, in general, a thicker toe than that of the hind in the same horse. Vertical sections, however, show that the thickness of the wall at any given point is the same from coronet to ground surface.

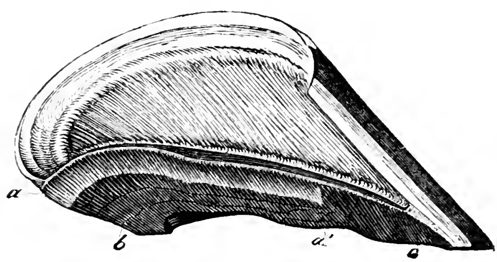



Fig. 47.—Mesial vertical section of hoof with horny frog removed, to show the disposition of the bars. At *a*, *b* the wall is reflected inwards and forwards to form the bar which finally amalgamates with and is lost in the sole at *c*; *a*, *a′* (the lighter tinted part) shows the spot from which the horny frog has been removed.

The angle of the bars (figs. 45 and 46, *d*) is, as stated, the point where each half of the wall is reflected in a forward direction. As the wall and bar are continuous, the result is to produce at the heel a strong three-cornered mass of horn, from which the bar runs obliquely downwards and forwards, in contact with the posterior part of the corresponding limb of the frog.

The bars are a continuation of the wall, which turns inward at the angle just mentioned. They run forward on either side of the frog, following its general direction, though, as they gradually become continuous with the horny sole, they do not actually reach the point of the frog. The bars are inclined to the perpendicular, so that their upper borders approach more nearly to the middle line of the foot than the lower, which are closer to the wall. In other words, the lower borders are wider apart than the upper. Each bar, therefore, has one surface turned towards the middle line of the hoof, and one turned from it, the former being the lower or inner, the latter the upper or outer (figs. 45 and 46, *e*). The upper surface lies within the horny capsule and bears horny laminæ. The lower, on the other hand, is free, and is bounded on one side by the furrow marginating the frog (lateral lacuna of the frog); its upper part unites with the upper part of the corresponding side of the frog (compare with the light-shaded portion in fig. 47, *a* to *a′*). The upper border (fig. 48, *e*) is to be regarded as a prolongation of the coronary groove, and is punctated; the lower border comports itself like the bearing surface of other portions of the wall (figs. 45 and 46).

The relations of the bars are often erroneously described. Certain authors believe that they extend as distinct and well-defined portions of the wall to the point of the frog, and there come in contact. This, however, is certainly not the case, though it might appear so on superficial examination.

Their real extent is at once seen by studying the inside of a hoof after removal. As only those parts which exhibit laminæ can be regarded as wall, the presence of laminæ may be taken as showing exactly how far the bars extend. A study of the lower sensitive surface, on the other hand, may easily lead to errors, and for two reasons. Firstly, because the bars, like every other part of the wall, grow in an oblique direction downwards and forwards, but also towards the bearing surface of the wall. Under these circumstances, they extend further forward on the ground than on the upper surface of the sole.

Secondly, because the sensitive bar insensibly fades into the sensitive sole, both being marginated by the frog; as, however, the horn of the sole wears away in the same direction as that of the bar, and the two unite close to the lateral lacuna of the frog, it is clear that no hard and fast line can be drawn between the two on this surface.

By examining the surface of the hoof, however, first discovering the white line between the sole and bar and following this, it becomes clear that the line (figs. 45 and 46, *g'*) never attains the point of the frog, always ceasing somewhat short of it, and, therefore, that the bars and sole are united into one mass a little behind the point of the frog. The bars must accordingly be regarded as an important means of union between the horny wall and horny sole. At all other points, and over a much more extensive area, the two portions of the hoof are united through the medium of the white line—a much weaker and less rigid method of union. This fact is not without importance in connection with the physiology of the foot.

The wall may be divided into three superposed layers, corresponding to the position of the epidermis from which they arise.

A. The periople is the most superficial and is formed by the perioplic ring. It consists of soft horn, which in living animals is yielding, very elastic, and when dry presents a glistening appearance. In horses which have stood for a considerable time in water, or in dead feet, which have been macerated, this horn swells up, becomes white, and exhibits a fibrillated character. It then forms a soft, elastic, convex strip of varying breadth (fig. 44, *a* to *a'*, and fig. 48, *a*), which extends around the foot parallel with the groove below as far as the bulbs of the heel. It is somewhat broader at the toe than at the quarters. At the heels it increases in width and is prolonged over the soft structures of the bulbs (*a'*). The perioplic horn of either side becomes continuous at the heels, where it extends upwards in a point, rising rather above the highest part of the frog. When removed by maceration, it presents the appearance of a broad strip, the inner surface of which is free above, but below covers and is attached to the upper part of the wall and the posterior portion of the frog, with the horn of which it imperceptibly unites. Its upper (free) portion is punctated, the small holes accommodating the horn-secreting papillæ of the perioplic ring. Fresh sections of the entire foot (fig. 41, *b″*) show that its surface is convex and that it extends into the depression exhibited by the coronary band.

Although the perioplic horn is most distinct and easily seen at the upper border of the hoof, at which point it forms a light-coloured ring and extends towards the bulbs of the heels, it is by no means confined to these points. With the exception of the bars it covers all portions of the wall (fig. 44, *a″*), giving the hoof a more or less shiny appearance. Hoofs which have been rasped, and the hoofs of horses which work continuously in loose ground, have usually lost this thin layer, though it may be found at the heels close to the frog, and near the upper margin of the wall, whence it is less frequently rasped away. The hoofs of young equines always show it.

This sheath has been the subject of most varying views. Some altogether deny its existence; others regard it as a prolongation of the cuticle, but such views chiefly depend on want of close observation. Leisering regards it as a layer of soft horn, produced by the perioplic ring. It is easily seen in animals which have been shod and in which the sheath has been partially torn away. Macerated dead feet exhibit it very distinctly. The soft striated prolongation from the perioplic ring, which is then easy to follow, shows beyond doubt the direct communication between the sheath and perioplic ring, and the correctness of the statement that the sheath grows from the ring. On drying, the whitish look of the sheath disappears and is succeeded by a brittle, shiny appearance.

The essential difference between the periople (and its expansion at the heels) and the horn of the wall or frog is well seen by studying the development of the parts. In a 20–24-week fœtus, a sharply marked strip will be found between the future cutis and the hoof, indicating the position of the perioplic ring, and showing no visible horn formation, whilst the wall, sole, and frog are already quite covered by masses of young horn.

B. The middle sheath is produced by the coronary band, and is by far the strongest of the three. It consists of a very tough, strong, and durable horn, which scarcely swells up in water and is the most difficult to cut of all the varieties of horn. It forms the principal mass of the wall. The middle sheath begins at the furrow (figs. 44, *f*, and 48, *b*) formed by its upper border, which is known anatomically as the "cutigeral groove." This groove is broadest in front, becoming narrower as it passes backward, and accommodates the coronary band. In the neighbourhood of the bulbs it is reflected downwards and forwards, loses its concave shape,—in fact, ceases to be a groove,—and is continued by a slightly convex or flattish strip (fig. 48, *c*), which indicates the upper border of the bars. Its course is in a forward direction between the horny frog and the continuation of the innermost sheath of the wall, until finally it is lost in the upper surface of the horny sole.

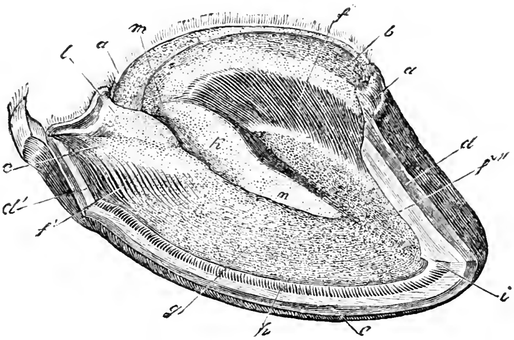


FIG. 48.—A portion of the wall has been removed by making vertical cuts through the wall of the toe and heel, and a horizontal cut connecting them just above the bearing margin. *a*, periople; *b*, coronary furrow or cutigeral groove, which is seen to become reflected forwards at *c*, and to form the upper border of the bar; *d*, the middle sheath at the toe, and *d'*, at the heel; *e*, horizontal section of wall just above the bearing surface; *f*, laminal sheath; this is reflected inwards and forwards at *f'* to form part of the bar; *f''*, free edge of horny lamina, which is continuous with the white portion of the middle sheath; *g*, horny sole; *h*, white line; *i*, small horny prominence at the centre of the toe; *k*, portion of frog which becomes continuous with the upper margin of the bar; *l*, frog stay, dividing the upper groove of the frog into two parts.

The floor of the cutigeral groove is closely punctated, the small holes being the openings of funnel-shaped depressions, in which rest the papillæ of the coronary band, and which have the general character shown in fig. 53. The holes in the coronary furrow are much larger than those in the perioplic ring. They vary, however, those in the lowest third of the furrow being rather larger and less closely packed than those in the upper. Next the laminal (innermost) sheath are one or two rows of still smaller holes. Generally speaking, where the holes are of large size the inner surface of the middle sheath is coloured white, even where the entire wall is dark coloured; in light-coloured feet this part is distinguished by its still paler tint. The fact can easily be verified on section. This division of the middle sheath into an outer, hard and dark, and an inner, soft, tough and light-coloured portion is of some practical importance, as the two sometimes become separated, probably in consequence of their unequal hardness.

The outer surface of the middle sheath in perfectly normal feet often presents transverse rings which must not be confused with those resulting from diseases of the feet. The middle sheath is the chief constituent of the wall, which extends below the sole and forms the bearing margin of the foot.

C. The laminal or connecting sheath (figs. 44, *g*, 47 and 48, *f*) is the innermost layer of the wall; it consists of a large number of closely packed horny laminæ, which cover the inner face of the inner sheath from the lower margin of the cutigeral groove to the horny sole.

The laminal sheath is moulded on the sensitive laminæ, and formed by the epithelial cells covering them. The horny laminæ interdigitate with the sensitive laminæ, so that each sensitive lamina is grasped by two horny laminæ and each horny lamina by two sensitive laminæ. As the inner sheath approaches the bars, its laminæ decrease in length to disappear altogether in the bars themselves (fig. 48, *f′*), the upper surface of which (corresponding to the middle sheath of the wall) it covers. In freshly stripped hoofs the individual laminæ feel smooth and slippery, and can be moved to and fro, but when dry they become stiff and usually assume a wavy contour. In number, course, breadth, etc., they correspond exactly with the sensitive laminæ, of which they form the counterpart; their free borders, therefore, point inwards towards the centre of the foot. The upper end of a horny lamina begins at the lower margin of the cutigeral groove and is slender, as is the lower end (fig. 49, *a*), which seems to become smaller and to disappear where it meets the sole. Between the horny laminæ, at this point, are little holes (fig. 49, *b*) for the reception of the papillæ of the corium, which lie at the lower ends of the sensitive laminæ. The diminution in size and disappearance of the horny laminæ is only apparent; in point of fact, they preserve their entire breadth between the second sheath of the wall and the horny sole, which parts they unite by means of the horn secreted in their interspaces. This arrangement can readily be verified on vertical section. The horny laminæ lying between the wall and horny sole, together with the horn filling their interspaces, are termed the white line, as will be explained in treating of the horny sole.

If more closely examined the individual laminæ in the fresh state are each seen to present a striped appearance (fig. 56, *d–e*), the striations extending in an oblique direction from the free border upwards and outwards; attempts to tear through a lamina succeed best when made in this direction (fig. 56, *f*). Until recently, it was generally stated that the horny, like the sensitive, laminæ possessed secondary laminæ running in the direction of their greatest length. Professor Mettam, however, who has given special attention to the subject, is sceptical of the existence of secondary

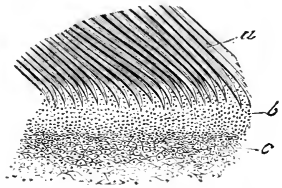



FIG. 49.—A portion of the inner surface of the hoof where horny wall and horny sole join (about natural size). *a*, laminal sheath; *b*, line of union; between the individual laminæ are seen spaces which accommodate the horn-secreting papillæ; *c*, horny sole.

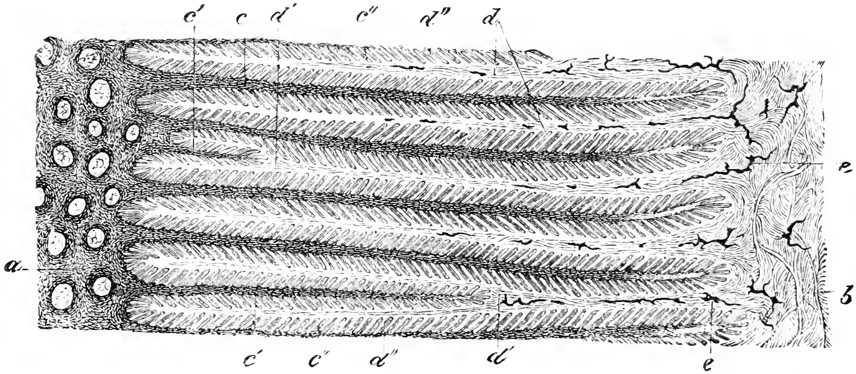



FIG. 50.—Transverse incision through the laminal sheath. *a*, inmost part of the middle sheath; the horn tubules are seen to reach right up to the horny laminæ; *b*, body of the sensitive wall; *c*, cornified portion of laminæ connected with middle sheath of wall; *c′*, irregular laminæ, which do not extend as far as body of sensitive wall; *c″*, non-cornified portion of rete mucosum; *d*, vascular laminæ; *d′*, vascular laminæ which during development have split, thence given rise to the irregular horny laminæ *c′*; *e*, injected artery.

horny laminæ. He says:—"The cells formed by the secondary sensitive laminæ had not changed to horn, and consequently, when a section of the horny wall and laminæ is viewed, no projections are seen on the latter." The relation of the horny to the sensitive laminæ will be seen by reference to fig. 50, which represents a transverse section of these parts. The innermost or laminal sheath is the real means of union between the horny wall and sensitive laminæ, because the former is the derivative of the latter and intimately united to the middle layer.

Fambach's researches ("Beitrag zur Anat. und Physiol. der Blättchenschicht des Pferdehufes," *Der Hufschmied*, iv., Jahrgang 1886, pp. 137 and following) on twenty-four horses show that the average number of horny laminæ is 554. Fambach states that at the toe fifty laminæ occupy an average space of 18·5 millimetres; at the quarters 23 millimetres; at the heels 29·36 millimetres, and at the bars 38·9 millimetres. Fambach specially mentions that there is a distinct difference between flat hoofs (that is, such as form an angle of less than 45°) and upright hoofs. In flat hoofs the spaces between the laminæ become relatively greater towards the heel, while in upright hoofs they remain approximately the same.

Fambach further found that the depth or breadth of a horny lamina—that is, the distance between the horny wall and the free central margin of the lamina—was in direct proportion to the thickness of the wall with which it was connected. In flat feet the laminæ at the heels were narrower in proportion to the thinness of the wall. According to his measurements, which were in each case made in the centre of the particular section of the wall and perpendicular to the laminæ, the depth (or breadth) was:—

| In Flat Feet. | | In Upright Feet. | |
|---|---|---|---|
| At the toe, | 4 to 5 mm. | At the toe, | 3½ to 4 mm. |
| ,, quarter, | 3 to 4½ ,, | ,, quarter, | 2½ to 3½ ,, |
| ,, heel, | 1 to 2½ ,, | ,, heel, | 2½ to 3 ,, |

## 2. The Horny Sole
### (Figs. 45 and 46, *f*, and 48, *g*)

Is produced by the sensitive sole, and takes the form of a strong plate, covering the greater part of the under surface of the foot. It consists of hard horn, which, however, is not so tough as that of the wall. After a time, portions loosen in the form of flakes or plates, and either break away by themselves or are removed in shoeing, so that the sole never exhibits the smoothness of the wall, but has a rough, uneven appearance. The detached pieces are often so changed that they can readily be reduced to a pulverulent mass, nor does even the newly-formed horn close to the sensitive sole exhibit the firmness of the horny wall; it can easily be cut with a knife, and permits of foreign bodies, like nails, penetrating much more easily than that of the wall. The horny frog and bars complete the under surface of the foot. They are inserted into the triangular, wedge-like space which the sole exhibits towards the back, and which divides it into an anterior continuous part, termed the body (figs. 45 and 46, *f*), and two posterior parts, separated

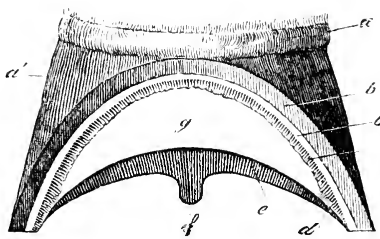



FIG. 51.

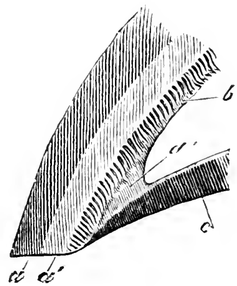



FIG. 52.

FIG. 51.—Vertical transverse section of hoof with very thin sole. *a*, periople, continued over the entire wall as indicated by *a'*: *b*, middle sheath, showing at *b'* its white tint; *c*, laminal sheath: *d*, union between laminal sheath and sole (white line); *e*, sole (excessively trimmed): *f*, point of frog; *g*, space occupied in life by pedal bone and vascular structures.

FIG. 52.—Left lower part of above section (natural size). *a*, middle sheath: *b*, laminal sheath, continued as far as the ground surface; *c*, sole; *d*, yellow soft tubular horn between wall and sole, to be found also between the individual laminæ.

by this space, the branches or wings of the sole (figs. 45 and 46, *f'*).

The sole presents an upper and a lower surface, an anterior semicircular and a posterior indented border, as above noted. The upper surface is convex (fig. 51, *e*) and lies in contact with the sensitive sole. The highest part is above the point of the horny frog (*f*); whence it slopes downwards towards the wall both in front and at the sides, rising again, however, to a slight extent in the immediate vicinity of the wall.

Exactly in the middle line of the toe, where the sole joins the wall, is a small but distinct prominence (fig. 48, *i*), which extends on to the wall and corresponds to the excavation in the sensitive wall mentioned on page 72. It is difficult to ascribe any particular purpose to this prominence, which is not invariably present. The degree of convexity of the upper surface of the sole varies greatly in different hoofs, being, *cæteris paribus*, greater in hind than in fore feet, while in diseased hoofs it may be entirely suppressed or the hoof may even be concave.

The upper surface of the sole, like the cutigeral groove, is dotted with small holes, the openings of little funnel-shaped canals of varying size, which lodge the horn-secreting papillæ of the sensitive sole.

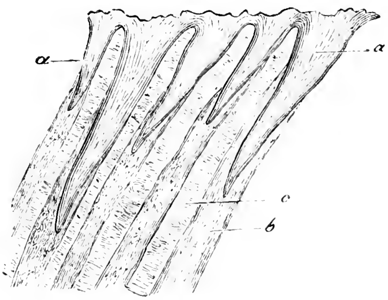


FIG. 53.—Vertical section from sole, magnified. *a*, funnel-shaped openings in which are lodged the horn-secreting papillæ of the sole; they vary in size; *b*, horny tubules; *c*, intermediary horn.

The under surface usually presents a concavity corresponding to the convexity of the upper, though in horses kept in the stable this space may be filled by masses of horn which would otherwise have been shed. In a normal foot the most marked concavity is near the point of the frog, whence the sole falls towards the wall.

The outer border of the sole is usually somewhat weaker than the centre. It corresponds in shape to the form of the wall, that is, in fore-feet it is nearly circular, in hind-feet more or less oval, and is attached to the lower portion of the wall through the medium of the white line. The inner triangular space for the reception of the frog is bordered, not by the sole, but by the bars, which throughout its greater extent can be differentiated from the sole by following the white line. The anterior part of this border is formed by a fusion between the horn of the bars and sole; to it is attached the point of the horny frog.

The white line (figs. 45, 46, *g*, and 48, *h*) consists of portions of the laminal sheath of the wall, which by continued growth are carried down and appear between the horny sole and the bearing surface of the wall. On careful examination, the individual laminæ may be distinguished at the white line as small, whitish, parallel streaks lying close together. The intervals between the separate horny laminæ, filled, within the foot, by the sensitive laminæ, are in the white line occupied by a yellowish, semi-transparent, waxy horn (fig. 52, *d*), which is softer and more yielding than the horn of the sole. This horn is produced by the papillæ, which are situated on the border between sensitive wall and sensitive sole, and are in many cases merely the terminations of sensitive laminæ.

The mixed horn of the white line is soft, breaks down more readily than that of the sole, forming a whitish pulverulent material, easily distinguished by its colour from the horn of the wall and sole, hence the name "white line."

The white line is of special importance in shoeing, as it indicates the thickness of the wall. Separation between the horny wall and horny sole in the white line gives rise to the condition termed "loose wall."

Wherever the horny wall exhibits horny laminæ, it must necessarily show the "white line." On close examination it will be found that the white line does not cease at the angle of the bars, but that it is reflected, precisely like the horny wall, and runs forwards and inwards, at an angle, towards its fellow, dividing the sole from the bars for about half the length of the frog (figs. 45 and 46, *g'*). It is certainly not so apparent here as at the circumference of the sole, but this is explained by the fact that the corresponding portion of the laminal sheath is slender, and has thinner and fewer horny laminæ than the other parts: also, and principally, because the bars grow obliquely outwards and downwards, and, therefore, tend to cover these parts of the white line. In order to see the white line at this point, a considerable portion of the bar must be removed. In front of the anterior third of the frog it is no longer visible, the bars and sole here being united.

## 3. The Horny Frog.

(Figs. 35, 45, 46, 48, 54, and 55.)

The horny frog exhibits, in general, the form of the plantar cushion, or more precisely the sensitive frog on which it is moulded. Considered as a whole, it resembles a four-sided pyramid lying on one face, and thrust like a wedge into the triangular space bounded by the bars and sole at the back of the under surface of the hoof. The horn of the frog is soft, resembling that of the periople, is very elastic, and has been compared with india-rubber. In spite of its softness and the readiness with which it may be cut, it possesses considerable tenacity, and does not break like that of the sole, but tears away in shreds or larger masses.

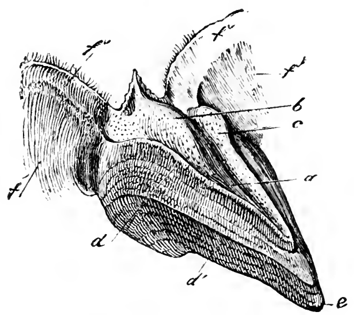



Fig. 54.—Horny frog removed from hoof, together with the periople and the expansion of the latter which covers the wall. *a*, depression divided into two by *b*, the frog-stay; *c*, portion of the horny frog which unites with the bars; *d*, portion of frog which above is in contact with the bar, but below, at *d'*, appears as a free surface; *e*, point of frog; *f*, periople; *f'*. perioplic sheath of wall.

The horny frog presents four surfaces and two extremities. The upper surface, which only becomes visible after removal of the hoof, is an exact though reversed reproduction of the plantar cushion, to which it stands in the same relation as does an impression to the seal producing it. It, therefore, resembles an elongated, triangular, flattish furrow (figs. 54, *a*, and 48, *m*), bounded by two lateral surfaces running obliquely downwards and towards the middle line (figs. 54, *c*, and 48, *k*), the whole fitting into the space between the bars. At the back of this depression and in the centre line rises a well-marked prominence, overtopping, more or less, the upper margins of the bars, and dividing the depression into two equal parts (fig. 48, *m*). It is called the frog-stay (figs. 35, *b*, 48, *l*, and 54, *b*), and exactly corresponds with the depression on the under surface of the plantar cushion into which it fits.

The two lateral surfaces of the frog-stay run obliquely downwards and outwards, and the part is, therefore, thicker below than above. Behind, its upper border is comparatively sharp and straight, but as it advances and descends becomes flattened, at length being lost at the bottom of the depression.

As the periople, with its posterior expansion, the horny bulbs, is united at either side with the frog-stay, and extends upwards into the cleft of the frog, it forms at the back of the hoof two shallow basin-like concavities, occupied by the rounded extremities of the plantar cushion (compare with horny bulbs, page 79).

The entire upper surface of the horny frog is permeated with small openings for the reception of the papillæ which secrete the horn of the frog. The under surface of the horny frog (figs. 45 and 46), which in the normal condition lies in the same plane with the bearing surface of the wall, is broadest behind and draws to a point in front. At its posterior part, corresponding to the frog-stay above, is a depression, the furrow or median lacuna of the frog (figs. 45, 46, and 55, *c*). The portions of the frog, bounding this furrow on either side, are termed its limbs (*i*). The upper portions of the lateral surfaces (fig. 54, *d*) are united with the upper and inner surface of the bars and with the sole (compare with fig. 47, *a*), the lower portions are free, and, aided by the corresponding inner surface of the bar, enclose a furrow termed the lateral furrow or lateral lacuna of the frog (figs. 45 and 46, *m*).

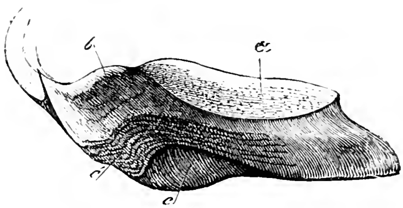


FIG. 55.—Vertical mesial section of horny frog. *a*, upper surface; *b*, frog-stay; *c*, cleft of frog, showing at *c'* overlapping layers of horn.

As the horn of the frog grows obliquely downwards and forwards, the antero-inferior extremity reaches further forward than the antero-superior (figs. 54, *c*, and 55). The posterior end or base of the frog is its broadest part. It is formed by the limbs of the frog, which here unite with the horny bulbs (figs. 45 and 46, *kk*). At this point also the well-marked perioplic horn covering the heel-wall becomes continuous with the horny frog.

# SECTION II.

# THE FUNCTIONS OF THE FOOT.

A KNOWLEDGE of the structure of its separate parts is the key to that of the functions of the foot as a whole. Only those who have acquainted themselves with the anatomy of the foot can thoroughly understand its action. In many parts of the foot the function is immediately apparent from a study of the formation, but in others close and careful consideration is required. Thus it is at once apparent, on examining the bones of the foot (fig. 11), or a longitudinal section (fig. 10), that the bones form the basis for the attachment of other parts, and may be regarded as the framework of the machine. The relations of the bones, the connection of these by ligaments, the form of contact of the surfaces, their smoothness, and the presence of lubricating material between them, allow the bones to move to and fro in certain definite directions with great ease. Again, the resiliency of the articular cartilages of the bones, the presence of several bones in one joint, their ligamentous attachments, and the angles which the joints form with one another, not only admit of extensive movements in certain planes, but of movements between the bones themselves, which in a great measure nullify the effects of sudden shocks. The elasticity of the plantar cushion and of the lateral cartilages is of even greater importance. The part played by these structures and by the limb itself in neutralising concussion will be considered later.

The functions of the muscles, blood-vessels, and nerves are less striking on mere anatomical examination.

The bones and ligaments are set in movement by the contraction of muscles; and, though not with invariable certainty, the result of such contraction may largely be determined by studying the position of the muscles themselves, and the points at which their tendons are inserted. Owing to the position of the muscles, much can be learnt of their functions by studying living animals. We see, for instance, during movement, a constant change of form in the more superficial muscles. Sometimes the muscle becomes more, sometimes less prominent. Each change is followed by movement of the bones. As we see the bones of the foot move, though we are aware this region possesses no muscles, it is easy to deduce that such movement depends on muscular force developed in other parts and transmitted by the tendons. The justness of the conclusion is verified when muscles or tendons are injured. Movement in the affected parts is then limited or altogether inhibited, just as in ourselves the hand and fingers become stiff after severe injuries of the muscles or tendons of the fore-arm.

The parts played by the blood-vessels and nerves are, at first sight, obscure, and for many centuries remained unrecognised. For our purpose it is quite sufficient to know that the arteries carry bright red blood, the nutritive fluid of the body, to every part; that this supplies nourishment to the tissues, that from it are elaborated the secretions, and that the veins again carry it off when exhausted. The return of blood from the extensive venous net-works of the foot is greatly assisted by the peculiar mechanical formation and the large amount of elastic tissue within the hoof.

Similarly, it is sufficient to know that the work of the nerves is to control movement and secretion, to convey impulses recognised by the brain as sensation, and to preside over nutritive processes in particular organs. The nerves may be likened to telegraph wires. Let us suppose that a certain movement is contemplated; at the right moment the muscles involved are made aware, through the nerves, of the amount of contraction required of them, information which is immediately followed by the execution of the movement. Wherever a sensitive part, that is, one containing nerves, is touched or injured, the brain or spinal cord receives an impression of what has occurred. Should a nerve be cut through, the part supplied by it is deprived of sensation and motion, and nutritive processes are no longer carried on in a well-ordered and normal fashion. In prolonged, painful diseases of the foot, section of the (digital) nerves is sometimes practised: but though this may render the animal sound for a time, it must not be forgotten that the nerves are concerned in other functions than that of common sensation, and that neurectomy is often followed by unfavourable results.

# CHAPTER I.

## HISTOLOGY OF HORN.

By studying a hoof which has recently been removed and carefully cleansed, we see that the wall presents a fine vertical striation in addition to the longitudinal ring formation already referred to. This striation is also apparent on the surface of

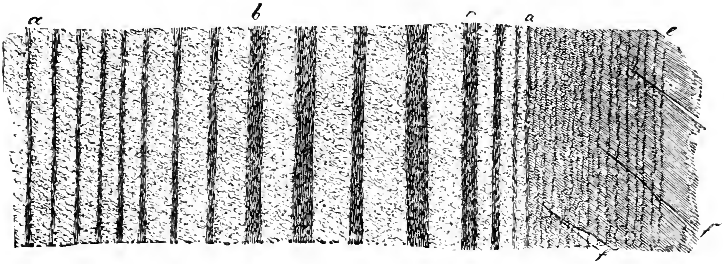



FIG. 56.—Perpendicular section from horn of wall (magnified). The parallel dark striæ are horn tubes; the lighter intervening portions represent inter-tubular horn. The portion from *a–b* represents the outer (dark-coloured) portion of the wall; *b–c*, the inner (whitish) portion of wall; *c–d*, margin between protective sheath and horn laminæ; *d–e*, horn laminæ. At *f* are seen splits in the laminæ, running in an oblique upward direction.

vertical sections through any portion of the wall; it usually appears best marked in the inner third of the thickness of the wall, that is, in the portion nearest the laminal sheath, which even in dark hoofs appears light coloured. By removing a thin slice of the dirty or burnt horn from the ground surface of the wall, a number of small, closely packed points will be seen, somewhat resembling the little openings which we have already studied in the cutigeral groove. Little more than this can be seen, and therefore, in studying the finer structure of the wall, we have recourse to thin sections and high magnification. By making a thin section in the direction of the striation noted, selecting either the outer surface of the wall, or still better, the vertical section already mentioned, and examining this under a magnification of 25 to 50 diameters, we find a number of straight striæ of varying thickness, and usually dark in colour, lying parallel with one another and connected by a more transparent and lighter coloured material.

Taking a fine section at right angles to the striation we shall, first, be able to detect with the naked eye the same punctated appearance already recognised in the transverse section from the bearing surface of the wall. By holding the section up to the light many of the points appear to be mere minute holes—a conclusion confirmed by the microscope (compare fig. 57). Under a low power the section shows a number of rounded or oval holes (*a*) surrounded by dark, crossed lines, which again are embedded in a lighter coloured material (*b*).

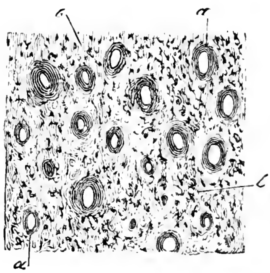


FIG. 57.—Horizontal section of wall. *a*, cross sections of horn tubes; *b*, inter-tubular horn. The dark specks seen in the section represent masses of pigment.

The holes and their dark surrounding tissue correspond in position to the parallel dark striæ found in longitudinal sections, hence we conclude the striæ of the wall are hollow tubes, which, however, are not always empty but often contain loosely packed cells or broken-down cell products. They are, in fact, horn tubes, a more correct term than that of horn fibres, which has also been given them. The lighter horny material surrounding them has been termed inter-tubular or connective horn.

Examination of the sole and soft horn of the frog or periople shows an almost exactly similar appearance. The lower surface of the sole, like the upper, exhibits minute openings. On section in an antero-posterior direction, striæ are seen running obliquely from above downwards and forwards, the microscopical examination of which shows them also to be horny tubes, though they differ from those of the middle sheath of the wall in their greater breadth and more oblique direction. Sections of fresh, soft horn (like that of the frog) exhibit very fine striæ, which usually take a somewhat wavy course. When, however, soft horn is allowed to soak in water for some time striæ appear as thicker, thread-like lines, and are then very distinct.

By making a horizontal section, embracing portions of the bearing surface of the wall, of the white line and of the sole (fig. 58), we see that the spaces between the individual horny laminæ are not filled by connective horn alone, but that a number of horn tubes are included. The horny laminæ possess no horn tubes. Their surfaces show slight striæ and small secondary laminæ or lamellæ, more or less vertical (fig. 56, *d* and *e*), resembling those of the sensitive laminæ already described at p. 71. Transverse sections of the horny laminæ show these secondary laminæ as small radiating prominences (fig. 66, *d*), which are to be found both in old and young hoofs. The horn

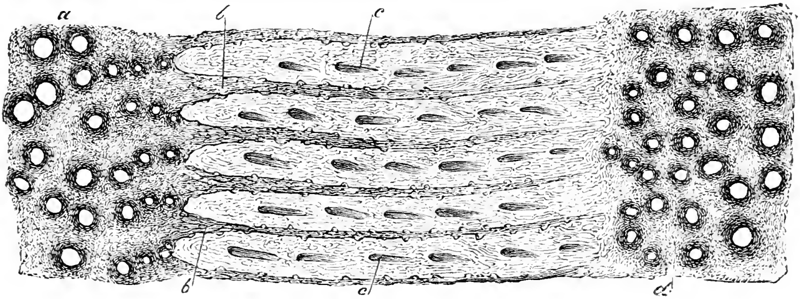



FIG. 58.—Horizontal section through a part of the wall, the white line and the sole. *a*, horn wall; *b*, horn laminæ. The horn surrounding the laminæ contains horn tubes *c*, cut through obliquely; *d*, horn sole.

of the hoof, therefore, with the exception of the horny laminæ, consists of innumerable distinct, parallel, closely-packed horn tubes, running obliquely downwards and forwards, and surrounded by an inter-tubular horn which cements them firmly together.

We may next go a step further, and seek to discover the nature and mutual relations of the horn tubes and of the inter-tubular horn which connects them. The moderate amplification which revealed the tubular structure of the hoof is now insufficient. Powers of 200 to 300 diameters are required, and the examination will be found to present peculiar difficulties. To facilitate cutting we must employ horn which has been long macerated, or, if possible, parts from young animals, and sometimes subject the horn to solutions which soften its structure and make clearer its finer characteristics; the most useful is caustic potash or soda.

Taking some dead, almost powdery, horn from the sole, or a little of the white cheesy material from the cleft of the frog, we place it on a slide, add a little clean water, and dropping over it a cover-glass, subject the specimen to moderate pressure. Under the microscope such a preparation shows only a number of cells resembling those of the epidermis described on p. 61. These are horn cells.

By making a second preparation with some of the slimy

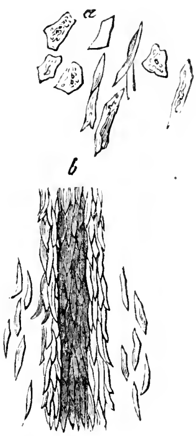



FIG. 59.—*a*, horn cells from wall; *b*, isolated horn tube from the wall of a new-born foal's foot (has been treated with caustic potash).


FIG. 60.—Horn cells from the sole. *a*, young cells from the surface of the sole; *b*, cells from horn which has been cast.

material always to be found on the inner surface of the sole, frog, etc., after removal of the hoof (especially when the hoof has undergone prolonged maceration), we see nothing but thousands of horn cells, though in this case they are younger than in the former. Of horn tubes and inter-tubular horn we see absolutely nothing in either case.

We may next take a minute particle of dead horn from the sole, or loosen a fragment of the striated soft horn from a macerated foot, and examine it microscopically after the addition of a little caustic potash. We shall then see clearly both horn tubes and inter-tubular horn. The horn tubes are formed, like the inter-tubular horn, from single cells (compare figs. 62, *c*, 64, and 65). By pressing on the cover-glass, cells may be detached from the horn tubes and are then difficult to distinguish from those forming the inter-tubular horn.

The same appearance is presented by the horn of the middle sheath of the wall (fig. 59, *b*), though in this case examination is more difficult, and seldom succeeds without the use of some caustic fluid. Leisering has, however, made


FIG. 61.—Horn cells from the perioplic ring. *a*, young; *b*, older cells.

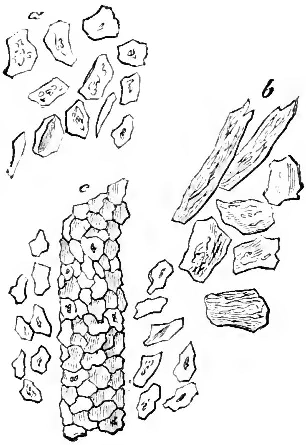



FIG. 62.—Horn cells from the frog. *a*, young; *b*, older cells; *c*, isolated horn tube.

good preparations from macerated young hoofs. The horn tubes which project above the bearing surface of the wall in new-born foals, after the removal of the cap which covers the toe until birth, are useful for such demonstrations. The horny laminæ, as we have seen, contain no tubes, but may be divided in a similar way into single horny cells. In their case it is not so essential to add an alkali. From the results, then, of microscopical examination it may be concluded that the horny cells are the elements from which the horn is built up.

The horn tubes, the inter-tubular horn connecting them, and the horny laminæ all consist of cells, which are variously described as tubular, and inter-tubular or connective cells. Leisering states that, in general, the cells of the soft horn and of the sole are larger than those of the wall. The cells of the horny laminæ are longer and less thick than those of other portions of the hoof. Young, imperfectly cornified cells lying close to their point of formation (papillæ, sensitive laminæ) are rounded, soft, and soon disappear after the addition of caustic potash solution; they are, therefore, better studied in dilute acetic acid, which destroys them less rapidly.


FIG. 63.—Cells from horn lamina. *a*, fresh cells obtained by scraping sensitive wall; *b*, older cells from a fragment of horn lamina (treated with caustic potash).

Leisering believes that the cells of the horn tubes lie with their greatest length in the direction of the tube; the inter-tubular cells, however, at right angles to the tube. The tubular and connecting cells, therefore, cross more or less in direction. This is well shown in sections of the soft horn of the frog, where the cells cross almost at right angles (fig. 65). Leisering has observed the same fact in the middle sheath of the wall, especially in young hoofs and in such as have been long macerated. In the sole the formation is somewhat different. The tubular cells there lie with their greatest length more nearly transverse to the direction of the tube. Perhaps this position of the cells and the less intimate connection which exists between them throughout the sole explain the flaking of the sole during work. The cells of the horny laminæ always lie with their greatest length across the

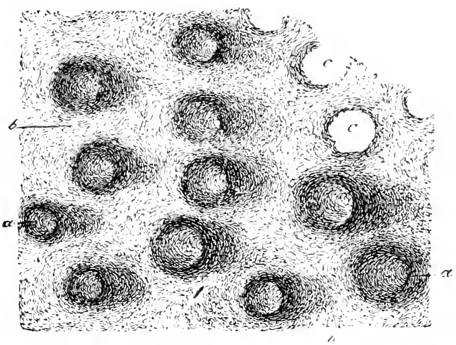



FIG. 64.—Horizontal section of a fragment of cast horn from sole. The horn tubes *a*, like the inter-tubular horn *b*, are seen to consist of cells. At *c* some of the horn tubes have been torn away.

lamina, in a somewhat oblique direction from fixed border to free edge, or downwards and inwards. The tendency of the horny laminæ always to tear in this direction appears due to the arrangement of their cells (fig. 56, *f*).

The exceedingly fine particles of brownish, blackish, or deep black material which the microscope always shows to be present in greater or less amount between the cells of the tubes and inter-tubular horn is pigment. As its presence interferes greatly with microscopical examination, it is best to employ uncoloured hoofs.

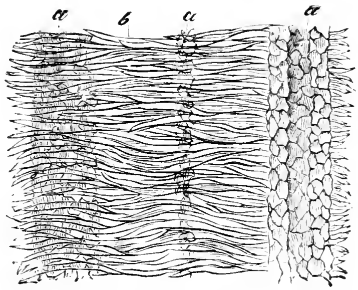


FIG. 65.—Perpendicular section of horn frog. *a*, horn tubes; *b*, cells of the inter-tubular horn, which are seen to run at right angles to the horn tubes.

This pigment appears to serve no particular purpose in the construction of the hoof, the colour of which varies from white, yellow, or grey to a deep black according to the amount of pigmentation. As the pigment is produced by the corium, striped hoofs are due to absence of pigment-forming cells in certain regions of the coronet. It is said that dark hoofs are stronger than light, but this requires confirmation.

The contents of the horn tubes consist of loosely packed, incompletely cornified cells, with broken - down material. Sometimes traces of blood are found in the tubes, especially after severe bruises of the corresponding horn-secreting parts.

A very few lines on the physical and chemical properties of the horn must suffice. The horn forming the hoof, when fresh or after soaking in water, is fairly elastic; but after drying it loses this property. It is a bad conductor of heat, and therefore protects the parts it covers from freezing in winter weather and from burning during the fitting of a hot shoe. Burning horn produces a thick smoke, which has a characteristic smell resembling that of burning feathers. Acetic acid acts least, nitric acid most on horn, the latter turning it soft and yellow; sulphuric acid produces its effect slowly and renders the cells more distinct. Caustic alkalis (soda and potash) dissolve the inter-cellular substance and break up the horn into its component cells. Ammonia acts similarly:

hence it must be injurious to the feet to be continually in contact with manure which contains considerable quantities of this alkali. According to Mulder the elements of the horse's hoof are:—Carbon, 51·41; hydrogen, 6·96; nitrogen, 17·46; oxygen, 19·94; sulphur, 4·23.

Clément's analysis is as follows:—

| | Wall | Sole. | Frog. |
|---|---|---|---|
| Water, . . . . . . | 16·12 | 36·00 | 42·00 |
| Fatty material, . . . . . | 0·95 | 0·25 | 0·50 |
| Material soluble in water, . . | 1·04 | 1·50 | 1·50 |
| Insoluble salts, . . . . . | 0·26 | 0·25 | 0·22 |
| Animal matters, . . . . . | 81·63 | 62·00 | 55·78 |
| | 100·00 | 100·00 | 100·00 |

Lungwitz found by experiment that fresh, healthy horn from the frog contained about 40 per cent. of water. In the case of perioplic horn, however, this figure rises to 50. The excess of water in the perioplic horn explains its greater softness and flexibility. Fat is also present in small quantities in the horn, being formed by fatty degeneration of the loose cells contained in the horn tubes. In the soft horn structures of newly-born animals the quantity of fat is sometimes so considerable that little drops of it may be seen under the microscope.

# CHAPTER II.

## THE GROWTH OF THE HOOF.

Möller distinguishes three periods in the development of the hoof:—(1) The period of general epidermal formation; (2) The period of the provisional hoof; and (3) The period of the hoof proper.

The period of general epidermal formation comprises the first two months of uterine life, during which one can only distinguish at the extremity of the limb a slight thickening of the epidermis, marking the position of the future hoof.

The second period extends over the third, fourth, fifth, and sixth months of fœtal life, during which are formed the coronary band and the remainder of the keratogenous or horn-secreting membrane. At the seventh month the wall itself appears distinctly, then the sole and frog, which are completely developed soon after birth.

The third period is characterised by the greater hardness of the horn. Development takes place from the region of the toe towards that of the heels. During the latter half of gestation the hoof begins to assume the appearance of ordinary horn, the change commencing at the coronet.

At birth the hoof is conical in shape; its horn soft and elastic. The frog is greatly developed and the sole is not yet apparent. It is only towards the fifteenth to eighteenth month that the hoof assumes its final form. At first like a truncated cone with its base above, it gradually assumes a cylindrical form, finally changing once more to the conical shape, but with the base below. The heels, formerly very oblique, become parallel to the toe, and the sole develops a marked concavity.

An examination of the feet of a fully grown but unshod horse which has been employed in field work, and has not been much on hard roads, will show that they are of the same size and length. If the hoof be marked with a rasp or file, it will be found, after some time, that the mark is receding from the coronary border and approaching the ground; in a word, it is "growing" downwards. If, however, the horse is not working (or is shod) its hoofs will become longer.

Both appearances—the recession of the mark and the elongation of the hoofs—show that the latter grow from above downward, just as do our nails and hair. The explanation, however, why the unshod hoof of a horse working on the land remains the same length and the shod hoof increases, is to be found in the fact that in the first instance as much horn is worn away from the bearing surface as is produced above, whilst in the other, wear is prevented by the protection afforded by shoes or by the absence of movement.

Growth seems to be regular, at least in the wall. Hartmann, who made numerous experiments to discover whether the toe grew faster than the quarters or heel, always found that the fine transverse incisions, which he made at similar distances from the coronary border (though at different points of the circumference of the foot), preserved an equal distance from the coronary border during their passage downwards, so that he concluded growth was equal at all points in the wall. It being so difficult to study the growth of horn in the sole and frog, it is at present not possible to say whether it takes place there more rapidly than in the wall. Hartmann says the frog grows most rapidly when the animals are kept hard at work, though only then if the part comes in contact with the ground.

Gröhn ascertained negatively the influence exerted by nerve supply upon the growth of the hoof, and found that when the digital nerves of one leg were divided, the wall of the corresponding foot grew more rapidly than that of its fellow. The time required for the horn to grow from the coronary border to the ground edge of the wall varies greatly, being from eight to sixteen months at the toe, six to ten months at the quarters, and four to six months at the heel. The length (or height) of the wall and the angle it makes with the ground must, of course, be taken into consideration. If we regard the average growth as 8 millimetres ($\frac{5}{16}$ inch) per month, the length of time required for complete renewal of the hoof at any point is easily reckoned. But, as before stated, the rate of growth is not always the same. Lungwitz studied this question somewhat closely and formulated his results as follows:—

1. The growth of the horny wall is slow and averages about 8 millimetres ($\frac{5}{16}$ inch) per month. 2. Unshod hoofs grow more rapidly than those shod. 3. Hind hoofs grow more rapidly than fore. 4. The wall grows slower in stallions than in other horses. 5. Growth takes place to an equal extent round the entire hoof. 6. There is no connection between the colour and rapidity of growth of the hoof.

Growth is favoured by the horse going barefooted. The following case is given in the *Hufschmied*, v. p. 38:—

A horse, the normal growth of whose front hoofs was 3 millimetres monthly, was sent to grass without shoes for three months. A light cantharides blister was applied around the coronet. During this period the growth rose to 8·9 millimetres per month.

In horses which are shod, growth is favoured by free movement on moderately soft ground, by careful shoeing which provides for the expansion of the foot, by regularly shortening the wall, by nourishing diet, normal state of health, and by all factors which increase local circulation. Growth is retarded by want of movement, ill health, low condition, exercise on hot sand or on stones, drought, excessive length of the hoof, unequal distribution of weight in the two limbs, and by continued standing on one foot.

Wear depends to some extent on the pace. Thus at a full gallop or fast trot the heels seem to wear most, at a walk or slow trot the toe. That is to say, that at a fast pace the foot is brought flat to the ground or even with the heel first, but at a walk the toe strikes the ground first. It is worthy of note that draught horses usually wear the outer quarter more than the inner.

The question of how the hoof grows cannot well be answered by direct inspection of the parts, and requires a careful study of the formation of the specialised corium, which produces the horn, of the microscopic appearances of the horn itself, and of the processes of renewal which are always going on in the hoof-forming tissues. On page 62 it was shown that the surface of the corium is continually secreting cells which form the epidermis, that the older of these are compressed by the younger and last-formed, in consequence of which they become flatter and drier, take on a horny character, and finally are thrust off. The growth of the hoof is very similar. Like the epidermis, the hoof consists of cells secreted by the specialised corium, and gradually compressed and dried into a solid adherent mass corresponding to the more superficial epidermal layers. Nevertheless, the arrangement and forward growth of the horn cells differ essentially from those of the epidermis. As the hoof corium, which produces horn cells, is not a level surface like that of the skin, but presents numerous papillæ and laminæ, the growth and formation of horn naturally presents many peculiarities. This folding of the horn-secreting surfaces ensures a very intimate connection between the horny and sensitive parts, a union characterised by firmness and resistance to displacement, but presenting also a sufficiently yielding character to permit of the growing down of the wall. Leisering suggested the following theory of the growth of the hoof :—

Every point in the corium, however small, is capable of producing horn cells. The papillæ, the little surfaces between them, the sensitive laminæ and their interspaces, are all concerned in producing horn, but each in a particular way.

Let the reader imagine the papillæ in function. Firstly, they produce a circular layer of horny cells: below these another layer, a second, a third, a fourth, and so on. As, however, the older cells cannot continue to retain their original position as the newer cells are formed, they are gradually thrust outwards and onwards in proportion to the space required by the new cells. As each papilla is more or less conical, the rows of cells are first arranged in a funnel shape, and finally each papilla becomes the growing base of a horn tube. As, however, the individual (and concentric) layers of cells are firmly united to one another, and as each layer is intimately connected with the next, there are no marked intervals between the little tubes thus produced. Each papilla, therefore, furnishes the material for and produces a horn tube modelled on its own form. The horn tubes correspond in size to the papillæ producing them, the thicker papillæ producing larger tubes.

But this is only a part of the process, for were there no cementing substance the innumerable tubes thus produced would only loosely cover the sensitive foot, just as hair covers a man's head or the mane a horse's neck, and therefore we have to note that whilst the papillæ are producing tubes, the surfaces between are secreting inter-tubular cells which interlock with those of the tubes, and bind the whole into one firm mass of horn.

The strength and hardness of horn depend to some extent on the age of the hoof. The older the cells the harder they become ; hence the horn close to the secreting parts is softer and more readily cut than that further removed. The degree of toughness appears to depend largely on the arrangement of the cells, being greater the more varying the direction between the cells of the tubes and those of the inter-tubular horn ; it is perhaps greatest in the softer horn structures and middle sheath of the wall, where the cells run in every direction (compare fig. 65). The horn of the sole in which the arrangement of the cells is entirely different exhibits little toughness.

Having obtained an idea of the method in which the horn of the wall, sole, and frog is produced and grows, it only remains to note how the horny wall and horny sole are connected with their respective sensitive tissues.

The wall is produced by the coronary band. The horn grows downwards, surrounding and protecting the internal portions of the foot. But it would be connected with neither the sensitive laminæ nor with the horny sole were it not that the laminæ have the property of producing horny material. The laminal horn is produced in comparatively small quantities, and is not tubular.

As there is no spot between the coronary band and sensitive wall where the secretion of horn is interrupted, and as the inter-papillary parts of the lower border of the coronary band are continuous with the commencement of the sensitive laminæ, there can be no sharp margin drawn between the horn produced by the coronary band and that produced by the sensitive laminæ. The horn produced by the vascular laminæ, however, has a different structure, and bears the impress of the tissue from which it grows.

The following explanation has been given of the production of horn by the sensitive laminæ. Each lamina produces a row

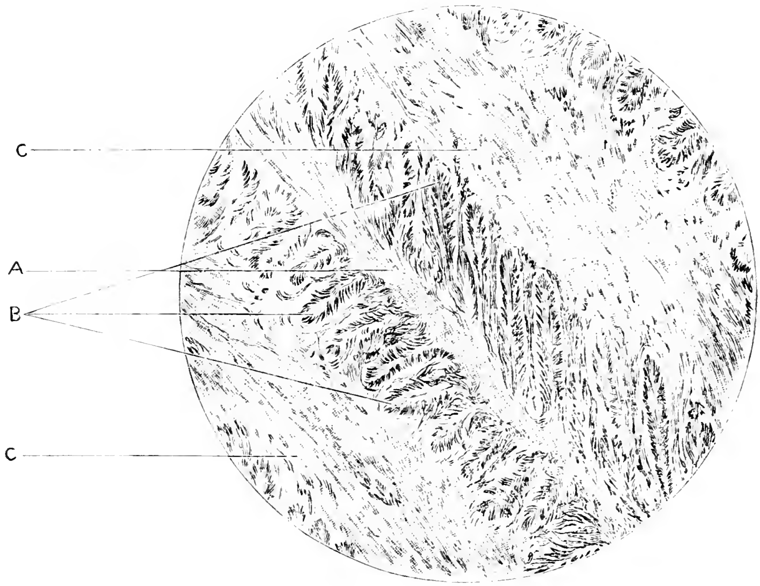



FIG. 66.—Horizontal section, showing relation of a horny lamina to the corium. A, the horny lamina derived from the cells B, B, which have grown into the corium C. When the horny lamina is withdrawn after macerating the foot, the space it occupied is the cleft between the "fleshy" laminæ, and the processes upon which the lines from B end are then known as secondary laminæ. It will be seen that they increase the horn-producing area; the cellular character of the horny lamina is, however, still evident. (From a micro-photo., Oc. 3, obj. 7.)

of horny cells on either of its surfaces. The opposing rows of horny cells between each pair of sensitive laminæ unite, forming a single horny lamina. Hence each pair of sensitive laminæ enclose a horny lamina, and the total number of horny and sensitive laminæ is approximately equal. The amount of horn contributed by the sensitive laminæ to the middle layer of the wall is extremely small, being confined to a very thin layer of cells secreted by the margins of the sensitive laminæ, and collected in the interspace between two horny laminæ. All the rest of the cells go to the formation of horny laminæ.

Henle (*Das Wachsthum des menschlichen Nagels und des Pferdehufs*, Göttingen, 1884, p. 32) says, "In my opinion the laminæ of the sensitive wall correspond to the folds of the corium in the human nail-bed. The horny laminæ correspond to the stratum mucosum of the nail, and between the two structures there is only this difference, that in man the stratum mucosum and the horny layer are sharply differentiated from one another, whilst in the horse the horny laminæ and the horny wall insensibly coalesce. From this fact I conclude that in man the body of the nail glides forward over the deeper structures without taking up new elements, whilst, as in the hoof the horny laminæ and wall are intimately connected, it seems quite possible that the wall may receive additions from the laminæ. That this increment is very slight however, is shown by the fact that the wall remains of equal thickness throughout any vertical line." (For cut of human nail-bed, see p. 61.)

The horny laminæ produced by the sensitive wall are gradually thrust or carried by the downward growth of the horny wall towards the ground, remaining, however, in unbroken continuity with the middle sheath of the wall, and, as a whole, representing the inner sheath. On the ground surface of the hoof they form the white line. Normal growth of the wall essentially depends on a normal condition of the sensitive and horny laminæ. The layers of cells formed by the latter may be regarded as permitting the gradual downward movement of the horny wall, and as preventing its quitting its proper direction. Such an explanation is strengthened by the existence of a remarkable peculiarity in the formation of the horny laminæ, which will later be described.

The firm connection between the laminal and middle sheaths of the wall, and the interdigitation of the horny and sensitive laminæ, explain the intimate connection between the horny and sensitive walls, but not that between the horny wall and sole, for the laminal sheath, which in its continuous downward progress projects beyond the laminæ, would not of itself form a sufficient bond between the two. The lower ends of the sensitive laminæ are provided, however, with horn-secreting papillæ, which again are continuous with those of the sensitive sole, so that in the hoof after removal from the foot they appear merely to be the marginal papillæ of the sensitive sole. At the point where wall and sole meet, and between the individual horny laminæ, these papillæ and the surfaces between them produce tubes and inter-tubular horn, and thus fill the spaces previously occupied

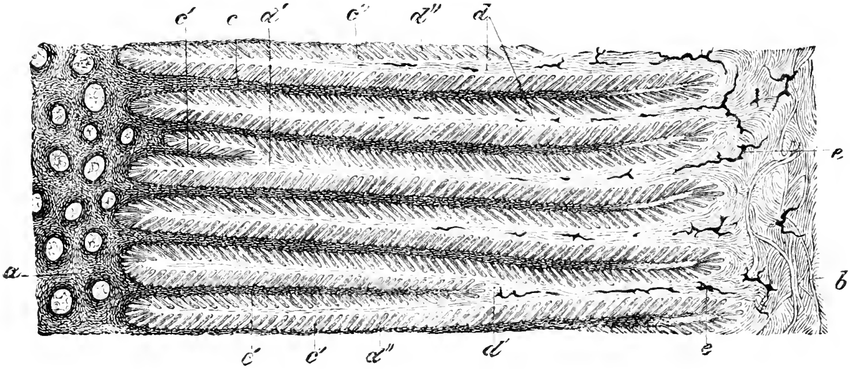



FIG. 67.—Cross section of the connecting sheath of the wall. *a*, innermost portion of the protective sheath of the wall: the horn tubes are seen to extend right up to the horn laminæ; *b*, portion of the vascular wall; *c*, portions of horn laminæ connected with horn wall; *c'*, irregularly developed horn laminæ; *c''*, the so-called secondary laminæ; *d*, sensitive or vascular laminæ; *d'*, irregularly developed vascular laminæ; *e*, injected arterial vessels.

by the sensitive laminæ, which would otherwise divide the horny laminæ. The horn thus thrown out connects the lower portions of the laminal sheath with the sole, and assists in forming the "white line" (compare fig. 58). Strictly speaking, therefore, the white line is produced by the sensitive wall alone. The horny laminæ are derived from the lateral surfaces of the sensitive laminæ, which, however, they have left behind; the inter-laminal horn is a later acquisition, being produced by the papillæ which terminate each sensitive lamina, and, like the horn of the sole, is still in connection with the structure producing it.

An interesting point has been raised as to how the coronary papillæ secrete tubes of horn and not solid cylinders. It is, of course, clear that, as the papilla becomes covered with cells and these again are thrust off by continued growth, a cylinder must be formed. It would seem, however, that the cells produced by the tip of the papilla are different in character to those produced by the sides, and that at a very short distance from the papilla itself the central cells of the horn cylinder begin to contract so that spaces are left, much in the same way as in the stalks of certain grasses. As growth proceeds, the central cells contract more and more, until the original cylinder becomes a veritable tube.

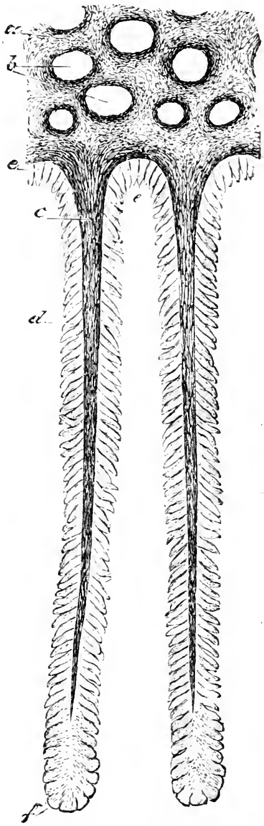



FIG. 68.—Transverse section of two horn laminæ still connected with the middle sheath of the wall. *a*, middle sheath; *b*, transverse section of horn tubules; *c*, central cornified portion of horn lamina; *d*, *e*, and *f*, young horn surrounding the fully cornified parts.

By examining a cross section of horn laminæ, like that shown in fig. 68, with $\frac{1}{4}$-inch objective, it is seen, even after treatment with water alone, that the lamina consists of two distinct parts. The condition is better brought out by the use of alkalis or colouring materials. On treating the section with dilute potash solution the outer part of the lamina clears up and becomes almost invisible, while the centre remains unaltered, save that its cells become rather more distinct. Again, the outer layer of cells readily absorbs a carmine stain while the inner refuses it. The outer portion consists of young, uncornified cells just secreted by the sensitive laminæ. The central, darker part is made up of cells which have already become cornified. The function of the well-developed mucous sheath (stratum mucosum) of the wall appears to be to facilitate the downward movement of the wall from coronet to bearing margin. After disease of the sensitive wall the downward growth appears impeded and the crust is apt to show deformation.

The function of the sensitive wall has been the subject of lively controversy. The principal views on the point are as follows:—

(1) The sensitive wall only produces the laminal sheath of the horn wall. This is the generally accepted view, and is supported by H. Bouley and Leisering.

(2) The sensitive wall produces the entire mass of cement substance or inter-tubular horn (Fuchs).

(3) The sensitive wall produces the inter-tubular horn of the inner (white) sheath of the wall (Brauell).

(4) The sensitive wall has no part in the production of horn laminæ, but the entire wall, including the laminæ, grows downwards from the coronet. The sensitive wall produces a fine layer of horn lying between the laminæ and the mucous sheath of the sensitive laminæ. This view appears untenable, if only because it fails to explain the gradual increase in width of the horny laminæ as one proceeds from above downwards.

## CHAPTER III.

### THE MECHANICAL FUNCTIONS OF THE FOOT.

At rest the horse's weight is distributed over four columns, the framework of each of which is formed by bones. Taking any one of these columns we find the load finally falls on the pedal bone, and is transmitted by it to the hoof, which may be compared to a socle or plinth sustaining the entire limb. The body-weight, however, is not distributed equally over the four hoofs, the front feet, which lie nearer the centre of gravity of the body, carrying a greater proportion than the hind.

Every object must be supported, at least at one point. If all the parts surrounding this are themselves in equilibrium the point of support will lie vertically below the centre of gravity. Living objects, including the horse, have, instead of a point, a surface of support, which, in the horse, may be delimited by lines uniting the outer borders of the hoofs, and will therefore be found to take the shape of an elongated rectangle. The centre of gravity of the body falls at a point somewhat in advance of the intersection of the two diagonals.

When the horse stands on three legs, the centre of gravity is shifted, and the surface of support becomes triangular. If a hind-foot is rested, the point will be displaced in a backward direction, if a fore-foot, forwards. As the feet can only sustain weight when in contact with the ground, it follows that in movement the surface of support may be an elongated strip, *i.e.*, a surface as broad as the hoof, and as long as the space between the two hoofs (trot), or may even be diminished to the area presented by the single hoof, which for the time being carries the entire body-weight (gallop). In addition to the weight of the body, the limbs have often to bear a considerable added load, and are hence exposed during severe work to many chances of injury and disease.

The action of weight on the hoof differs at a slow walk and at higher rates of speed. At a walk the rise and fall of the load is slight, but at the trot, gallop, or leap it greatly increases. At these paces the impact of the body-weight is violently transmitted to the lower parts of the limbs, and, in proportion to the rapidity with which the animal moves, the hoof suffers a more or less violent shock at each contact with the earth, such shock producing in its turn a corresponding counter-shock. Considering the weight of the animal's body, it is clear that, were it not for the peculiar anti-concussive arrangements in the hoof and limb, such violence must be followed by severe injury both to limb and trunk. The angular formation of the limbs, and the position in which they come in contact with the earth, the presence of joints, and the excentric form of their articular surfaces, the resiliency of articular cartilages, the lubrication by synovia, the elasticity of ligaments, of the lateral cartilages, plantar cushion, coronary band, and horny capsule, and, finally, the peculiar union between hoof and pedal bone, all co-operate in diminishing the effects of violent impact with the earth, and in preventing transmission of shock to the trunk.

An exhaustive examination of these anti-concussive media would extend to even more distant regions, for the entire limb is elastic, while the fore-limbs are connected with the trunk, not by bones, but by muscles, a device which, in itself, tends very materially to minimise shock. The hind-limbs, certainly, are directly connected with the rest of the skeleton, but this is compensated for by their angular formation, and by the ligamentous tissues connected with the stifle and hock joints. In every joint, therefore, the vibration transmitted to the limb is somewhat diminished, and, as a consequence, the body sustains only slight and unimportant disturbance. Of the lower joints of the limb, the fetlock shows this anti-concussive mechanism best. Its articular depression, into which fits the lower extremity of the metacarpal bone, consists of three bones, connected together, but nevertheless relatively movable. By means of the powerful suspensory ligament, the sesamoid bones are suspended from the bones of the carpus, and are connected to the upper end of the metacarpus ; hence, when the fetlock joint is excessively flexed under the incidence of the body-weight, these bones yield to a considerable extent. The suspensory ligament, in common with the inferior and lateral sesamoidean ligaments, and the two bands of the suspensory which pass downwards and forwards (fig. 25, *b'*) to unite with the extensor pedis tendon, assure to this joint a secure position without any exertion of muscular strength, while yet permitting the backward and downward movement of the lower end of the metacarpal bone during movement.

The anatomical peculiarities indicated greatly assist the fetlock joint in neutralising shocks produced by the incidence of the body-weight, so that in the normal position of the fetlock the force of impact is at least diminished by one-half, and what remains is transmitted through the bones of the foot to the hoof. As at the coronet joint the coronet bone is firmly attached to the suffraginis, little movement can occur, and, therefore, little diminution of shock. The coronet bone is connected directly with the suffraginis, and indirectly with the sesamoid bones and common extensor pedis tendon, an arrangement which prevents displacement of the coronet joint under any ordinary load.

So far as the dissipation of shock is concerned, the pedal joint is much better arranged, its lower articular surface consisting of two bones, the pedal and navicular. The mobility of this joint is greater than that of the coronet joint, though not equal to that of the fetlock; on the other hand, the joint allows of considerable lateral deviation. It is assisted in distributing concussion, firstly, by the division of its articular surface into two; secondly, by the possibility of movement between the pedal and coronet bones; and thirdly, by the elastic nature of the structures between the pedal bone and hoof.

The pedal and navicular bones are connected by ligaments, namely, two strong lateral ligaments, two suspensory ligaments of the navicular bone (postero-lateral ligaments), which run upwards somewhat spirally arranged, and the fibro-elastic apparatus attached to the skin, referred to, p. 43 (fig. 27, *e*), in addition to the ligaments connecting the navicular and pedal bones (strahlbeinhufbeinbänder) and the navicular bone and lateral cartilages (strahlbeinhufknorpelbänder).

Broadly viewing, then, the collective ligaments of the three joints of the foot, they are seen to lie chiefly on the posterior surfaces of the bones, and, owing to their method of origin and insertion and their radiating formation, to be capable of assuring the relative position of the bones forming the joints without the intervention of other structures. The justice of this theoretical deduction is shown by the fact that, after section of the flexor pedis perforans and perforatus, the angle between the metacarpus and os suffraginis often remains little altered.

The joints named, and especially the pedal joint, are further supported in position by tendons, particularly by the flexor tendons, with their limiting and encircling ligaments.

Immediately the foot comes in contact with the ground the ligaments and tendons are thrown into tension, the position of the hoof remaining the same from the beginning to the end of this period. We see that the articular depression of the pedal joint forms the point of rotation for the termination of the column of bones carrying the weight of the body. We see, also, that, varying with the weight carried by the limb, the fetlock joint moves to a certain extent backwards and downwards, though it returns again immediately the load diminishes, and that while the fetlock has full play the hoof remains stationary. This play of the fetlock would be impossible were the pedal joint immovably connected with it.

The strain on tendons and ligaments is not, however, equally severe throughout these joints at all times, but tension and relaxation alternate according as the axis of the fetlock is more or less inclined to the horizontal plane. At the moment when the fetlock is most oblique, all the ligaments of the fetlock joint, and especially the superior suspensory ligament and the perforans and perforatus tendons, are exceedingly tense. The ligaments of the pedal joint, on the other hand, are relaxed. But just before the hoof leaves the ground, all the ligaments of the pedal joint become tense to their extreme margins. At this moment, in consequence of the forward movement of the body, the foot is tilted, but the flexor muscles do not begin to act fully until the toe of the foot quits the ground. As the weight diminishes, the suspensory ligaments of the navicular bone, the four posterior corono-suffraginal ligaments, the ligaments passing between the lateral cartilages and skin of fetlock, constituting the plantar aponeurosis, and especially the cartilaginous plate at the back of the pastern (fig. 27, *e*), become excessively tense, causing the navicular bone to be applied closely to the posterior part of the articular surface of the coronet bone, and the anterior rounded part of its articular prominence to be pressed firmly into the articular depression of the pedal bone. The formation of the articular groove of the coronet bone favours the fixation of the pedal joint at the moment when the parts are relieved of weight. When flexion is complete, extension immediately begins, and the hoof is advanced, whereupon the stage of weight-bearing commences and is followed by relaxation, a series of changes which recurs again at each step.

In order to ensure free and perfect action, it is absolutely necessary that the hoof should leave the ground lightly and easily. Everything which impedes this phase of movement interferes with action, and may lead to disease of tendon, ligament, or bone. Such action can, however, only result when weight is equally distributed throughout the joints of all four limbs, and the (imaginary) axis of the foot, as viewed from the side, appears nearly straight. Slight deviation of the axis of the foot in a forward direction, thus  does no harm, but deviation backwards is excessively injurious, because it leads to greater weight being thrown on the above-mentioned ligaments, and may produce lameness without the horse being exposed to any special strain. Injury may result even when standing in the stable, especially when the surface of the pavement falls too much towards the heel-post.

Bearing in mind these facts, the farrier should strive to so form the hoof that the load between the ligaments and tendons in the region of the pedal joint is evenly distributed.

## Changes in Form of the Hoof.

We have seen that the body-weight is conveyed to the pedal bone through the medium of the coronet bone. As, however, the pedal bone is connected through the laminal sheath of the sensitive wall with the horny wall, it is clear that the weight is further conveyed to the horny wall itself. This, like the other parts of the hoof, is somewhat elastic. Elastic bodies change their shape under pressure, a rule to which the hoof is no exception. The character and extent of these changes of form, and how and at what times they occur, are points which have been studied both in living and dead hoofs, though results vary greatly, and in some instances even contradict one another. This is explained partly by the different interpretations of different observers, partly by the difference of the objects examined, and partly by variations in methods of examination, though it is also probable that contradictory results have, in certain cases, been caused by unappreciated or doubtful anatomical conditions in the hoof.

HISTORICAL.—The elasticity of the hoof was recognised even in the last century by Lafosse, jun., and J. Clark, although they attributed it to the elasticity of the horn alone. In 1810 Bracy Clark went a step further. He referred the elasticity of the hoof to the formation of the horny capsule, which he divided into three chief parts—wall, sole, and frog. He also laid great stress on the flattening of the concavity of the sole, and the driving apart of the heels by the frog at the moment when weight was placed on the foot. He concluded that any interference with this lateral movement of the heels by the shoe might be injurious, and his observations were, therefore, of great practical importance, for they form part of the foundation of our present system of shoeing. The shoe he recommended had no heels, possessed a perfectly horizontal bearing surface, and had nail holes distributed through its anterior half only. A Frenchman, Périer, attacked these views to some extent in 1835, for while he allowed that the sides of the bearing surface of the hoof might move slightly, he denied that the heels as a whole did so. An English experimenter, Gloag, of the Army Veterinary Department, working on both living and dead hoofs, initiated new ideas in 1849. He found no lateral movement, no sinking of the sole, but only a slight sinking of the bulbs of the heel. Next year, however, Gloag's results were contradicted by Reeve. In order to demonstrate the descent of the sole in the living horse, he used a shoe which carried between the quarters a cross bar provided on the upper side with small upright spikes. After the horse had been walked a few steps, the hoof was examined, but showed nothing to indicate that the sole descended. The horse was then trotted and galloped;

a second examination left no doubt, for each spike, which was still at the same distance from the surface of the sole as at the commencement of the examination, had produced a mark in the sole. There were altogether nine visible punctures, showing that the sole during movement had sunk and risen again. In a similar way he also proved the lateral expansion of the hoof at the bearing surface.

The famous French experimenter, H. Bouley, in 1851, likewise proved the dilatation of the hoof and the descent of the sole during movement. In 1852 Mills traced the circumference of the hoof, both when bearing weight and when free, and showed that the circumference of the hoof when loaded was greater than when unloaded.

Leisering and Hartmann, in 1861, made experiments on dead and living hoofs. Leisering found that in dead feet the posterior parts of the horny sole sink more than other points, provided the navicular bone is also under pressure. He considered that the descent of the sole is accompanied by only a slight dilatation of the periphery and bearing surface, and that at the coronary border of the wall there is even diminution in size. According to his view, the hoof carries the greatest weight at the moment when the fetlock joint is most extended forward (dorsal flexion). Experimental measurements of living hoofs, which he made in company with Hartmann, gave the following results :—

Dilatation of the lateral walls of the hoof at the bearing surface, about 1 to 2 millimetres, at the coronary border an equal degree of contraction; dilatation of the walls of the heel at the coronary margin, 2 to 4 millimetres, and at the bearing surface, 2 to 3 millimetres.

Leisering's views on the movement of the foot were generally accepted until 1880, but in 1881 Lechner came forward with his experiments made on dead hoofs. These seemed to directly contradict the views previously received. Lechner even believed that the previously received views as to the movement of the hoof were entirely erroneous and had stood in the way of rational shoeing. He placed especial weight on what he called rotation of the foot, and laid down the following dicta :—

1. Dilatation at the bearing surface in the sense of the older theories, that is, increase beyond the normal size of the

hoof when bearing weight, never occurs in a normally formed and sound hoof.

2. The hoof dilates, or at least becomes tense, at the moment of greatest dorsal flexion* of the fetlock, along the entire coronary border, but not along the bearing margin. On the contrary, at this moment the posterior part of the hoof "rotates" on the bearing surface, especially the angle of the bars and the walls of the heels, together with the other tissues lying between them, whilst the wall and sole of the anterior half of the hoof move towards the middle line, that is, the hoof becomes narrower below at the moment when the anterior half of the bearing surface is under the greatest strain.

3. The sole does not sink at the moment indicated, the bars and portions of the sole next them rather rising and approaching one another laterally. The sole, therefore, presents a narrower and not a wider appearance.

4. The limbs of the frog are not thrust asunder at the above-named moment, that is, broadened and pressed backwards, but are pressed together, thickened from the sides, and their length, as a whole, increased, the under portions of the bulbs being drawn somewhat backwards and outwards.

5. This rotary movement in the hoof occurs both above and below synchronously and isochronously, that is, simultaneously and at equal periods of time.

Lechner's results, which are entirely supported by those of Gierth, introduced new views as to the physiology of the horse's hoof, and at the same time gave rise to fresh experiments. Lungwitz and his assistant (now Oberroszarzt a. D. H. Schaaf) made experiments on living hoofs in regard to dilatation of the hoof at the bearing surface, using a specially constructed instrument. The dilatation of the bearing border during the period when the hoof carries weight is shown in the following table:—

* It will be noted that the fetlock joint may be flexed in a forward direction (dorsal flexion), as during the last phases of movement, preparatory to the foot leaving the ground. Dorsal flexion of the fetlock is sometimes, though perhaps less precisely, described as "extension." Flexion backwards (volar flexion) takes place during movement of the limb through the air, and is the condition most often indicated, in this country, by the term "flexion."

| | Number of Experiments. | Dilatation in Millimetres. | | |
|---|---|---|---|---|
| | | At Outer Wall of Heel. | At Inner Wall of Heel. | Between. |
| At rest, . . . . . . | 32 | 0·25 | 0·30 | 0·55 |
| Walk, . . . . . . | 33 | 0·55 | 0·70 | 1·28 |
| Trot, . . . . . . | 69 | 0·84 | 1·22 | 2·23 |
| Gallop, . . . . . . | 12 | 1·06 | 1·81 | 3·04 |

In addition, Lungwitz by himself undertook another series of experiments on living feet, using girdles, callipers, and pieces of gummed-on paper. He came to the following conclusions :—

1. Dead hoofs, both sound and diseased, except those with ossified lateral cartilages, dilate at the coronary margin of the heels.

2. In healthy hoofs the bearing surface dilates, both at the coronet and at the ground surface.

3. This dilatation results in a slight shortening of the longitudinal diameter of the hoof, which is best shown at the coronary border.

4. Dilatation of the bearing surface of the wall is shown in different ways, according to the form of the hoof. In flat or laminitic hoofs it increases from the toe towards the heels, but diminishes again towards the bearing surface.

5. Dilatation of the bearing surface is impeded by shoeing and by dryness of the horn.

6. Flexibility of the horn, and a well-developed but untrimmed frog, favour dilatation of the hoof at the bearing surface.

7. In hoofs with wired-in heels and compressed bars, dilatation under the body-weight may still occur, but the most posterior part of the bearing surface of the heel does not take part in it—rather the contrary.

In the year 1882 Bayer undertook experiments on the dilatation of the living hoof, using an electrical apparatus. He also found that, when weight was placed on the foot, dilatation occurred at the heels both at the coronary and bearing margins.

Martinak measured the living hoof by means of callipers, and found well marked dilatation at the bulbs and heels of the hoof when loaded. His experiments on the living hoof, in which he used a bar shoe, also seemed to contradict Lechner's rotation theory.

Steglich, along with Schenkel, made experiments on dead hoofs. They concluded that:—

"The weight of the body produces lateral dilatation of the hoof, greatest at the coronary border and least at the bearing surface of the horny capsule. Dilatation both of the coronary and bearing surfaces is best marked in the region of the heels. Towards the quarters it becomes less, and where the quarters abut on the toe it entirely disappears. The cause of dilatation at the coronary margin is the thrusting downwards and inwards of the broader parts of the os coronæ between the lateral cartilages at the moment of greatest extension (greatest weight). Dilatation at the bearing surface is produced by lateral displacement of the plantar cushion and horny frog under the pressure of the body-weight. The simultaneous descent of the horny sole permits of expansion of the bearing surface of the foot."

Schwentzky measured twenty-two living hoofs, and, except in the case of four abnormal hoofs, found that, when the animals were standing at rest, the amount of dilatation at the bearing margin was from 1 to 2 millimetres; the average 1·45 millimetre.

Peters has taken a prominent part in the study of the expansion of the foot. He advanced what was termed the "depression theory," and placed particular stress on the possibility of elongation of the laminal sheath of the wall and on the direction of its fibres, by which alone descent of the pedal bone becomes possible, and in the further study of which the explanation of all the phenomena of the movements of the foot is to be found. His experiments led him to the conclusion that the pedal bone, which is fastened to the wall, enjoys a certain degree of mobility, owing to the possibility of elongation of the laminal sheath and to the elasticity of the coronary border of the hoof; that movement occurs around the toe of the os pedis as around a fixed point, and, therefore, that the navicular bone, being, as it were, an appendix of the os pedis, must take part in these movements. The depression or elastic distention of the wall occurs in a backward direction, causing change in the lateral profile of the hoof. He advances, as the most important of his conclusions, the following :—

1. The os pedis and lateral cartilages, together with the navicular bone, perform movements within the horny capsule, rotating in the segment of a circle round the point of the toe.

2. The elastic wall, through its laminal sheath, is forced to follow this movement, and, therefore, the quarters of the hoof change in shape, while the coronary border, being thrust outwards and backwards, descends to a slight extent, and the height of the hoof is diminished.

3. Diminution in height is accompanied by increase in the transverse diameter of the hoof; as much space being thus gained at the sides, both at the coronary and bearing borders, as is lost by reduction in height. Lateral dilatation is produced by the walls being pressed outwards and the bearing surface following suit under the pressure of the pedal bone and lateral cartilages.

4. The posterior part of the sole becomes flattened under the pressure of the body-weight, and, by thrusting aside the portions of the wall nearest it, provides space laterally exactly corresponding to that lost owing to the pressure from above.

Fambach's experiments on the laminal sheath of the hoof also support the depression theory. Bendz refers the dilatation of the heels to the pressure of the navicular bone on the bars. Bayer, who employed an electrical instrument to detect the changes of form in the hoof, was of the same opinion. Föringer, and afterwards Lungwitz, Gutenäcker, Schwentzky, and others, made similar experiments. Föringer, who employed a specially constructed electrical apparatus, with an alarm bell, examined living hoofs, and found that the wall of the heel dilated both at the coronary and bearing surfaces, and that the sole was depressed during movement. Gutenäcker, employing Föringer's apparatus, made certain discoveries which appear to support Peters' depression theory. Schwentzky also used an electrical apparatus. His experiments appear to agree on essential points with those of Bayer, Föringer, Gutenäcker, and Lungwitz. Lungwitz probably made the greatest number of experiments on the living hoof. He modified Föringer's apparatus in such a way as to permit all parts of the hoof to be examined. He experimented both on the animal at rest and in motion, and demonstrated movements in all parts of the wall. His researches prove the occurrence of expansion at the coronary and bearing surfaces of the heels, and simultaneous depression of the sole at the moment when the fetlock joint was most extended (or dorsally flexed). Dominik's experiments, on the other hand, which extended to both living and dead hoofs, seem rather to favour Lechner's rotation theory.

The complicated construction and form of the hoof, its connection with the limb, and the continuous variation of the conditions during movement, prevent our attaching the same importance to *post-mortem* experiments as to those made on the living animal. *Intra-vitam* experiments, moreover, have a greater claim to consideration, partly because of the great number which have been performed, and partly because of the agreement in their results. The following principles, based on numerous experiments, agree in great part with the more important experiments both old and new, and only conflict with those of Lechner and a few others.

The point of rotation is the pedal joint. At the moment when the foot first meets the ground pressure is slight. It increases as the limb approaches the perpendicular, and is greatest when the fetlock is most markedly extended, after which it diminishes until the hoof is raised from the ground. The changes in form are most marked at the moment of greatest extension (dorsal flexion) of the fetlock joint. They consist, firstly, in lateral expansion of the entire heel region; secondly, in contraction of the coronary border of the anterior half of the hoof; thirdly, in diminution in the height of the hoof as a whole, with simultaneous descent of the bulbs, and, fourthly, in descent of the sole. These changes occur simultaneously and bear a direct proportion to the weight imposed on the foot. Leisering accepts Peters' depression theory as explaining these, with, however, the qualification that he regards the moment of greatest change in form as coincident not with the removal of weight but with greatest extension (or dorsal flexion) of the fetlock joint. The extent of displacement of the heels and sinking of the sole is slight, and varies from 0·5 to 2 millimetres, seldom more.

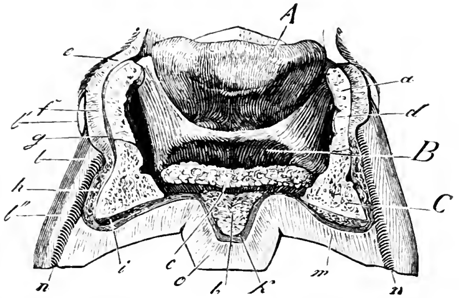



Fig. 69.—Vertical cross section of a foot seen from behind. *A*, coronet bone; *B*, navicular bone; *C*, pedal bone; *a*, lateral cartilage; *b*, anterior portion of plantar cushion; *c*, divided part of flexor pedis perforans tendon; *d*, postero-lateral ligaments of navicular bone; *l*, horn wall; *m*, horn sole; *n*, white line; *o*, horn frog.

In order to understand the mechanics of the hoof, it is desirable to study the changes in movement somewhat more closely. According to Peters' theory, the pedal bone, with its complementary parts, the navicular bone and lateral cartilages, rotates in the segment of a circle around its own point, which is to be regarded as its axis. If we bear in mind that the intervals between the elastic laminæ and the horny wall increase towards the heels (Fambach), it will be seen that the connection between the sensitive and horny laminæ is not everywhere equally firm, but becomes less so towards the heels, and, therefore, that at this point the greatest movement might theoretically be looked for. In consequence of its formation, its strong and long wall, and its connection with the pedal bone, the toe would be expected to suffer least displacement under pressure, whilst the posterior parts of the hoof, being less thick and less firmly attached to the bone, would yield to a greater extent. In its descent the os pedis tends to draw the laminæ backwards and downwards, so that their inner margins, instead of pointing towards the centre of the foot, tend to point towards the bulbs, a condition which results in slightly diminishing the height of the hoof, diminishing the diameter of the toe and lateral parts of the coronet, pressing backwards the bulbs, causing the posterior parts of the sole to descend and the heels to widen. Immediately pressure is removed, the laminæ seek to return to their former position and thus restore the normal state of the foot.

At the time when the fetlock is most extended, the lateral cartilages and plantar cushion also come more prominently into play. The posterior, *i.e.*, the broadest, part of the coronet bone glides backwards and downwards between the lateral cartilages, thrusting them apart, and through the medium of the tendons exercising pressure on the plantar cushion. As the latter is closely connected with the lateral cartilages and completely fills the upper depression of the horny frog, it tends to drive apart the quarters and to cause the bulbs to swell, while, as the horny frog now rests on the ground, it contributes to this dilating effect. In the shod hoof, however, the horny frog is not always in contact with the ground, or at least not throughout its whole extent; it is, therefore, easy to understand why the expansion of the hoof is more marked at the coronary border than at the bearing surface of the heels. It must also be remembered that hoofs when shod are apt to be very dry, and the frog poorly developed, or diminished by excessive paring or by disease, and, therefore, dilatation at the bearing surface is often difficult to detect. These considerations go far towards explaining the somewhat common, though erroneous, belief that the bearing surface of the heels is incapable of dilatation.

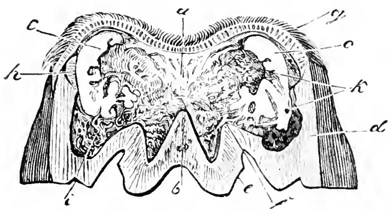


FIG. 70.—Vertical cross section of foot seen from behind (this section has been made nearer the heels than fig. 69). *a*, posterior part of plantar cushion; *b*, median ridge of frog; *c*, lateral cartilage; *d*, horn wall; *e*, lateral face of frog; *f*, point of union between the bars and frog.

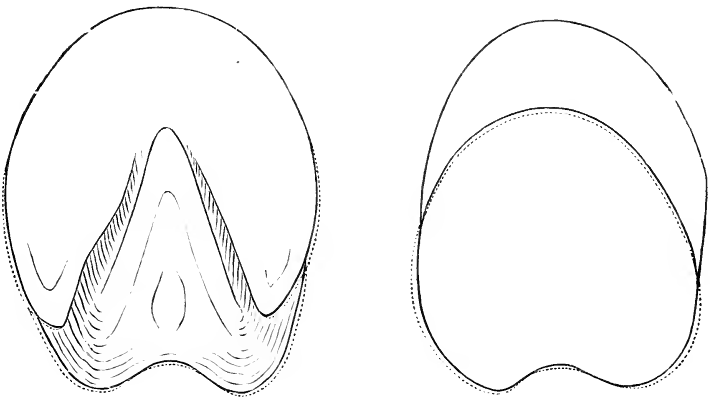
All parts of the foot, not even excepting the os pedis, are elastic, although not to the same extent. The os pedis is least elastic; then comes the horny wall, horny sole, horny frog, lateral cartilage, plantar cushion, coronary band, cutis, and subcutis. The posterior half of the hoof allows of the greatest change in form; a fact which explains the frequent occurrence of disease of this portion of the foot under the influence of severe work, neglect of the hoof and faulty shoeing.

1. *Movement at the Coronary Border* (fig. 72).—While the horse stands equally on all four feet, the anterior and lateral parts of the coronary border, and especially the points opposite which the wall forms an acute angle with the earth, are in a condition of tension and incline to contract. At the posterior part, where the wall forms an obtuse angle with the ground, there is a tendency to dilatation. When considerable weight is placed on the foot, that is, during backward and downward movement of the fetlock, a slight contraction occurs in the anterior parts of the hoof, and extends backwards to a varying

distance. In the region of the heels, on the other hand, there is distinct dilatation; the coronary border of the heels bulges outwards, a condition clearly visible in hoofs in which the coronary border is well curved. Where, however, the latter is straight, bulging is imperceptible or fails to occur. The bulbs of the heels swell, and are thrust somewhat backwards and downwards. If, now, the fetlock rises, the dilatation of the coronary border of the heels disappears in a forward direction like a fluid wave and with a rapidity proportioned to the speed of ascent of the fetlock; while the contraction of the lateral and anterior regions of the coronary border is replaced, immediately the foot is lifted, by slight swelling and dilatation of the coronary border of the toe. With the renewed sinking of the fetlock these changes of form are repeated in inverse order. Low, flat, broad hoofs show these changes more distinctly than those which are deep and upright. Absolute rest of the coronary border (at least while the animal is standing on the foot) is inconceivable, for the slightest movement of the body immediately evokes some change in its form. The coronary border of the hoof may be compared with an exceedingly elastic ring which yields to the slightest pressure of the body-weight, dilatation at one part producing a corresponding retraction at another. The great elasticity of this ring is due to the perioplic horn, which is found at the points where the greatest movement occurs—along the quarters as far as the bulbs, and at the toe front. Permanent defects in the position of the limbs (such as knuckling, etc.) interfere with the normal function of the coronary border, and may be followed by irregular formation and distortion of the hoof.

2. Movement at the bearing margin or ground surface differs somewhat from that at the coronary border. In front, and as far as the centre of the quarter, no distinct change occurs; from the centre of the quarter, however, to the end of the bearing surface (fig. 71) it is always possible to demonstrate dilatation in sound, unshod hoofs, especially when the horny sole and horny frog are supported. The amount of this dilatation varies, with the weight on the foot, from 0·1 to 1·5 millimetre at either side, while it is also greatly dependant on the angle formed by the heel with the ground. In heels which converge in their course from above downwards

dilatation is slight, and, in fact, in narrow-heeled feet contraction may replace the normal expansion. The greatest obstacle to dilatation, however, is shoeing, inasmuch as it removes the counter pressure of the ground to a greater or less extent, and prevents the horny sole, horny frog, and bars performing their functions in the same degree as they otherwise would. In horses working on hard roads it has been recommended to employ pads of rubber, so as to transmit the counter pressure of the ground to the sole and frog, and so promote dilatation, but the advocates of this plan overlook the fact that pads press *continuously* on the frog, and that much of their beneficial action is thus lost.



FIGS. 71 and 72.—Right fore-foot seen from below and above. The dotted lines show the changes in form which occur at the moment of extreme extension of the fetlock joint.

3. *Movements of the Sole.*—The horny sole becomes flatter under the body-weight, most distinctly at the posterior parts of the sole, and least so at the toe and towards the periphery. The width of the hoof and thickness of the horny sole are of considerable importance in determining the extent of this movement, the descent of the sole being greatest towards the heels in flat and spreading hoofs. A proof of the changes in form of the hoof may be found in the bright and sometimes excavated friction surfaces at the heels of the shoe. Peters says these prove the existence of two movements of the bearing surface of the hoof, that occurring in the longitudinal direction

producing the deepest depression. One result of this friction is the wearing away of the bearing surface of the heel on the shoe; the loss of horn may amount to 5 millimetres or more within a month.

The advantages of expansion of the hoof are manifold. 1. The yielding of the tissues protects the hoof and its contents from injury, even under the greatest shocks. 2. It greatly diminishes at its point of origin the concussion, which would otherwise be transmitted to the body, thus assisting the action of the limb and adding to its elasticity. 3. It favours nutritive processes in the parts enclosed by the horny capsule, and is of importance in the production of the hoof itself. Movement is of great importance in insuring sound hoofs and the production of healthy horn. If for any reason movement is lessened or prevented the hoof suffers.

### Bearing of the above on Practical Shoeing.

In the practice of shoeing, the chief precaution is to preserve normal movement in the foot. We know that shoeing, by diminishing or preventing contact between the horny sole and frog and the ground, and by fixing the bearing surface of the wall to an inflexible ring of iron, checks or prevents movement at the bearing margin. One method of shoeing which avoids this disadvantage is the tip or modified Charlier. The task of the farrier is, therefore, to so form and affix his shoe as to minimise ill consequences. In paring the hoof and frog, intelligent ideas must prevail. The counter pressure of the ground should, if possible, be preserved, and the parts allowed to sustain weight each in its appropriate degree. For this reason the flat shoe is the most natural. For diseased feet the bar shoe is very advantageous; it unites in itself all the good points of the ordinary shoe with few of its disadvantages. It arouses the normal movements of the foot when in abeyance, regulates them when disordered, and, if properly used, never injures but always improves the diseased or faulty hoof. A further point of great importance is a horizontal bearing surface in the posterior half of the shoe, equable distribution of pressure over the entire circumference of the wall, and the insertion of nails in the anterior half of the shoe alone.

As pads of different kinds indirectly convey to the sole and frog the counter pressure of the ground, they may be of use for horses working on hard, stony ground, or the pavement of towns. For military and agricultural horses they can be dispensed with.

# PART II.

# THE HORSE'S FOOT IN RELATION TO SHOEING.

## SECTION I.

## SHOEING OF HEALTHY FEET.

## CHAPTER I.

### HORSE-SHOES, ETC.

THE production of a good shoe demands intelligence, skill in the use of tools, and the ability to measure accurately with the eye; while the farrier who desires to excel must possess and constantly apply a knowledge of the formation and functions of the foot.

### 1. MATERIAL FOR THE MANUFACTURE OF SHOES.

*Wrought Iron.*—The best material is tough, fine grained, ductile, wrought iron, which, however, must retain its toughness when hot and stand the test of fullering. To obtain special durability old shoes are sometimes employed, from one and a-half or two of which is produced a new shoe. Such are more difficult to make, but being 'steely' last considerably longer.

A great many patterns of rolled iron are on the market, from which shoes for light horses and for special purposes can be made. These special bars when of English manufacture are usually seated on the hoof surface; the German patterns are flat. The ground surface of some is roughened by projections and recesses, arranged either cross-wise or length-wise or in both directions. Of these latter there are many different patterns (fig. 73), but they are now comparatively little used in England. With, perhaps, the exception of the 'Grip' (fig. 80) pattern, bars with cross depressions are liable to break on the outside when being bent, and, as a rule, shoes prepared from them are less tough than those made from ordinary bar.

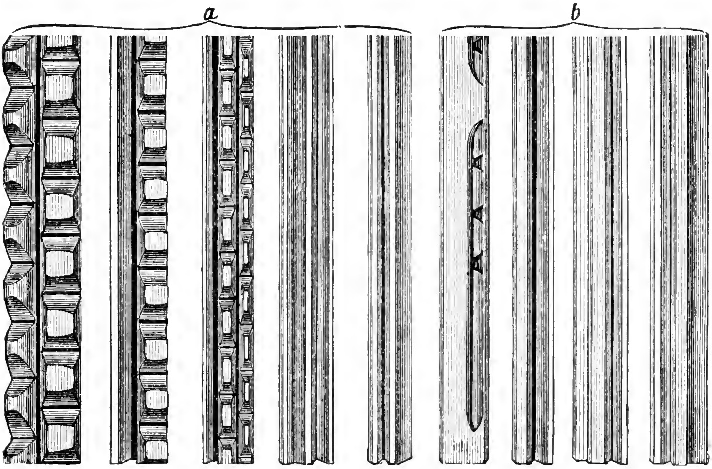



FIG. 73.—Special forms of rolled bar iron.

English manufacturers have always been noted for the high quality of their products and the essentially practical nature of the improvements they have introduced. Below are figured the sections of rolled bars most widely used.

Fig. 74. Rodway section, seated on hoof surface, made in sizes from $\frac{3}{4} \times \frac{3}{8}$ inch to $1\frac{3}{8} \times \frac{5}{8}$ inch. This iron was introduced many years ago by Messrs Phipson & Warden, the patentees, and is now very extensively used. It makes suitable shoes for all animals drawing light vehicles in cities. The corrugated surface gives an excellent foothold, which, on the first introduction of the section, was sought to be increased by the use of a specially soft iron. Though excellent for the purpose mentioned, this section is not sufficiently durable for horses in heavy work.

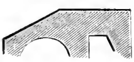


FIG. 74.—Rodway bar.*

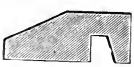


FIG. 75.—Single fullered bar.*

Fig. 75. Single fullered iron, made in sizes from $\frac{5}{8} \times \frac{3}{8}$ inch to $1\frac{1}{8} \times \frac{5}{8}$ inch, is most suitable for light harness and saddle horses. As the nails are scarcely

so secure in a fullered as in a plain stamped shoe, and the durability is less, it is not so useful for horses in very heavy work.

Fig. 76. Plain bevelled bar is made in sizes from $\frac{3}{4} \times \frac{7}{16}$ inch to $1\frac{1}{2} \times \frac{5}{8}$ inch, and is used for making plain stamped shoes, the bevelling saving labour in seating out. It serves for shoes for all horses in medium and heavy draught, and is especially useful for defective feet on account of the facility with which plain shoes can be fitted. This subject will be referred to later when speaking of stamped shoes.

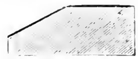


FIG. 76.—Bevelled bar.*

Figs. 77 and 78. Concave iron is made in sizes from $\frac{1}{2} \times \frac{5}{16}$ inch to $1\frac{1}{8} \times \frac{5}{8}$ inch and is used for hacks and hunters, occasionally for carriage horses, which must, however, have strong feet and well arched soles. Section 77 has rather less hold on the ground than section 78, but wears correspondingly longer. On account of the shape of its inner margin, the latter is best suited for horses which forge.

FIGS. 77 and 78.—Concave bar.*

Fig. 79. Plain concave bar, sizes from $\frac{5}{8} \times \frac{1}{2}$ inch to $1 \times \frac{5}{8}$ inch, useful for ponies, hacks, and hunters. When nail holes are stamped in this iron the outer wall becomes vertical, so that a bevelled edge is only left inside. Horses shod with it require, on account of the narrow bearing surface, specially strong feet with arched sole and strong wall.

FIG. 79.—Plain concave bar.*

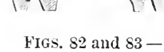
Fig. 80. Corrugated 'Grip' iron, sizes $\frac{3}{4} \times \frac{7}{16}$ inch to $1\frac{1}{8} \times \frac{9}{16}$ inch, useful for horses in medium draught. This iron is less liable to break than other sections with cross depressions, but should only be used on strong feet, as the nails cannot be placed just where needed, and (owing to the projections) cannot be so well driven home as in plain shoes.

FIG. 80.—Corrugated 'Grip' bar.*

FIG. 81. —Charlier steel bar.*

Fig. 81. Charlier steel, sizes from $\frac{3}{8} \times \frac{1}{4}$ inch to $\frac{3}{4} \times \frac{1}{2}$ inch. For Charlier shoes only.

Figs. 82 and 83. Racing plate steel; 82, $\frac{1}{2} \times \frac{1}{4}$ inch; 83, $\frac{5}{8} \times \frac{1}{4}$ inch. This section used only for actual racing. In training, light fullered shoes are commonly employed.



FIGS. 82 and 83 — Racing plate steel.*

Fig. 84. Racing plate iron, $\frac{5}{8} \times \frac{1}{4}$ inch. Now little used, having been superseded by steel.

FIG. 84.—Racing plate iron.*

*Cast Iron.*—To effect a saving in cost many attempts have been made to introduce cast shoes. Up to the present no real success has been recorded, although shoes have been produced which admit of being shaped and punched at a red heat, if special precautions be observed. Even the best cast shoes are extremely brittle both when hot and cold, are difficult to 'fit out,' wear more rapidly than wrought shoes, give a bad foothold, and expose the horse to the danger of slipping.

*Steel* is fairly ductile and malleable and possesses the power of being 'tempered,' in which condition it is harder and more elastic, though more brittle, than before. Certain improvements recently made in the manufacture of steel seem to point, however, to the possibility of using it more extensively, and the Paris General Omnibus Company have now employed it for some years both for front and hind shoes, to the exclusion of iron. In France steel of the kind used costs less than iron. It is said to wear with perfect regularity until the shoes are extremely thin. The farriers like it, and can turn out per day a larger number of shoes than with iron, but certain precautions are needful where it is employed: the metal must not be overheated, suddenly quenched, nor much worked, in this respect differing from iron, which is improved by hammering. The present opinion in England is that good iron is sufficiently durable, and that steel, unless of a low grade, is too difficult to work, and becomes too smooth in use, so that it gives no foothold; but this view deserves reconsideration after the successful experiments in Paris.

*Aluminium,* being one-third the weight of iron, has been used with success for racing plates. When pure, it can even be worked cold, but must then be free of silicon, which renders it brittle. It should never be heated above a dull red. To diminish wear of the shoe, steel nails, with soft shanks and hardened heads, are used. Chrome aluminium, being very hard, might perhaps be used with advantage.

Aluminium bronze, composed of aluminium 90 parts, copper 10 parts, is harder than the pure metal, but must be heated, being difficult to work cold. Shoes of this substance are therefore cast, but have not been found sufficiently durable.

Aluminium copper can be wrought at a red heat, but is just as heavy as iron.

Although aluminium resists the action of acids it is readily attacked by alkalies, and even on chalky roads wears away very quickly.

*Phosphor bronze* was used at Brussels in 1880. The shoes are cast, must not be warmed, are softer than iron, and seem to check slipping. The difficulty of fitting and want of durability are, however, against their extended use.

## 2. Shoes and their Properties.

A horse-shoe is an iron or steel rim fastened by nails to the wall and covering the bearing surface of the hoof to a greater or less extent. All ordinary shoes present two branches, an inner and an outer. The anterior part, where both branches unite, is termed the toe. The upper surface, upon which the hoof rests, is termed the foot surface, the lower is the ground surface. The fullering is on the ground surface, the seating on the foot surface. Shoes are variously named, according to the objects for which they are destined, or to the method of manufacture; for example, fullered shoes, stamped shoes, flat shoes, shoes with calkins, summer and winter shoes, etc., of which more will be mentioned below. Another division is into hand-made and machine-made shoes, but neither of these divisions is of special importance.

*Characters of the Shoe.*—These may be divided into essential and non-essential. The non-essential, however, such as calkins or grips in winter, may, under certain circumstances, become of great importance.

(1) *Form.*—A good shoe should respond exactly to the shape of the hoof; the farrier must therefore, in making the shoe, keep clearly in his mind the form of the foot for which it is intended. Front and hind, left and right feet differ in shape, and each requires a shoe with certain special modifications (figs. 85, 86, and 87). Too much stress, therefore, cannot be laid on the fact that the farrier must make himself thoroughly acquainted with the normal form of the bearing surface and fashion his shoe accordingly. It is always well to make the shoes in pairs, that is, a left and a right.

(2) *Breadth and Thickness.*—The breadth of the shoe depends, firstly, on the form of the hoof, whether it is narrow or wide; secondly (but the point is very important), on the

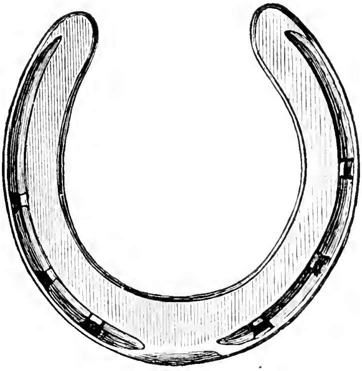


Fig. 85.—Right front shoe seen from below.

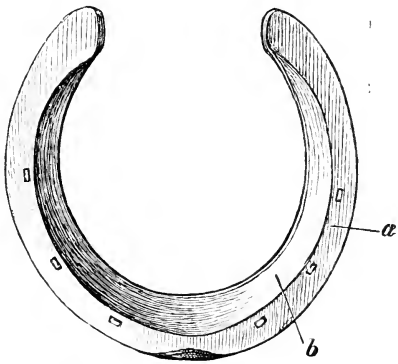



Fig. 86.—The same seen from above. *a*, bearing surface; *b*, seated surface.

thickness of the wall. As a general rule, twice the thickness of the wall, including the white line, will be sufficient. The breadth of the toe will, therefore, be from $\frac{3}{4}$ to $1\frac{1}{4}$ inches. Wide hoofs require a broader shoe than narrow ones. As the wall varies in thickness at different points and in different feet, the shoe also varies, being broader at the toe than at the heels; and when intended for fore-feet, being broader than for hind. For special purposes, like racing, very narrow shoes may be required, whilst for work on stone-paved streets the breadth may advantageously be increased. In Paris, where the shoes, for economical reasons, are made very narrow, the feet are in general exceptionally bad. Excessive breadth, however, increases the risk of slipping on muddy or frozen roads. The thickness of the shoe also varies according to the size, weight, and duty of the horse and to the kind of ground on which it

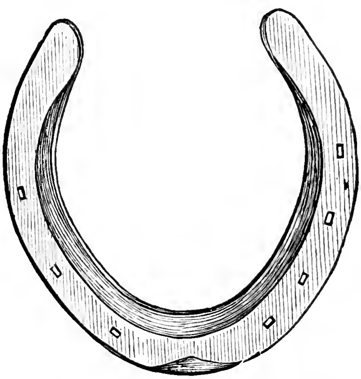


Fig. 87.—Left hind shoe seen from above.

works, and may vary from $\frac{3}{8}$ up to $\frac{3}{4}$ of an inch or even more. As a rule, shoes should be of such thickness that on a horse with sound limbs and doing ordinary work they wear for four weeks. Generally, the shoe is made of an even thickness throughout, though this is subject to exceptions,—flat shoes being sometimes thicker at the toe, sometimes at the heels. The necessity for such special shoes must be judged of by the wear of the old shoes.

Before thickening any portion of a shoe it is well to recall that, *cæteris paribus*, undue thickness at any point means unequal tread, that thickening one side of the shoe only transfers the wear to the other, that if one side *has* to be raised it is usually advisable to narrow it from side to side so as to preserve an equal balance of weight between the two sides, and lastly, that the upper surface of the shoe must always be flat, *i.e.*, the projection must appear on the ground and not on the foot surface of the shoe. As a rule, it is inadvisable to attempt correcting excessive local wear by thickening the shoe at the point worn; by far the better course is to weld in a piece of steel, or to give more cover, which increases the durability of the part without disturbing the correct relative heights of the two sides of the foot.

(3) *Surfaces and Borders.*—The upper or hoof surface of the shoe may be divided into a bearing surface and a seated surface. The bearing surface (fig. 88, *a*), or that part of the shoe which comes in direct contact with the wall, must be absolutely horizontal and broad enough to cover the bearing surface of the wall, including the white line, and a narrow ring of the outer circumference of the horny sole. In making shoes it is certainly not always possible to know how broad the bearing surface of the wall may be, but this is not so very important, because the bearing surface of the shoe can very easily be made a little broader or narrower when fitting. Shoes for heavy horses are always made with a rather broader bearing surface than those for light horses. The seated part of the surface (fig. 88, *b*), which is opposed to the horny sole, without, however, touching it, is more or less hollowed out according to the condition of the sole, but must

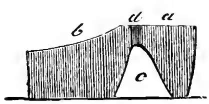



FIG. 88.—Transverse section of a fore shoe through one of the nail holes; natural size. *a*, bearing surface; *b*, seated surface; *c*, fullering; *d*, nail hole.

always be quite distinct from the bearing surface. Shoes for horses with very concave soles require little seating, and it is only necessary to carefully round off the inner margin. This is usually the case in hind shoes (fig. 87).

The object of this rounding off is to prevent pressure by the shoe against the sole. The seating of the hoof surface of front shoes need not be deep; it is sufficient if it amount to, say, $\frac{1}{8}$ of an inch; its width varies from a quarter up to a half the width of the entire upper surface. A greater amount of seating than this is, in shoes for sound hoofs, rather injurious than useful. It is, however, absolutely necessary to see that the inner upper edge of the shoe is rounded off. As a matter of fact, in many districts shoes having an absolutely level hoof surface are used, though the ground surface is recessed or deepened in some other way. This shows that, if the paring of the foot and the other details of shoeing be carefully performed, no injury results. Shoes with recessed or dished ground surface are not, as is often supposed, at all new. They were known at the beginning of the present century (see *A New System of Shoeing Horses*, by J. Goodwin, London, 1820). Many different forms of shoe with recessed ground surfaces exist.

The under or ground surface of the shoe exhibits the nail holes, with or without fullering. The fullering, or nail furrow, is a groove near the outer border of the shoe, through which the nail holes are stamped; sometimes it extends from one heel to the other, sometimes it is interrupted. In the latter case, the toe and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch of the heels are plain. The fuller should extend through at least two-thirds of the thickness of the iron, which will, therefore, also determine its breadth (fig. 88, *c*). To ensure proper stamping of the nail holes both walls of the fuller must be oblique. When the inner wall is perpendicular (fig. 89, *1*) to the surface of the shoe the nail holes are apt to point inwards. The outer border of the fuller should never be sharp, and, considering the deeper position of the nail holes at the toe, must be somewhat wider towards the front. Although fullering is not absolutely necessary, as horses work very well in stamped shoes, yet it is certainly a great advantage, for, firstly, it lessens the weight of the shoe; secondly, on account of its roughening the ground surface, it somewhat diminishes slipping; thirdly, it gives the shoe a greater range of usefulness; and fourthly, it facilitates the renewal of nails.

It is scarcely necessary to say that a shoe which is intended for fullering must be forged with an oblique outer border, as otherwise the outer under edge would be driven too far outwards by the fuller.

Opinions, both of authors and practitioners, vary greatly as to the form of the outer border of the shoe. Some believe that the border of the shoe, when the latter is in position, should run obliquely downwards and outwards, as though it

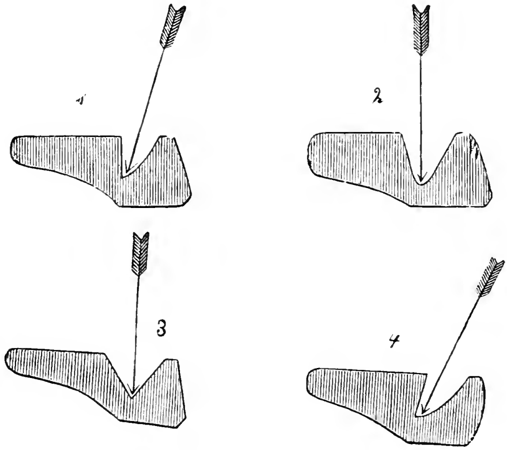



FIG. 89.—Cross sections of four fullered shoes. 1. Fullering bad, inner wall being too upright. 2. Good. [This is a rolled section of iron. In hand-made shoes the bottom of fullering is sharper.] 3. Faulty; the fullering being too broad for its depth. 4. Very faulty; inner wall inclining inwards.

formed a prolongation of the hoof. Others are of opinion that it should be rounded off, as a round border is best calculated to diminish brushing and other like injuries. As a rule, the outer border should run downwards and inwards, that is, the circumference of the shoe should be slightly smaller at the ground than at the hoof surface; otherwise the width may cause striking, the shoe will be heavier, and there will be increased danger of its becoming loose, or even being cast in soft, heavy ground. Exceptions, nevertheless, occur, and will, later, be dealt with in the chapter on Fitting. The inner border should be smooth and rounded off above and below or dished.

(4) *Nail Holes* (figs. 86 and 88, *d*).—The form, direction, distribution and number of the nail holes are very important and deserve careful consideration. The fact must be carefully borne in mind that the nail should not lose its hold until the shoe is virtually worn out, and, therefore, the nail is formed with a pyramidal head and the shoe with a deep fuller, through which the nail holes are stamped. The fullering must, therefore, correspond with the form of the nail head, so that the one exactly fits the other, and necessarily the fullering tool must correspond in section to the shape of the head of the nail.

The shoe should be fastened with the smallest number of nails which will hold it firmly, and it has been stated by Miles that under some circumstances even three nails are sufficient to give a good hold. Each nail makes a hole, which weakens the wall. Experience teaches that six nail holes are sufficient, at least in front shoes, and that only very large and heavy shoes, and hind shoes especially, require as many as seven or eight. A well-fitted shoe is very easy to affix, but a faulty shoe may be difficult to secure even with eight or ten nails. The best formed nail holes, however, may be very bad indeed if badly placed, and it is imperative to remember that nail holes should be so disposed that nails driven through them with reasonable care will enter sound horn, will not injure the soft parts, will not split the horny wall, and will not diminish the elasticity of the hoof. To meet these demands the nail holes must, when the shoe is in position, correspond with the white line at the point where the latter comes in contact with the bearing surface of the wall. In a well-formed shoe, therefore, the nail holes appear close to the inner border of the bearing surface (fig. 88, *d*). The distance of the nail holes from the outer margin of the shoe must vary according to the thickness of the horny wall. When they are so far from the outer margin that the nail tends to penetrate the horny sole, the nail holes are 'coarse'; when, on the other hand, they approach the outer margin of the shoe so that the nail passes directly into the outer sheath of the horny wall, they are 'fine.' In either case, the holes are improperly punched or the shoe is 'badly holed' if intended for a normal foot. When the holes, though in good position, point too obliquely inwards, and, therefore, give the nail a wrong direction, the shoe is also described as badly holed. Each hole must be funnel-shaped, clean and open. In the fore-feet the nail holes can only be placed in the anterior half of the shoe without injury to the elasticity of the foot, and the last nail hole in the outer quarter of the shoe should not be more than $\frac{3}{16}$ to $\frac{3}{8}$ of an inch behind an imaginary transverse line dividing the shoe into two equal parts; that in the inner branch as close as possible to it. This division of the foot into an anterior and posterior half responds to the varying thickness of the wall and to the dilatation which occurs in the posterior half of the foot. The direction of the holes must vary according to the varying obliquity of the wall of the foot. The nail holes of the toe should, therefore, be directed obliquely inwards, the more lateral less so, and the nail holes of the quarter should point almost directly upwards. In contracted feet it may in fact be needful to even give the nail holes of the quarter a slight cant outwards. Further, it should be remembered that the less thickness of the inner horny wall and the position of the shoe on the foot call for *finer punching* in the inner limb of the shoe.*

The nail holes of the hind shoe may be distributed through the two anterior thirds of the shoe, though the nail holes of the toe should be wider apart (fig. 87). The hind foot has, in comparison with the fore, stronger quarters and is less exposed to disease. The extension of the nail holes into the posterior half of the shoe is justified by practice. Were it neglected, the shoe would soon become loose or lost during work in heavy ground. This practice is especially necessary in shoeing military horses, either during manœuvres or in war. The official German military shoe, according to its size, contains from sixteen to twenty nail holes (fig. 90); not, however, for the purpose

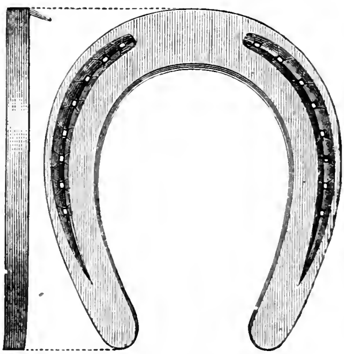


FIG. 90.—German military shoe for fore-feet.

* In this connection it is surprising to find veterinary surgeons (who are also owners of forges) still gravely disputing as to whether nail holes should correspond in inclination to the wall of the foot or be perfectly perpendicular. See *Veterinary Record*, Nos. 404 and 405, 1896, and *Veterinarian* (Reports of Veterinary Medical Societies), Fourth Series, No. 497, May 1896, p. 181.

of allowing more nails to be driven, but only to permit of selecting a better position. Contraction of the hoof need not be feared if the horse has plenty of movement.

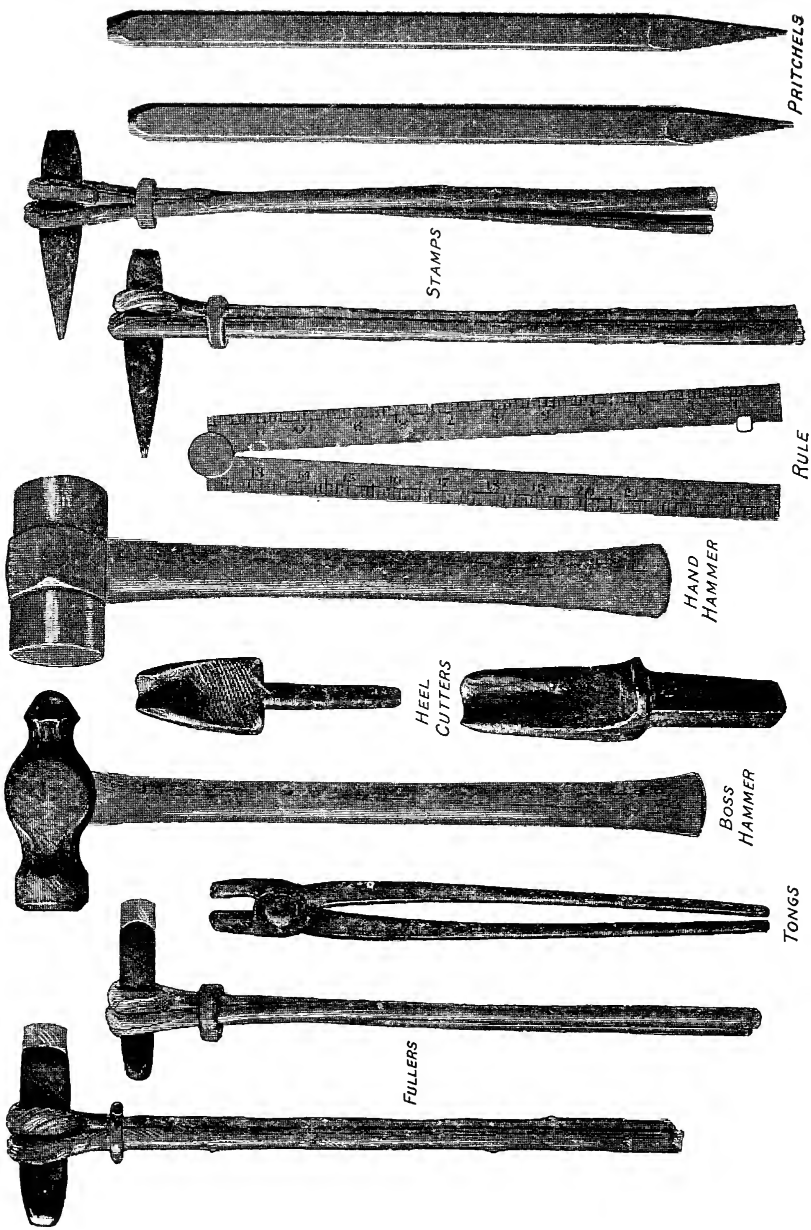
(5) Clips are small, flattened, upward projections from the outer border of the shoe. They are 'drawn' from the edge on the anvil. The base of every clip must be strong and sound. Above, the clip becomes thinner, so that it may be moulded to the form of the wall by a few taps of the hammer. To prevent injury of soft parts, the free border of the clip should be bevelled off. Clips on hind shoes should be stronger than those on fore. In light shoes the clips need only be as high as the shoe is thick, but in shoes for heavy van horses they may advantageously be made higher.

According to their position we distinguish toe, quarter, and heel clips. In either case the object is to strengthen the hold of the shoe, or, rather, to prevent the shoe shifting in position. Where the horse wears unequally, a tendency always exists for the shoe to be displaced towards the side which comes last in contact with the ground. The clips should, therefore, be placed on the opposite side. Only a toe clip is necessary when the tread is level. In the greater number of cases the shoe is displaced inwards, for which reason the outer rim of the shoe is often provided with a quarter clip. Heel clips may sometimes be required when a horse overreaches and cuts, or when the feet are excessively broken.

In forming the heels of a flat shoe, it is advisable to cut off each heel with the half-round cutter in such a way that the posterior margin runs downwards and forwards, and the outer angle of the heel is moderately rounded off.

### 3. Forging the Shoe.

With slight modifications the method of forging hereafter described is applicable to both light and heavy shoes, and has the advantage of producing a clean, workmanlike, and elegant shoe. The method of forging seen in France, where the shoe is formed under three hammers and with only one heat, is also practised in Austria and South and West Germany, but although we admire the dexterity displayed, we cannot regard the system itself as worthy of imitation, the results being very imperfect.




FIREMAN'S TOOLS.

*To face p.* 141.]

The fireman's tools (see Plate) consist of a turning hammer, boss hammer, tongs, stamps, fullers, pritchels, drawing knife, footrule, heel cutters, heel crease, compass (with or without set-screw), concave tools, anvil and vice. A very few words on each must suffice.

The turning hammer has one flat and one convex face, weighs about $3\frac{1}{2}$ lbs., and is used for turning the shoe; hence its name. The boss hammer is about the same weight, and is used for drawing clips and fitting on the shoes. Many farriers use only a turning hammer.

The tongs are used for holding the iron whilst making the shoe, and several sizes are required to take different sizes of iron.

Stamps are used to make, and pritchels to clear out, the nail holes. The stamp, having a comparatively obtuse point, forms the countersunk part of the nail hole which accommodates the nail head, the pritchel completes the operation, and finishes that part of the nail hole in which lies the 'neck' of the nail. Fullers form the groove or 'crease' around the edge of the shoe, and should correspond in section to the shape of the nail-head.

The fireman uses a drawing knife only to cut out the clip-hole at the toe, and to press the shoe home when fitting it to the foot. The knife drawn indicates very clearly how this is done.

A footrule is sometimes useful in measuring the width of foot preparatory to cutting iron for a shoe, and in measuring the length of iron required. A compass often replaces the rule. When roughing, the width of the shoe at the nail holes is measured, the set-screw turned, and a permanent record obtained for fixing the exact width of the shoe at the heels.

The purpose of heel-cutters is sufficiently explained by their name. Several sizes are needed for different work. The heel crease is used after the heel is cut off; it finishes the work and saves labour in filing up the shoe.

'Concave tools' are used to give the proper bevel to the concave shoe. For good work they are very necessary. Three sizes ($\frac{1}{8}$ inch, $\frac{3}{4}$ inch, and 1 inch) are required.

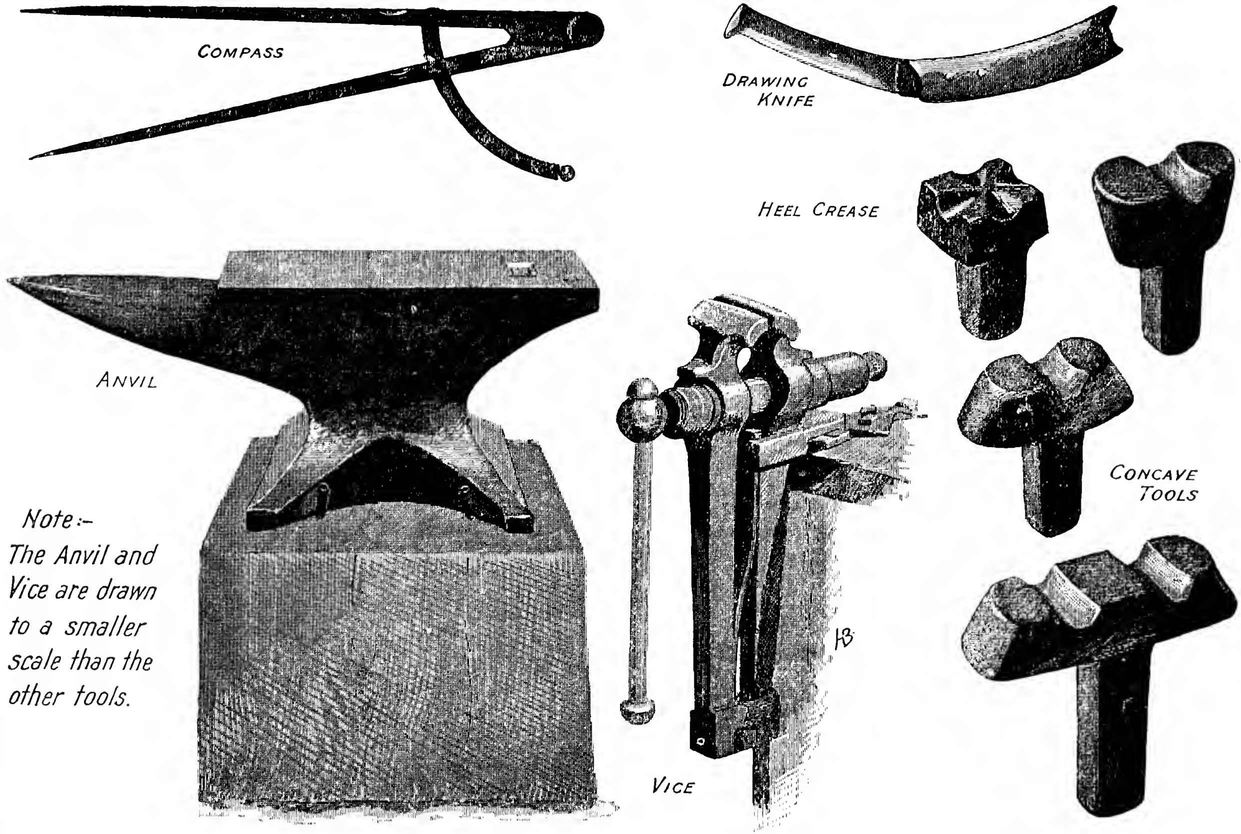
The anvil is of the form shown, weighs from $2\frac{1}{2}$ to 3 cwt., and is firmly fixed to a block of wood deeply sunk in the ground, or, nowadays, is more frequently carried on an iron anvil-block of specially strong construction. The face of the anvil should be about 27 inches from the ground and slightly tilted away from the side at which the fireman works. The anvil itself consists of a body and beak. The body has two holes pierced at the end furthest from the beak, one square, the other round. The square hole takes the concave tools, large-sized heel cutters, and the heel crease, etc.; the fireman works over it when pritchelling the nail holes of large shoes. The round hole is for small heel cutters and for working over when punching holes for cogs, screws, etc. The body of the anvil is of iron, the working surface being formed of a thick plate of well-tempered steel, welded on. The edges should not be too sharp, especially at the points where clips are usually drawn, as the clip may be cut off.

The vice holds the shoe when being hot-rasped or 'filed up.' In some instances, as when it is necessary to thicken up the heels, work can be done in the vice which could scarcely be effected on the anvil. The vice also comes into play for holding the shoe when holes are being tapped to receive frost screws.

For a description of other tools used in shoe-making, see p. 203, where the doorman's tools are described together.

Though superfluous to the working farrier, a few words on managing the fire may not be altogether out of place. On commencing work the fire is lit with a few shavings or a bundle of straw. Immediately a good body of red embers is produced, the doorman inserts a piece of ½-inch round iron (or the farrier's poker) in the nozzle of the tue-iron, and, whilst keeping the bellows gently acting, begins ramming damp coals around this and over the surface of the back plate with a sledge, fire-tongs, or other heavy object until a firm coherent mass about 9 inches in thickness and 5 in height is produced (the 'back').* He then builds up the fire, which extends beyond the back, with dry coal, and inserts the bars of iron, which have been cut meanwhile by the fireman and second doorman, in pairs in the fire. As a rule, a good workman will be content with six bars in the fire at one time, each pair being laid horizontally, alongside, and as close as possible to the preceding pair. The bars inserted are at once covered with dry coal, the bellows worked

* *Note.*—If the 'back' be made up overnight it will last much longer.




FIREMAN'S TOOLS.

[To face p. 142.

vigorously, and once the fire is found to be going well a few shovelsful of damp coal are scattered over all. During the time the first doorman is preparing the fire and heating the bars the fireman and second doorman will have cut a couple of dozen lengths of iron.

*Forging a Fore Shoe.*—As soon as the first pair of bars is seen to have reached a regular bright cherry-red heat, the fireman grasps a bar in his tongs and, withdrawing it, lays one end on the head of a sledge held by doorman No. 1, near the heel of the anvil, and, allowing it to rest lengthwise on the anvil, strikes with his turning hammer near the centre in turn with the second doorman, who, of course, uses a sledge. He then lays it edge up on the flat of the anvil, and the two doormen, striking alternately, and working from toe to heel, draw down the bar and partly form (bend) the shoe. The bar is then transferred to the beak of the anvil, and, still working from toe to heel, is still more drawn down, while, by reason of the manner in which it is held, the foot surface is fashioned rather wider

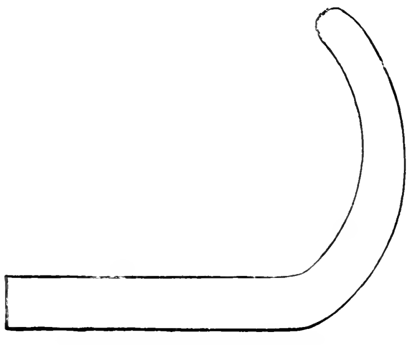


FIG. 91.—Partly completed fore shoe.

than the ground surface, to allow for subsequent dilatation at the ground surface caused by punching nail holes. Shoes to be afterwards fullered must be made *much* wider, as the fullering drives out the edge of the shoe to a considerable extent. It is at this stage, when the shoe is transferred to the beak, that it acquires the form necessary for a right or left foot as the case may be. By turning his hand outwards, so that the knuckles come upwards, the fireman gives the bevel for a right-sided shoe; on the other hand, by turning the hand inwards, with the thumb above and the knuckles downwards, a left-sided shoe is started. Though difficult to describe, the manœuvre will be easily understood on grasping a pair of tongs and imagining the results of turning the hand in either of the directions described. In bending the shoe at this stage the curve must be exaggerated, as the subsequent 'seating-out' tends to straighten the iron once more. In making a fullered shoe a good workman will, *while working on the beak*, diminish not only the thickness, but also the breadth, of the toe, leaving it slightly thinner than the quarter. The width is restored in seating-out, as the seating is more pronounced at the toe than elsewhere. We have italicised the words *while working on the beak*, because, although often omitted nowadays, owing to its difficulty, it is only at this stage that such thinning can properly be performed.

From the beak the shoe is returned to the flat of the anvil and seated out to within $\frac{1}{2}$ or $\frac{3}{4}$ inch from the heel under the rounded ends of the two sledge-hammers. If needful, the shoe is next fullered, commencing at the toe and terminating at the heel. The 'crease' is applied $\frac{1}{12}$ to $\frac{1}{6}$ of an inch from the outer margin, according to the size of the shoe. Doorman No. 1 then leaves to prepare the next bar, and No. 2 strikes for the fireman who stamps the nail holes. These are formed so as to correspond in direction with the inclination of the wall, and *not vertically* as stated by certain writers. The fireman then pritchels the nail holes, removes the bulgings (due to stamping holes) from the outside of the shoe, finishes the seating-out, leaving the surface smooth and even, and returns the shoe to the fire. The inner branch of the shoe is formed in a precisely similar way, though fullering takes place in the reverse direction.

*Forging a Hind Shoe.*—In forging a hind shoe the iron is bent as above and transferred to the beak of the anvil, on which the quarter is drawn down under the two sledges, assisted by the fireman's hammer. The toe and heel must, however, be left of full strength, the former on account of the toe being the part most exposed to wear, and the latter because, to secure a sound and strong shoe, the calkin must be turned over in the full thickness of the iron. Many firemen draw down the heel excessively and have then to turn over a great length of iron to form the calkin and to bring it to the proper thickness under the sledge. This is bad practice for two reasons: it is wasting energy to draw down the bar and then 'upset it' again, and the fibre of the turned down portion cuts through and weakens that of the branch of the shoe just

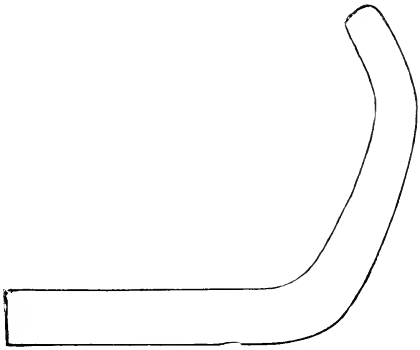


FIG. 92.—Partly completed hind shoe.

where it should be strongest, *i.e.*, just at the commencement of the calkin. In turning down the calkin the shoe is laid flat on the anvil and steadied by the doorman placing on it his sledge while the actual bending is done by the fireman with his turning hammer. Another fault of the bad workman is not to turn over his calkin *square*, and thus to render the inner margin of the shoe considerably shorter than the outer.

The shoe is now returned to the anvil, ground surface upwards, and the calkin flattened down under the turning hammer and sledge. The fireman then 'takes out the hammer-marks' on the beak of the anvil at the same time that he straightens the shoe, if, as is often the case, the toe be too round, and also rounds the quarter or heel to the necessary degree. The better the workman the less of this work will be needed. The nail holes are next stamped, the outside toe nail hole being stamped rather 'fine' (*i.e.*, near the outer margin of the shoe) but obliquely, and each succeeding nail hole being rather 'coarser' but more upright than its predecessor. The inside nail holes are stamped somewhat finer, but at about the same inclination, or perhaps a trifle more upright than the outer.

In making a double-heeled shoe the above process is repeated, the nail holes being, however, stamped in inverse order, but in making a wedge-heeled shoe, after forming the outside as before, the second operation is as follows: the iron is first turned on edge on the flat of the anvil and the wedge formed, after which the quarter is drawn either on the beak or flat as may be preferred.

In making a shoe for cutting or interfering, the second operation is all conducted on the beak. It commences by slightly drawing the toe (in this respect differing from the method of making all other shoes); the full strength of the iron is then used to form the inside branch of the shoe, while the bar is so inclined that the inside branch shows a marked bevel. Only two nail holes are stamped, slightly towards the inside of the toe. After punching these it may be needful to lay the shoe ground surface upwards on the face of the anvil and give two or three blows to flatten the shoe at the toe; otherwise everything is done on the beak.

In making a bar-shoe the piece of iron selected must be considerably longer than that needed for an ordinary shoe. The bar is bent at the toe, and with the same heat the amount of iron necessary to form half the 'bar' is turned round at right angles to the greatest thickness of the bar. The shoe is next rounded and shaped on the beak, seated on the face of the anvil, the half of the 'bar' turned round is 'scarfed' (*i.e.*, thinned down), and the nail holes are punched (in many cases only two or three nail holes are inserted at this stage). The inside of the shoe is formed at the second heat, and the fireman may then try the shoe on the foot. As the subsequent welding of the two parts of the 'bar' drives apart the heels by half an inch or more, the shoe must at this stage be somewhat narrow at the back. A third heat is required for welding the two parts of the 'bar,' and a fourth or even a fifth may be required for fully fitting out the shoe and stamping the last nail holes, especially if the foot be much broken or otherwise defective. Altogether the making of a bar-shoe is a very excellent test of the fireman's skill and judgment.

## 4. Varieties of Shoes.

A great number of varieties of shoes can be distinguished according to their breadth, thickness, weight, the presence of calkins or toe-grips, the kind of work demanded of the horse, and the special objects for which shoes are sometimes required, such, for instance, as the treatment of diseases of the foot, or the prevention of slipping in frosty weather.

Among them we distinguish shoes for (1) hacks; (2) hunters; (3) race-horses; (4) trotters; (5) carriage horses; (6) omnibus horses; (7) cart horses; (8) special systems of shoeing like Charlier's, Fitzwygram's, and the Turkish shoe; (9) winter shoes; (10) shoes for 'forging' and 'cutting'; and (11) shoes for defective and diseased hoofs.

When we remember that all these styles are of different sizes and vary in themselves, we may obtain some idea of the varieties of shoes, especially as each particular kind may be modified for a special purpose. For example, a shoe with toe-grip and heels may be used in forging and cutting or may serve as a winter shoe, or it may be arranged to take a special pad, etc.

A few remarks (chiefly in relation to manufacture) on shoes with calkins, toe-pieces, etc., are offered below, but a description of the special shoes required for different services demands considerable technical knowledge, and is therefore reserved for a later chapter.

*Shoes with Calkins.*—Shoes with calkins are formed by turning down the heels of the shoe towards the ground or

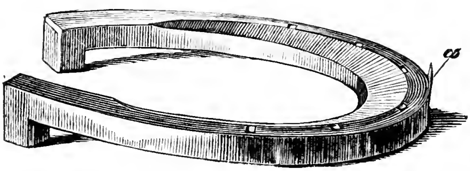



FIG. 93.—Right fore shoe with calkins. *a*, clip.

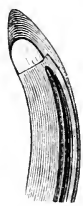


FIG. 94.—Shoe with obliquely cut off heel.

(occasionally) by welding on a piece of steel to the heel. Calkins may, therefore, be regarded as downward prolongations of the limbs of the shoe. Little need be said of the making of such, the form, breadth, surfaces, borders, and nail holes being of just the same description as in other shoes. Under the head of cart-horse shoes may be included a short description of calkins and toe-grips, especially in relation to front shoes.

Calkins should be at right angles to the shoe, regular and quadrangular in outline and not too high. The best are more or less square in section and their corners are rounded off (figs. 93 and 103, *b*). When of this form they are most easily sharpened in winter. Front shoes are sometimes provided with calkins bevelled away obliquely at the back. They are most useful for horses that cut (fig. 94).

The height of the calkin should be twice the thickness of the portion of the shoe immediately in front of it, and both calkins should be of the same height. The greatest injury is done when the outer calkin is lower than the inner. The inner upper edge of the heel should be well rounded off so as to give space for the frog.

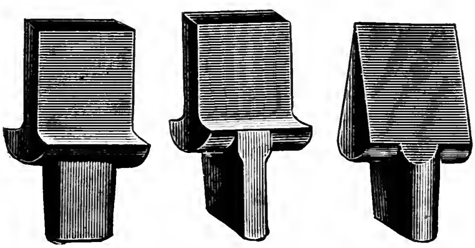
Shoes are sometimes formed with a longish quadrangular projection termed a toe-piece or toe-grip (fig. 103, *a*). Toe-grips were introduced later than calkins. They were intended to grasp the ground and to give the shoe greater durability. Toe-pieces in hind shoes give draught horses a much better hold in winter and on slippery ground.

The grips, usually made of a special steel, though sometimes only of iron, are separately forged. According to their form they are termed diamond-headed, chisel-headed, and blunt. The diamond-headed require two heats, the chisel-headed only one heat in forging. The chisel-headed also is a better and more useful form than the diamond and does not require any special anvil. The blunt grip is applied by heating the grip and shoe and then welding together. In practice some prefer one form, some another.

One manufacturer, Mr Wooldridge, makes a specialty of self-fastening toe and heel-pieces. His system consists in fitting a tapered-shank cog into a parallel-sided hole. The hole should be of such size that when the cog is inserted and lightly driven home a space exists between the shoulder of the cog and the surface of the shoe. The weight of the horse acting on the cogs then tends to drive them still further home, so that the longer the cogs are worn the more firmly do they become fixed. We believe this method of shoeing has proved very successful and is largely used in the North. In fitting, a punch is first driven through the foot surface of the shoe. Then a drift is passed through the aperture left by the punch, care being taken not to hammer the shoe so as to alter the size or shape of the hole after drifting. When the shoe is cold the rough edges left on the ground surface are filed away

FIG. 95.—Shoe fitted for removable toe and heel pieces.

and the holes opened with an opening punch, so that the cog or toe-piece will go half way into the shoe without driving. This completes the operation and leaves the shoe as shown in



FIGS. 96, 97, and 98.—Heel-pieces (sharp).

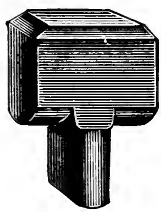


FIG. 99.—Blunt heel-piece.

fig. 95. The succeeding figures show various forms of cogs and toe-pieces. Owing to their form, these cogs, etc., always wear with a sharp edge, and their shanks being elongated, the holes required do not weaken the shoe.

To remove old cogs the wedge-shaped pronged tool illustrated is driven between the shoulder of the cog and surface of the shoe, when the worn cog can at once be detached and replaced by a new one. For winter use this method is of undoubted value. The inventor also recommends it as a permanent means of shoeing. Being without personal experience of the results, we pronounce no judgment on this head.

Toe-grips should never be higher than the calkins, but the

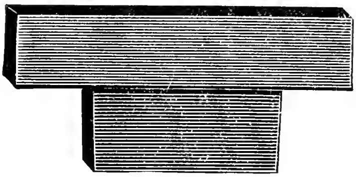


FIG. 100.—Removable toe-piece.

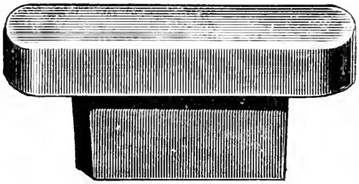


FIG. 101.—Removable toe-piece.

calkins may well be some fractions of an inch thicker than above indicated. The height and breadth of the grip, and even the exact position where it should be inserted, depend mainly upon the way the horse moves and the wear of the old shoe. Whether steel or iron should be employed depends upon special circumstances. When it is necessary to increase the durability of the shoe, or, as during frost, to make the sharpened grips last longer, steel is the best material, but

FIG. 102.—Tool for removing old heel-pieces.

when it is only a question of preventing slipping on stone pavement iron is preferable.

In fore-feet calkins and toe-grips are seldom necessary, nor are they desirable for the health of the hoof; on the other hand, in winter they are sometimes very useful (see 'Winter Shoeing'). In summer they do not prevent slipping and stumbling on stone pavement with absolute certainty. The condition of the pavement is here of less account than the convexity of the individual stones; the more convex the latter the less secure the horse's foothold. In this respect careful driving is of more importance than special shoeing. Though calkins are less used than formerly they are still often employed when they might well be dispensed with. In the majority of cases they are certainly not necessary in front shoes. Fore-feet are more liable to disease than hind-feet, which fact should alone be sufficient ground for using calkins on fore shoes as little as possible. In Glasgow, Edinburgh, the North of England, and in Vienna, calkins are very common; in Paris and London less so, a proof that the above principles are not to be rigidly adhered to in every case.

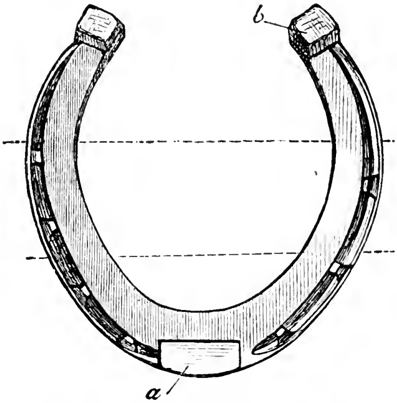


FIG. 103.—Left hind shoe with (*a*) toe-grip and (*b*) calkins.

*Machine-made Shoes.*—The trade in machine-made shoes, which has been in existence for the past thirty years, has now assumed enormous proportions, the small defects that exist in most machine-made shoes being more than counterbalanced by the saving in time and money. The nail holes are not always correct, most machine-made shoes being too finely holed. There is little distinction between right and left shoes, and to give increased durability, greater toughness is desirable.

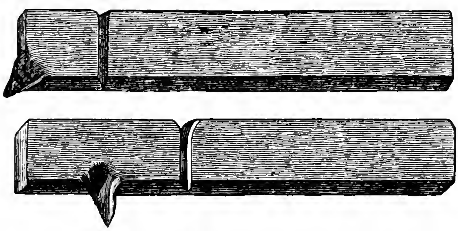


FIG. 104.—Steel rod with toe and heel grips partly formed.

In Germany many shoes are sent out ready for driving, the heels being finished, calkins turned down, toe-grips affixed, clips drawn, and the shoes finished complete in every part. Such shoes, therefore, only require to be selected and fitted to the feet, the necessary alterations being slight. They are especially useful when hot shoeing is inconvenient or impossible, as, for instance, in the Colonies and on military expeditions. Without going into the question whether cold is better than hot fitting, we may say that the production of finished machine-made shoes should certainly give a great impulse to the former method. Finished shoes are supplied by one or more German firms, and we should imagine some of our English firms might undertake the same business with success.

Every method of shoeing, even the best, produces numerous bad results, such as contraction, diminished horn production, etc., as well as other more recondite changes. Such results become most noticeable when the horse is worked on hard pavements, and are less serious on soft, heavy ground. They are aggravated by slipping on smooth surfaces and by shocks of all kinds. The many small but unavoidable effects of shoeing form a prolific cause of disease in the limbs. This fact has long been recognised, and attempts have been made to remedy it by changes in the method of shoeing. Each of such changes removes one or more evils. One of the most important was the attempt to produce an easier, softer method of going, which should both prevent slipping and diminish the shock to the limb. Accordingly, soft, elastic materials have been employed, either to entirely replace iron, or to be used in combination with it.

In consequence, pads composed of rubber, plaited rope, leather, wood, etc., have been provided to cover varying proportions of the hoof. These will be further considered in a special chapter.

The reasons why many of these novelties have only a fleeting existence are, that they do not sufficiently fit the hoof, and because they will not bear the necessary warming or working. As the hoof should never be formed to fit the shoe, but the shoe to fit the hoof (due regard being had to the distribution of weight), the ground of this failure is fairly apparent.

# CHAPTER II.

## WINTER SHOEING.

In order to give the horse a better foothold when the roads are covered with ice and snow, special shoes or special modifications of the ordinary shoe, which at other times would be superfluous or even injurious, become necessary.

These additions or modifications vary according to the severity of the weather and the work required of the animal. They are all comprised under the collective term 'roughing,' though the special styles are too numerous for detailed description here. Therefore only a few of the more practical will be noted.

In the far north, where snow lies deep and winter weather continues for several months, simple methods of roughing may be employed, though in more changeable latitudes these would soon be rendered useless by contact with the hard ground.

All systems of roughing at present in use are more or less imperfect. The chief objects to keep in view are briefly summarised below.

(1) *Simplicity.*—No system can ever succeed which is not *simple* of execution, or in which the farrier is required to use many special tools. Furthermore, the application of the 'rough' must be an even simpler matter than the preparation of the shoe, so that any stableman may affix it. Finally, the 'rough' must be easy to remove.

(2) *Rapidity* in the preparation of the shoe and the affixing and removal of the 'rough' is almost as important as simplicity of application, especially in the army.

(3) *Economy* must be kept in view, as the expense of roughing a large stud during a long winter would otherwise prove excessively costly.

(4) *Durability.*—The 'rough' must neither wear away fast nor become loose, otherwise it may lead to dangerous cutting or to severe falls. At the same time, as increase of weight is a disadvantage, durability must be sought by the use of the best material. The method of fastening must also be such that the 'rough' can be affixed even when the shoe is considerably worn.

(5) *Adaptability.*—A proper system should be adaptable to all horses, all kinds of work, and to all shoes.

(6) *Efficiency* is more or less represented by the sum of the above, but also depends on the depth to which the 'roughs' enter the ground, and on their number. It becomes less, of course, as wear advances.

## 1. Rough Nailing.

Rough nailing consists in removing an inner and an outer nail, and replacing them by others with pointed or chisel-shaped heads. This method does very well for saddle horses and animals used only occasionally and for light work.

In the German army rough nails are employed in addition to screws of three sizes. In Denmark and other northern countries large, strong nails, with heads case-hardened by means of ferrocyanide of potassium, are a common means of roughing, a specially large hole being punched in the toe of the shoe. Such nails are termed 'broddar,' and replace the ordinary toe-grip. They can, of course, be changed from time to time, and appear to suit the local requirements excellently. Rough nails, the shanks of which do not pass through the horny wall, but are driven through special holes in the shoe, and turned down on its upper and outer border, are technically known as 'stubs,' and are largely used in England, France, Denmark, Sweden, Finland, and North America. They can be inserted at any point in the shoe, though the heels and inner and outer parts of the toe are the best places.

Of those shown here the wedge-headed are the best, and wear longest. Owing to their small mass the diamond-headed soon lose their efficiency, in addition to which they are more likely to inflict injury on the coronet of the opposite foot.

Delpérier invented a special form of nail now largely used in France, to prevent slipping on smooth granite 'setts' and

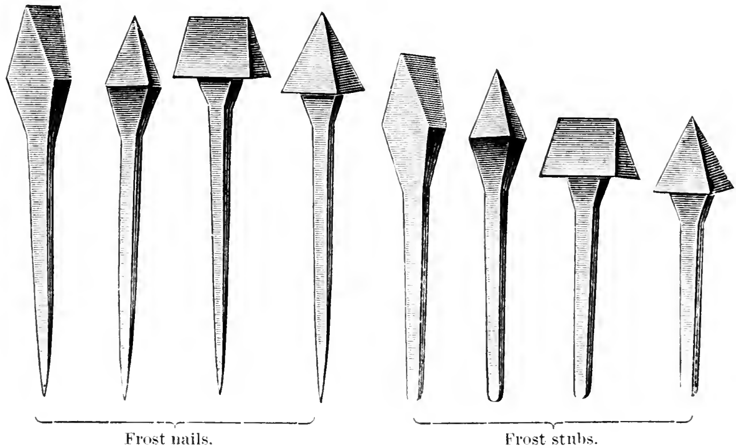



FIG. 105.

also on frozen macadamised roads. It is simple, durable, and effective.

The nail consists of a head, neck, and shank. The head is cubical, this form having been found more durable and generally useful than the pointed or wedge heads. The wearing surface presents two deep cuts dividing it into four parts, and

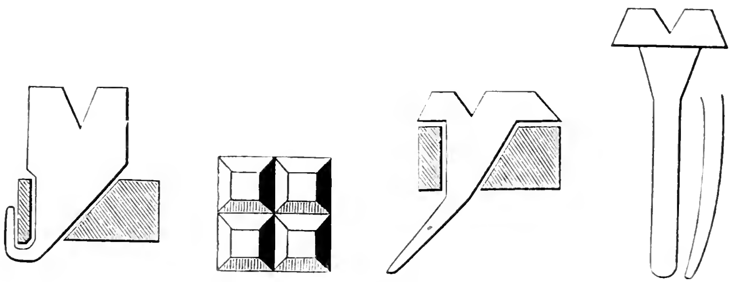


FIG. 106.—Delpérier's frost nail.

improving its holding power on the roadway. The head is of the same height as the web of the shoe to which the nail is attached. Experience shows that this is more than sufficient to wear for one day. The neck and shank are relatively very short and stout.

For making the holes in the shoe a special stamp (see fig. 109) is employed. The shoe being at a red heat, the stamp is applied at the proper point on the lower surface, and driven through half the thickness of the shoe in a vertical direction; the stamp is then slightly inclined, and with a few more blows of the hammer is caused to emerge at the upper and outer edge. The hole is then punched back so as to leave a clear passage, and when the shoe is cold, any burr is filed off. Two holes are punched in each limb of the shoe.

To prevent the holes being filled up or burred over, Delpérier uses two forms of nail, one for ordinary and one for frosty weather. As the nails are disposed at similar points in each half of the shoe, the balance is in nowise altered, and this method is now extensively used in Paris and other large towns throughout the year.

In use the nails are slipped into the holes, driven home and the shank turned down on the outer edge of the shoe. If

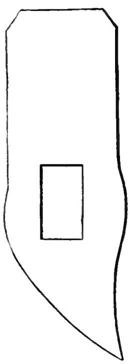


FIG. 107.—Stamp for Delpérier's frost nail.

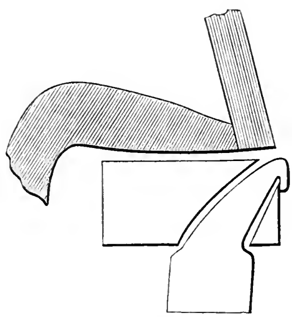


FIG. 108.—Section of shoe with Delpérier's nail inserted.

the shoe be thin, it may be necessary to cut the shank somewhat shorter, just as the point of an ordinary horse nail is cut before forming the clench.

## 2. Roughing by Means of Sharp Heels and Toes.

The outer heel is 'steeled,' then drawn down, and sharpened on the anvil at a right angle to the web of the shoe (fig. 109).

This form remains sharp for a longer time and wears more regularly than any other. The inner heel is wedge-shaped, and is also at right angles to the web. To prevent cutting it is best not to make it quite sharp and to round off the outer edge (fig. 110).

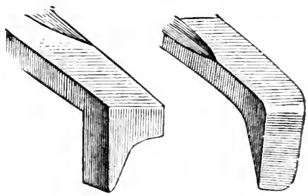


FIG. 109. FIG. 110.
FIG. 109.—Outer heel 'sharpened.'
FIG. 110.—Inner heel 'sharpened.'

This is the oldest method of roughing, and may be applied to all horses employed at slow work. In heavy cart horses a small piece of steel is sometimes let into the toe (of the shoe) and sharpened. A special kind of steel is made for this purpose, which welds easily and thoroughly with iron. In order to obtain the greatest wear, such toe-grips should be hardened, though it is not desirable to render them too brittle by suddenly cooling the entire shoe.

Roughing one heel is insufficient, and should be condemned.

As the above method of roughing requires the removal of the shoe each time it is renewed, serious disadvantages follow its repeated use. Firstly comes the loss of the animal's service while waiting at the farrier's, to which must be added the too frequent injuries from pricking as well as injuries to the wall.

FIG. 111.—Count von Einsiedel's winter shoe for front feet.

FIG. 112.—The same for hind-feet.

Even when the greatest care is used, the hoof will not bear removal of the shoe more than five to six times per month.

These drawbacks led to the invention of Count von Einsiedel's winter shoe (figs. 111 and 112). This shoe has neither calkins nor toe-pieces; its ground surface is divided into two sharp edges by means of a deep fuller. It is made from three-cornered rolled iron which is cut into the necessary lengths, bent into form, and then fullered. The hind shoe differs from the front in that its heels are sharp and are bent forward in the direction of the bars. They are thus very useful in preventing slipping in a forward direction.

### 3. Roughing with Screws.

The necessity for the use of good iron has already been indicated, but this is of special importance in the manufacture of shoes which are destined to carry screws, because if it be wanting in toughness, brittle at a red heat, or show a tendency to fissure, it will not permit of screwing. With the exception of the heels, the shoe exactly resembles an ordinary shoe, and even the heels do not require to be much thicker or broader than in the common variety.

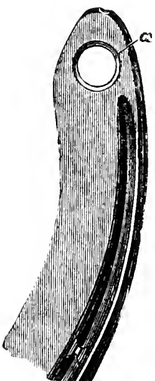



Fig. 113.—Heel of "screwed" shoe with countersunk hole.

The holes are made either by punching or boring. In punching an almost cylindrical punch is used, and the hole completed on a round drift thickest in the middle. This drift, for a distance of $\frac{3}{8}$ of an inch in the centre, should be as thick as the tap afterwards employed to produce the screw. The ground opening should be slightly countersunk (fig. 113), so that after the thread has been cut, the screw may sit close to the surface of the heel.

The screws are made either of iron or a special steel, and their manufacture is seldom undertaken by the working farrier. Iron is soft, and, therefore, less durable, but steel is excellent for the purpose, and when the screws, with the exception of the thread, are hardened by heating to a dull red and cooling in damp sand, they possess the greatest resistance to wear, and at the same time sufficient toughness. The method employed by Schäfer of Dresden is as simple as it is practical. It is also used in the School of Practical Farriery, Dresden. As it may be useful under certain circumstances, a short description is appended. The screws are formed of square steel from $\frac{1}{2}$ to $\frac{3}{4}$ inch in thickness, a special anvil being employed (fig. 114, *c* and *a*). The mould for forming the shank (*a*, *a*) is held in the centre of the anvil in two special guides (*n*, *n*). It is of steel, and possesses, as shown by the figure, two moulds or grooves of dissimilar breadth, of which that on the right is for the preparation, and that on the left for the completion of the shank. These moulds correspond also to the

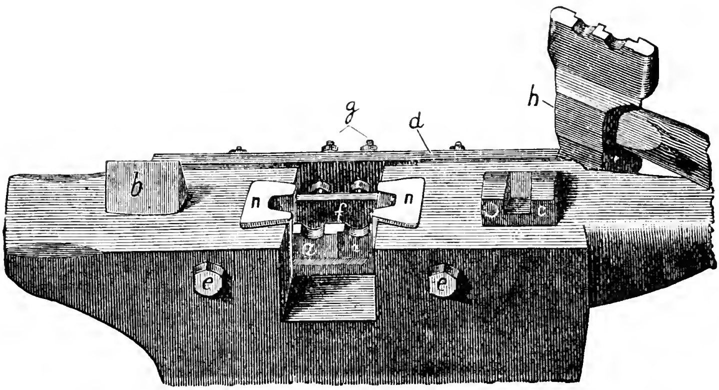



FIG. 114.—Anvil for making screws. *a*, mould for forming shank; *b*, cutter; *c*, mould for making sharp-headed screws; *d*, plate carrying set screws, *g*, and held in position by the two screws, *e*, *e*; *f*, die carrying the moulds, *a*, *a*. This can be set at any distance from the plate, *d*, by moving the set screws, *g*. The length of the shank is thus fixed; *h*, forging hammer.

forging hammer (*h*), which is slid into the grooves (*n*) and comes down on the piece of square steel: as soon as the hammer (*h*) and the mould (*a*) come in contact, the shank is of the proper thickness. Although the steel is drawn out by working in the right mould, it is still too large for the left, into which it is next inserted, and in which it is finished. The difference in the diameter of the two moulds determines the amount of elongation which the shank undergoes in the process. In making blanks or blunt screws, the height of the screw is next marked, the stop (*f*) placed in position, the heated bar passed first into the mould (*a*) and then into the mould on the left, and forged until the forging hammer and mould come in contact. It is then cut off, roughly finished.

In making chisel-headed screws (fig. 115) the mould (*c*) is first used, and the same process gone through to form the shank as given above. Before cutting the thread, which is performed with the machine shown in fig. 116, the screws are heated with charcoal and the end of the shank filed off square. The screw is then grasped between the claws ($a$) and the slide-rest ($b$) advanced until the shank engages the die ($c$, $d$) and the latter begins to cut; the graduating screw ($e$) serves to fix the position of the two portions of the die, so that the shanks of the screws may be of equal thickness. The thickness of the shank is about $\frac{1}{2}$ an inch, the thread is on Whitworth's scale, for saddle horses a trifle smaller, say, $\frac{7}{16}$ of an inch.

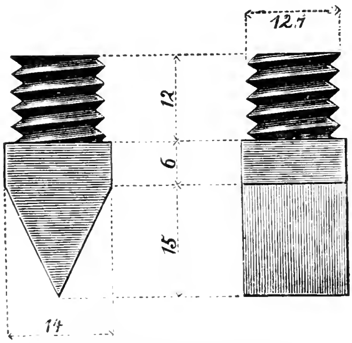


FIG. 115.—Screws (full size) provided with Whitworth thread.

In England and Denmark screws with a concavity on either face are also used (fig. 117). In the German army screws are largely employed. The shank is about $\frac{1}{2}$ an inch thick and about $\frac{3}{8}$ inch long, the screw being formed of square steel bar a trifle more than $\frac{1}{2}$ an inch on either face. The process is as follows:—A mould, specially designed for field use (fig. 119), is carried. The steel bar is first raised to a white heat and the chisel edge roughly sharpened on the beak or horn of the anvil by means of the hand-hammer. The steel rod is then laid in the hollow part of the mould, so that the chisel head rests against the front. With the help of the forging hammer, and by continually turning the

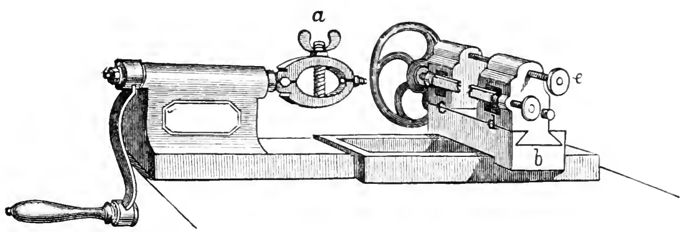


FIG. 116.—Screw-cutting machine. $a$, claws for grasping screw; $b$, slides for adjusting the cutting parts of die, $c$ and $d$; $e$, set screw for determining the thickness of the finished shank.

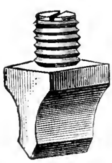


FIG. 117.—Frost screw with concave sides.

rod, the shank is formed, the hammer being used at first vigorously and afterwards more lightly. The chisel head of the screw, which has become somewhat turned up by striking against the front of the mould, is then once more sharpened, and the partially finished screw cut off with the hand-chisel on the front of the anvil. In making blunt screws a piece of the bar, about $\frac{1}{2}$ an inch in length, is left projecting beyond the mould. The end of the shank is rounded off and the thread cut upon it by means of a screw-cutting machine, which is dropped into the cross channel. A practised smith is said to be able with this mould to produce about 100 screws per hour. In forming the thread only one screw-cutting machine is required, as, of course, it will take any ordinary size of screw.

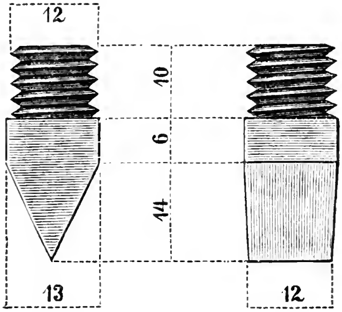



FIG. 118.—Frost screws used by the German army. Measurements in mm.

The advantages of well-manufactured screwed shoes are so many that this method deserves preference over any other. The objections that screws are lost, broken, etc., can usually be referred to carelessness in manufacture and the use of bad materials. The use of screws is one of the best methods of roughing. A set of sharp and blunt screws and a small key should be supplied with each set of shoes.

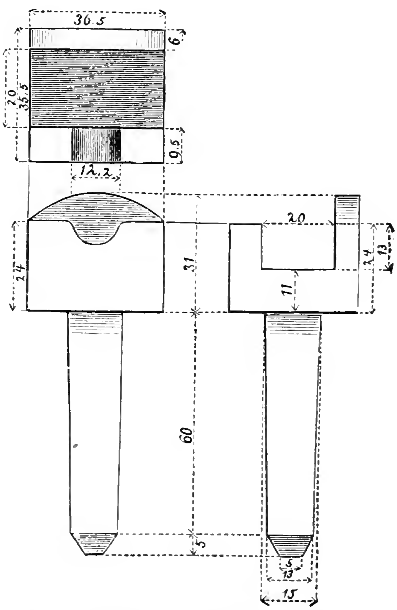



FIG. 119.—Mould for making screws. Army pattern for field use.

The screws shown herewith are those most commonly used in England. The wedge shape (fig. 120) is the most popular, as it gives a good foothold and at the same time wears well:

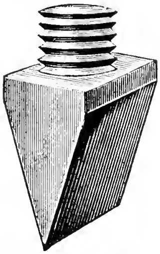


FIG. 120.

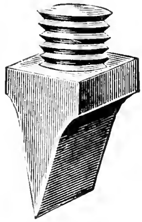


FIG. 121.


FIG. 122.

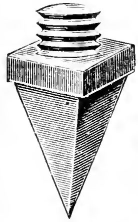


FIG. 123.

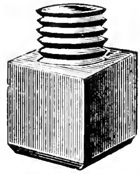


FIG. 124.

the modified wedge with concave faces (fig. 121), though perhaps giving a rather better hold, is not so durable, while the diamond-pointed screw (fig. 123) soon loses its sharpness, wears rapidly, and has the grave drawback when new of inflicting dangerous wounds on the coronet should the horse cross his legs or slip. For these reasons it is now little used. The square-headed screw (fig. 124) is called a 'blank,' and is used for preserving the holes during ordinary work. It also gives a certain amount of foothold, and is sometimes used even during frosty weather. The screw tap shown is preferable to the ordinary form, as the increased size of the head gives greater leverage in screwing, and renders the tap less liable to break at this point. Fig. 126 shows a plug tap for clearing the screw holes before inserting the screw, combining with the tap a 'picker,' useful for clearing the holes and removing hard masses of snow, etc., from the foot.


FIG. 125.—Taper tap.

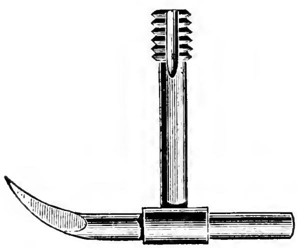


FIG. 126.

*Modified forms of Screws.*—The fact that in large towns, where snow is removed from the streets and the screws come in direct contact with hard pavement, all chisel or pyramidal screws soon become blunt, renders shoeing both more costly and more troublesome. Attempts have therefore been made to produce screws which remain permanently sharp and prevent slipping even after long wear on hard ground. Such, certainly, have advantages.

Amongst them we may cite, firstly, the screws and cogs with an H-formed surface (fig. 127). 2. Screws with a cross-shaped bearing surface (fig. 128). 3. Screws and cogs with T-formed

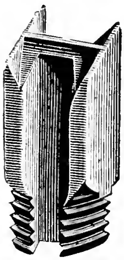


FIG. 127.—Screw with H-shaped head.

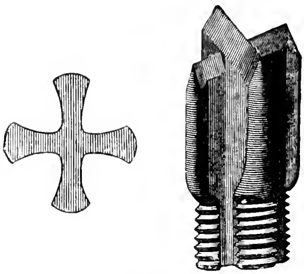


FIG. 128.—Screw with +-shaped head.

ground surface. 4. Screws and cogs with S-shaped ground surface. 5. Angled screws (fig. 129). 6. Screws and cogs with inserted rubber plugs. 7. Screws with radiating Y-shaped

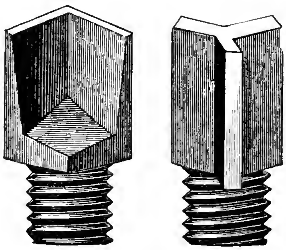


FIG. 129. FIG. 130.

FIG. 129.—Screw with angled head.
FIG. 130.—With Y-shaped head.

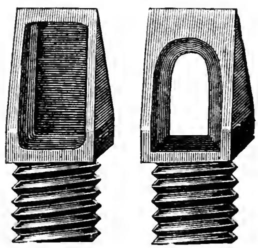


FIG. 131. FIG. 132.

FIG. 131.—Hollow screw.
FIG. 132.—Perforated screw.

bearing surface (fig. 130). 8. Hollow screws (fig. 131). 9. Perforated screws (fig. 132). And 10. Spring cogs.

The durability of these screws and the foothold which they

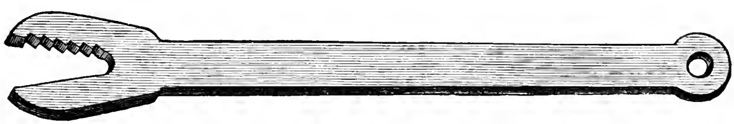


FIG. 133.—Universal screw-key.

give depend chiefly on their diameter and the direction of the wearing surfaces. So far as experience teaches, those with the narrowest and fewest wearing surfaces are least durable, but this may be compensated by the use of thoroughly good material. The improved foothold is of course a great advantage.

In inserting and removing screws a key is employed, one of the simplest and most effective forms being that shown in fig. 133, which fits all forms of screws; the head is hardened.

## 4. Cogs.

Shoes destined to receive cogs differ in no important respect from ordinary shoes. To prevent the cogs being lost they should be conical in form and exhibit a taper of about one in ten, while the holes for their reception must correspond exactly in size with the thickness of the centre of the shank.

(*a*) Round cogs were invented in 1869 by Judson. The holes to receive cogs can be made in the heated or unheated shoe. In the first case the hole is formed with a round punch rather smaller than the shank of the cog and finished, after fitting the shoe, by means of a conical slightly oiled steel drift tapering from either end about one in ten. The holes can also be bored and countersunk in the cold shoe. For this purpose a drill (the best form is the American twist drill) is necessary, the diameter of which exactly corresponds to the thickness of the upper end of the cog (figs. 134 and 135, *c*). After the shoe is fitted to the foot the holes are widened by means of the counter-sink shown in fig. 136, which is introduced from the ground surface. As the shank of the counter-sink corresponds in thickness to that of the cog, the latter should then fit firmly. Any little roughness of the margin of the hole is removed with a file and the border once more smoothed off by introducing the counter-sink. The cogs are made of rolled cast steel of round section, and may be the same diameter as the hole or about $\frac{1}{25}$ inch thicker.

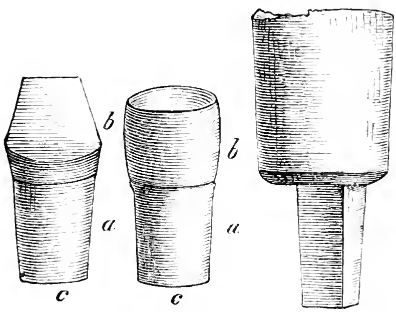



FIG. 134. FIG. 135. FIG. 136.

FIG. 134.—Sharp cog.
FIG. 135.—Blunt cog. *a*, head; *b*, shank.
FIG. 136.—Counter-sink for enlarging holes in shoe.

A mould, the holes in which have been made by the countersink, is necessary; the steel rod is slightly warmed and drawn until it will enter the mould to within about one-twentieth of an inch of the end. A sufficient length is then left projecting and the bar so deeply notched that it can easily be broken off. This may be done immediately, and the cog cooled, a blank resulting; or if a chisel edge is required, the cog is grasped with special tongs having short jaws bored out to receive the shank, and the chisel edge is then formed with a hammer.

It is much easier, however, not to give the shank a conical form, but merely to produce a chisel edge and to cut off the cylindrical cog thus formed. Diamond-headed cogs are produced on an oblique tool, similar to that in fig. 142, *b*, by using a special hammer and turning the bar frequently.

The cogs (fig. 137) can easily be cut to the same length by fixing a stop at the necessary distance in front of the cutter. They are made on the anvil shown in fig. 114, it being only necessary to have proper moulds and a proper hammer. Before nailing on the shoes the cogs should be tried. They are well made when the shanks fit tightly all round and their ends fill the entire hole, with the exception of a space of $\frac{1}{24}$ to $\frac{1}{12}$ inch at the upper surface of the shoe. The cogs are inserted after shoeing: the first introduced can be fixed by means of a light blow; in inserting the second, however, it is necessary to press gently on the first, which might otherwise jump out under the shock of hammering. All that is necessary to insure their holding is care in manufacture and fixing.

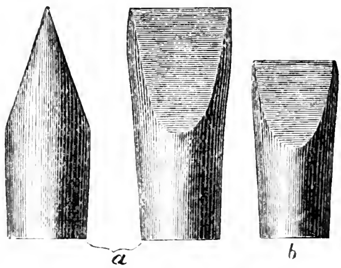


FIG. 137.—Round sharp cogs. *a*, for draught; *b*, for riding horses (nat. size).

(*b*) Quadrangular cogs were suggested by Dominik of Berlin. In using cogs of $\frac{3}{8}$ inch thickness in the shank, a hole is punched through the heel of the shoe by means of a square, moderately conical punch, the end of which measures, say, $\frac{1}{4}$ inch; this hole is enlarged with a drift. The holes should be punched from the ground surface, care being taken to hold the tool at right angles to the surface of the shoe.

The slight burr produced on the upper surface of the shoe by the passage of the drift should always be removed with a file, and never beaten down with the hammer. The first hole is widened by using a drift. In this process the heels of the shoe are warmed to a dull red, and the drift driven through at right angles to the surface by a few light rapid strokes.

A simple method of manufacturing cogs was invented by a veterinary surgeon named Schleinitz. The blunt cogs are made cold, the chisel-edged warm. In forming a blunt cog the end of the square rod is hammered on all sides until it will

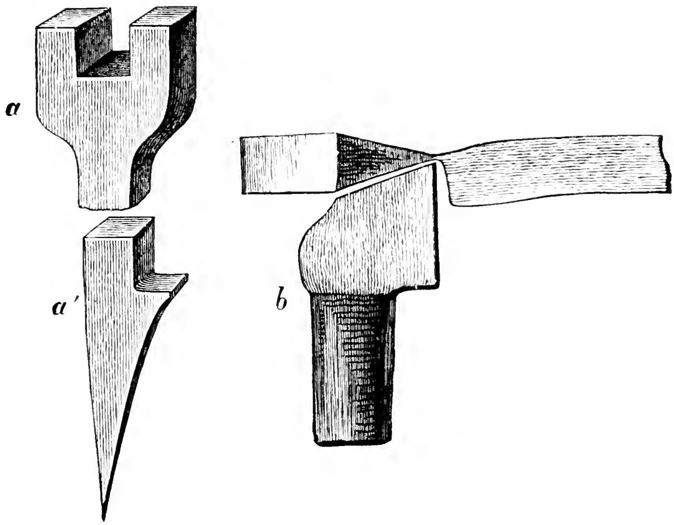



FIG. 138.—*a*, upper; *a′*, lower end of anvil for forming shank; *b*, anvil for forming head.

enter the mould (fig. 138, *a*) to within about one-twentieth of an inch of the end, when it is cut off with the ordinary cutter. Chisel-edged cogs are similarly fitted and sharpened and cut off on a special anvil (fig. 138, *b*). They can then immediately be hardened. The thickness of the drift at its widest part corresponds to the greatest width of the mould. One man can thus make cogs without assistance.

As compared with screws, cogs have certain advantages, viz. :—1. They never break off. 2. Their manufacture and use are simpler. 3. Being so cheap, everyone can keep a few in stock and affix them without special help.

Their disadvantages, however, are :—1. That even with careful fitting they are sometimes lost. This seldom occurs when the cogs are inserted by the farrier; on the other hand, it is favoured by the horse cutting. When the snow ‘balls’ in the feet, and when horses are going up-hill over hard roads, the cogs are very liable to become loose, because they fail to touch the ground.

2. Cogs are difficult to renew on account of becoming fixed in position, though this can be prevented by removing them immediately the horse returns home. To facilitate removal different instruments have been invented, most of which, however, can only be used when the heels are very long; but such heels are a great disadvantage, especially in riding horses. When the horse is worked without cogs the lower margin of the hole ‘burrs up,’ and the insertion of new cogs becomes difficult. After the drift has been in use for some time its edges become rounded and the cogs no longer fit the holes it produces.

### 5. Shoes with Removable Toe-grips.

Roughing by the insertion of one or two ordinary screws in the toe of the shoe has long been practised. Provided animals thus shod are not used on stone pavements this method succeeds; but in large towns screws of any form soon become loose and fall out. As they have afterwards to be removed the attendant frequently refrains from screwing them fully home: hence under the action of the severe strains to which they are exposed they are soon lost. It is better to employ blanks, which can be screwed in firmly at first, for although this certainly does not get rid of the strains to which the screw is exposed, it greatly diminishes the number of lost screws.

Toe-cogs have stood the test of many years' trial and deserve to be more widely employed. The simplest forms are the best, and none of those which require any special contrivance, such as a wedge, a split pin or screw, to prevent loosening, can be regarded as practical. The chief point is the shape of the shank. This should increase in thickness about 1 in 7 or 8; when less tapered,—for example, 1 in 10 or 1 in 12,—cogs at first become too firmly fixed and are difficult of removal, and later dilate the holes so that the crown of the cog comes in contact with the shoe; the cog then becomes loose and eventually lost. It is of little importance whether in transverse section the shank is elongated, rectangular, or oval, though it is very necessary that the measurement from side to side should greatly exceed that from before to behind.

The breadth, thickness, and length of the shank may vary within considerable limits, according to the weight of the horse and its work. In heavy horses, to which toe-cogs are most applicable, the shank may be $\frac{3}{4}$ to $\frac{7}{8}$ inch broad, $\frac{3}{8}$ inch in thickness, and $\frac{5}{8}$ inch in length: for lighter horses $\frac{5}{16}$ inch in breadth by $\frac{3}{8}$ inch in thickness and $\frac{1}{2}$ inch in length, thickness, and breadth measured close below the head.

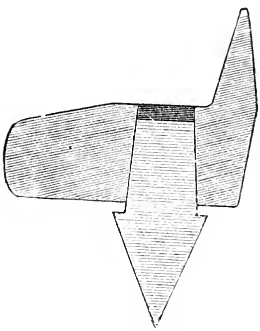


FIG. 139.—Transverse section of toe of grip-shoe for draught horse.

(*a*) Toe-grips with elongated rectangular shanks (fig. 139). These are manufactured of steel, about $\frac{7}{8}$ inch in breadth and $\frac{1}{2}$ inch thick. The shank is first forged, the head then formed on an anvil with an oblique face and so far cut through as only to require breaking off, warming to a white heat and placing in a mould of the necessary shape, in which a few light blows of the hammer suffice to perfect the form.

To change these grips a thin double-jawed lever with wedge-shaped head (see fig. 102) is driven between the shoe and grip, which is then loosened by a few blows on the shoe.

Shoes intended to carry these toe-grips must be somewhat thicker than usual at the toe. Heavy shoes should be from $\frac{5}{8}$ inch to $\frac{3}{4}$ inch and light shoes from $\frac{1}{2}$ inch to $\frac{5}{8}$ inch thick. This prevents dilatation and loosening. The dilatation of the opening for the toe-grip is peculiar and does not occur when cogs are used. It is produced by the enormous pressure to which the toe is exposed, especially in hind-feet, for which reason toe-grips should be formed of a more conical shape than cogs.

After the clip has been drawn, the hole for the grip is punched from the ground towards the hoof surface and the burr thus produced on the foot surface filed away, a drift being afterwards driven through the hole to give it its finished form. The drift should be a little smaller than the shank of the grip, so that when the latter is inserted its head will not come in contact with the shoe, but a space, from $\frac{1}{24}$ to $\frac{1}{12}$ inch, be left between it and the shoe, so as to allow of dilatation being compensated by the further penetration of the grip. After fitting, the hole is once more drifted.

(*b*) Toe-grips with oval shanks (figs. 140 and 141) are made in great variety, with and without safety nails, so that when

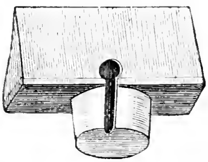


Fig. 140.—Toe-grip with oval shank and nut.

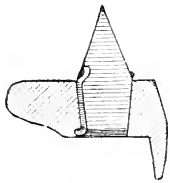


Fig. 141.—Transverse section of shoe, grip, and safety nail.

the aperture for the grip has become somewhat dilated a rather larger grip can be used, which will still hold well.

(*c*) Toe-grips with rounded conical shanks are made with a shank about $\frac{1}{2}$ inch in length and thickness, which diminishes towards the smaller end to the extent of $\frac{1}{24}$ to $\frac{1}{16}$ inch. Opposite the shank are a couple of ribs about $\frac{1}{12}$ inch in height and the same in thickness, which prevent the grip rotating. The shoes, machine-made, are $\frac{1}{12}$ to $\frac{1}{6}$ inch thicker around the aperture than at other parts.

(*d*) Malleable iron shoes with removable toe-grips. These have a grip-hole at the toe. The grip is held firm by a thin piece of flexible iron plate, which is bent and inserted, the grip being then placed in position and fastened by a few blows of the hammer. At the centre, near the inner border of the toe of the shoe, is a depression to permit of a pointed lever being passed under the iron plate, which, once removed, allows the grip to be readily taken out. Nevertheless, when horses are worked on stone roads, these grips are apt to become loose (fig. 142).

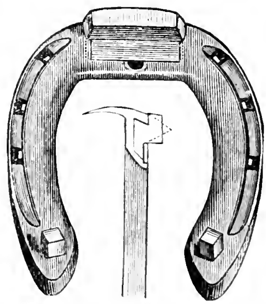


Fig. 142.—Patent shoe with movable toe-grip. The middle fig. shows a section of the shoe.

To prevent snow 'balling' in the feet, specially narrow shoes, or shoes with concave ground surfaces, are sometimes used, whilst in other cases the entire ground surface of the hoof is smeared with fat or soft soap. None of these means, however, is perfectly effectual. The only reliable remedy is some form of elastic pad. Among the oldest and best known are Hartmann's, then follow pads manufactured of felt, leather, cork, straw, hemp, and gutta-percha. The last named, however, in very cold weather become too hard, and then fail to act. Sheather's pneumatic pad is also good.

# SECTION II.

## CHAPTER I.

### THE FOOT IN ITS RELATION TO THE ENTIRE LIMB.

THE shape of the horse's hoof is so largely influenced by the conformation of the limb to which it is attached, that, before proceeding to more closely study the former, it will be helpful to devote a short space to the limb itself. The variations in conformation of the limb largely determine the style of going, the form of the hoof, and the distribution of weight. These factors deserve our best consideration, for in shoeing sometimes one, sometimes another, and sometimes all three become of very great importance, and, broadly speaking, neither the trimming of the feet nor the selection and fitting of the shoe can be correctly performed without an intelligent appreciation of the conformation of the limb and its action. The necessary knowledge cannot be learnt from books. More can be gained from the study of large diagrams; but without much practice and steady observation of living horses, both at rest and in motion, printed instructions are of little value. The best means of all is study under the direction of a competent teacher, who will amplify his lectures by demonstrations on the living animal.

#### 1. CONFORMATION OF THE LIMBS.

The conformation of the limbs depends upon the varying lengths of the individual bones, and upon the angles which they make one with another. Horses, however, do not always move as one might anticipate, and the observer, before coming to an opinion, should view the horse both at rest and in motion.

(*a*) The position of the fore-limbs when seen from the front is normal (fig. 143), when the limbs vertically support the body. A plumb bob let fall from the centre of the shoulder joint should coincide with the mesial plane of the limb or divide the limb into two equal parts. The fore-legs should be separated to a moderate extent, in order that the animal may have a fairly large base of support, be sure on his feet, and not be likely to strike himself in moving. A certain separation is also needful to accommodate the great pectoral muscles. The separation of the limbs should be approximately equal in front and behind. The base of support then takes the form of a parallelogram, and the impulse of the hind-limb is conveyed in a direction parallel to the direction of movement of the whole body, a condition which makes for stability and allows all the power developed by the hind-limbs to be utilised in forward movement. In simple language, when the hind-limbs are not in line with the front they tend to push the body more or less to one side instead of straight forward.

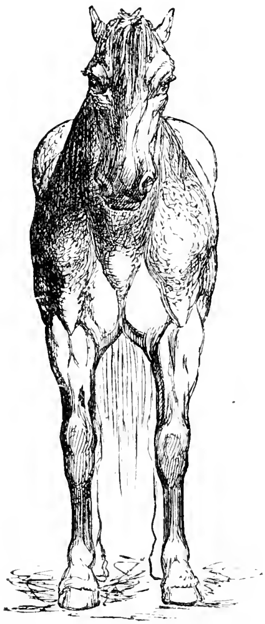


FIG. 143.—Normal position of fore-limbs.

When the toes are turned out (fig. 144) the plumb bob will fall towards the inner side; the chest is narrow, the limbs run obliquely downwards and outwards, and the body-weight falls more on the inner halves of the feet. Animals with this conformation are usually surefooted, but as the limb is not moved straight forwards but in the arc of a circle they are more readily tired than those of normal formation, the inside of the limb is surcharged with weight, and the pace is relatively slow.

Again, in the calf-kneed condition, where the knees are too close, the feet too far apart (fig. 145), we have perhaps the maximum of undesirable factors. In this conformation either the foot or the entire limb may be turned outwards.

Turned-in toes are found in conjunction with a very broad chest. The limbs run downwards and inwards; the plumb bob would then fall outwardly as does the greater part of the weight. This defect renders the action clumsy, and if the animal should stumble makes it very difficult for him to recover. A particular form of this abnormality is shown in fig. 146. Sometimes the limb is normal as far as the fetlock, below which it turns inwards, producing a condition termed 'pigeon-toed.'

The position of the fore-limbs, when viewed from the side, is normal when a vertical line let fall from the centre of the scapula divides the limb from the elbow to the fetlock joint in

FIG. 144.—Turned-out toes.

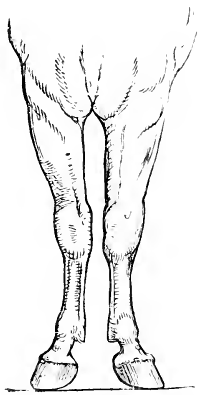


FIG. 145.—Calf-kneed formation.

FIG. 146.—Pigeon-toed formation.

halves, and strikes the ground close behind the bulbs of the heel.

Another method of stating the above is to say that, seen from the side, the limb should be perpendicular from the region of the fore-arm to that of the fetlock. It is evident that, when the limbs are thus perpendicular to the ground, they are best fitted for supporting the weight of the body, like a column, which should always be perpendicularly under the point to be supported.

The axis of the foot, that is, of the os suffraginis, os coronæ, and os pedis, and the toe of the hoof form an angle of about 45° to 50° with the horizontal plane. From this position there are variations both in a forward and backward direction; the body-weight in the former case falling more on the anterior, in the latter on the posterior half of the hoof.

Goyau states that, given normal conditions, the resultant of the body-weight may be represented as passing through the centre of the foot, *i.e.*, through the line formed by the intersection of the longitudinal and transverse axes, and that any reduction of the weight-bearing surface of the hoof, either in front, behind, or on either side, brings the part so reduced

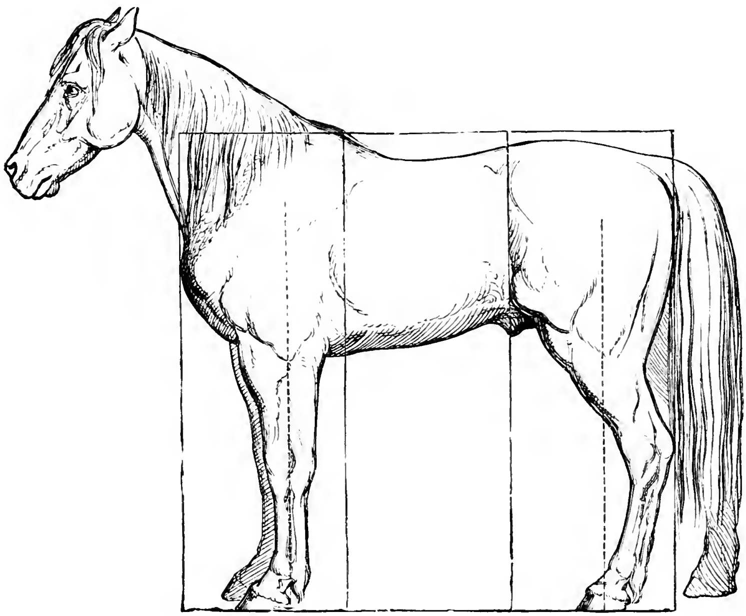


FIG. 147.—Normal conformation of limbs as viewed from the side.

nearer the centre of transmission of weight, and hence causes it to be unduly loaded, inasmuch as each unit of surface carries relatively more weight.

Pader has studied this subject very carefully by means of an ingenious apparatus of his own, and, although we cannot describe his experiments at length, we may state his conclusions, which are as follows:—

1. At rest, the centre of transmission of weight falls in front of the centre of the sole, about midway between the centre of the sole and the point of the frog.

2. The centre of transmission of weight falls further back as the pastern is more inclined.

3. Lifting the opposite limb, and thus throwing increased weight on that under observation, causes bending of the fetlock, and displaces the centre of weight backwards.

4. The centre of weight never falls further forward than the point of the frog nor further back than the posterior third of the total length of the foot.

By the conformation shown in fig. 148 the base of support is certainly increased in front, though this is more often an apparent than a real gain, because the animal then usually stands with his hind-legs somewhat advanced. The strain of support-

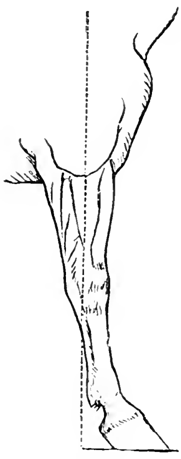


FIG. 148.

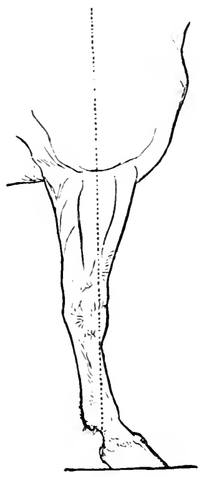


FIG. 149.

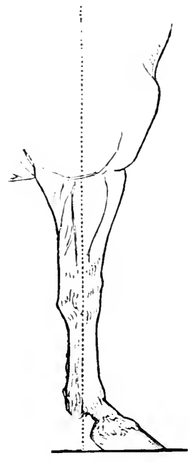


FIG. 150.

ing the body falls more on the tendons than on the bones, and the weight more on the heel of the foot than on the toe. The centre of gravity of the trunk is displaced backwards and the loins and hocks are exposed to excessive stress.

On account of the fore-limbs being already so far in advance the stride is short and the pace comparatively slow. This conformation is often acquired as a result of disease.

Backward incurvation of the knee (fig. 149) is a fault, inasmuch as the knee itself is badly developed and the bending stress caused by the body-weight falls on the ligaments, etc., at the back of the joint. Flexion of the knee joint, moreover, is not at once followed by lifting of the knee, as the limb has first to become perpendicular and then move slightly forward before its total length is diminished. Horses with this formation are liable to trip and have difficulty in recovering themselves. Fig. 150 shows a limb, otherwise normal, but with excessively oblique pasterns.

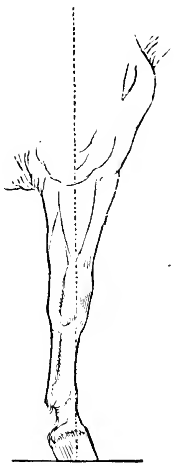


FIG. 151.—Upright pastern and limb.

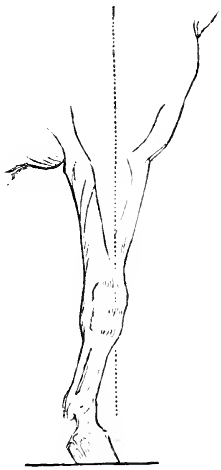


FIG. 152.—Bowing over at knees.

Horses with very upright or forwardly inclined limbs, *i.e.*, horses which 'stand over' in front (fig. 151) and whose shoulders are 'loaded,' are insecure on their feet, firstly, because this position entails shortening of the base of support, and secondly, because when they slip there is difficulty in advancing the leg sufficiently to prevent the body coming to the ground. The fore-limbs carry more than their fair share of weight, they cannot be sufficiently advanced at fast paces, the toe is apt to catch in the ground and the animal to fall, the fore shoes may be trodden off and the horse is prone to forge.

Such conformation entails fatigue and wear of the limbs, and predisposes to knuckling at the fetlock, especially in hacks where the body-weight is supplemented by that of the rider.

Fig. 152 is a more advanced stage of the condition shown in fig. 151. This attitude appears to be assumed by the horse in order to relieve the overcharged tendons of weight, though it may also be due to contraction of the tendons or to disease of the feet. It is usually seen in horses in which the pasterns are fairly long and oblique, and where 'knuckling at the fetlock' is not to be expected. Where the pastern is short and upright, on the other hand, knuckling at the fetlock is the commoner condition.

(*b*) The hind-limbs are normal (fig. 153) when a vertical line let fall from the point of the ischium divides the limb (seen from behind) into two equal parts. When viewed from the side, however, the line should touch the os calcis and fall a

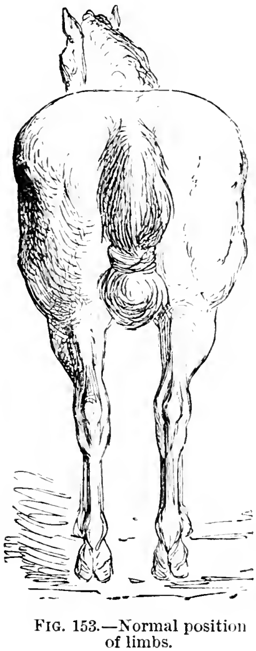


FIG. 153.—Normal position of limbs.

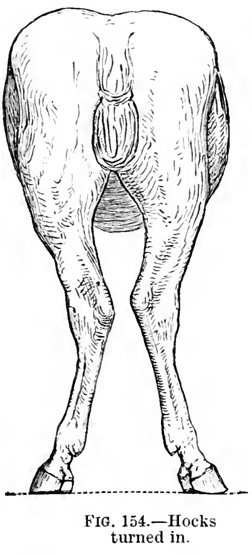


FIG. 154.—Hocks turned in.

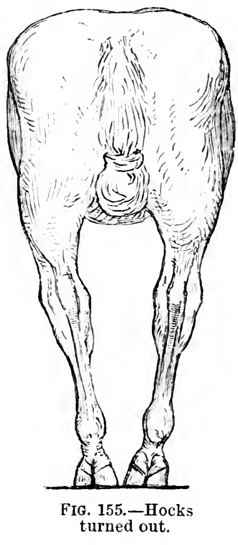


FIG. 155.—Hocks turned out.

short distance behind the bulbs of the heel. A vertical line let fall from the middle of the hip joint should meet the outer quarter of the hoof. The hind like the fore limbs may be bent outwards or inwards. The hocks may be turned either in (fig. 154) or out (fig. 155) or excessively curved (fig. 156), the lower portion of the limb being then too oblique; or, lastly, the limb may be placed too far back (fig. 157). This conformation, though at first almost advantageous and conducing to speed, is associated after much work with partial luxation of the fetlock joint and more or less pronounced spasmodic jerking of the fetlock (knuckling over) in certain phases of movement. It is quite possible for each of the two fore or two

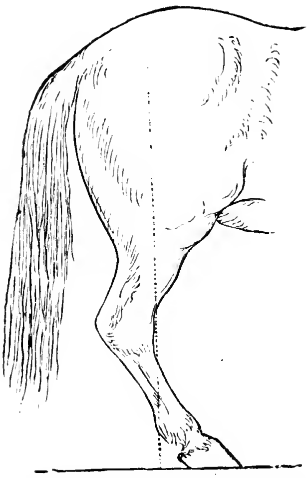


FIG. 156.—Excessively curved hocks. Limbs too far under the body.

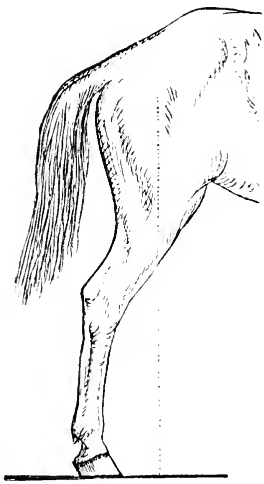


FIG. 157.—Entire hind-limb placed too far back.

hind limbs to take different directions. It is commonest for one pair, for instance the front, to be turned out, the other pair, the hind, to be turned in, or *vice versa*. Other slight differences occur, but are not of great importance to the farrier.

### 2. General Conformation of the Feet, when viewed from in Front, Behind, and the Side.

In a state of nature the hoof always corresponds, and is suited, to the formation of the limb to which it belongs, but immediately a shoe is applied, the horn ceases to wear, and instead of the formation of the limb determining that of the hoof, exactly the opposite may occur. This can be demonstrated experimentally. Given an animal of normal conformation, a perpendicular line is traced on the leg from the knee to the earth. If, now, the inside of the hoof be much lowered, the erstwhile straight line will be seen to form an angle outwards at the coronet, while if the outer quarter be cut away, precisely the opposite occurs. At the same time, the limbs will be seen in the first case to recede slightly from one another, causing the animal to go 'wide,' in the second case to approach, causing the animal to go 'close.' This confirms Moorcroft's experiments on animals which cut or brush.

But it cannot be too strongly insisted on that the *lowering of one side of the hoof can have little effect on the general direction of the limb*, because, owing to all the lower joints being ginglymoid or hinge-like, movement is confined almost entirely to the backward or forward directions. For this reason lower-

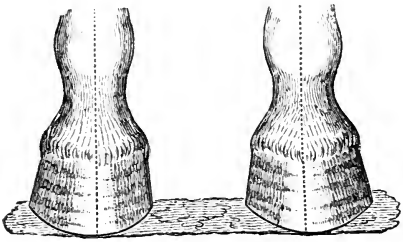


FIG. 158.

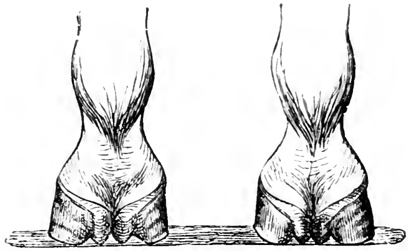


FIG. 159.

FIG. 158.—Pair of normal feet seen from in front; and 159, from behind.

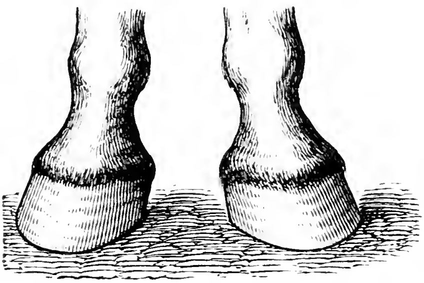


FIG. 160.

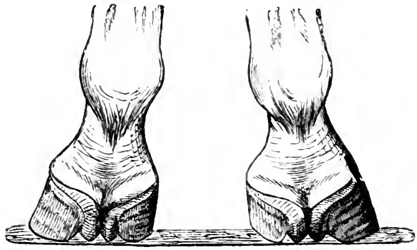


FIG. 161.

FIGS. 160 and 161.—Form of feet where toes are turned outwards.

ing the inner or outer side of the hoof only produces a very slight alteration in the distance between the fetlocks.

However diverse the variations in conformation of the limb, the changes they produce in the form of the hoof are all included under one of the three forms now to be described. By bearing in mind the principles enunciated, the form to be given to the hoof and the choice of the shoe will be greatly assisted.

Seen respectively from in front and behind, the form of the foot will be either normal (figs. 158 and 159), or that peculiar to turned-out or turned-in feet (figs. 160 and 161, 162 and 163).

The imaginary straight line drawn through the os suffraginis, os coronæ, and os pedis, which we term the foot axis (see figs.

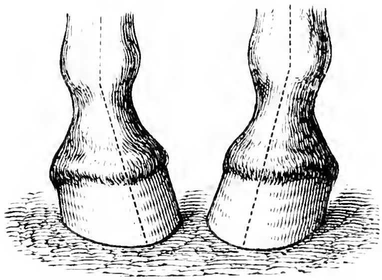


FIG. 162.

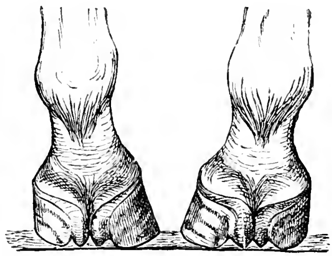


FIG. 163.

FIGS. 162 and 163.—Form of feet where toes are turned inward.

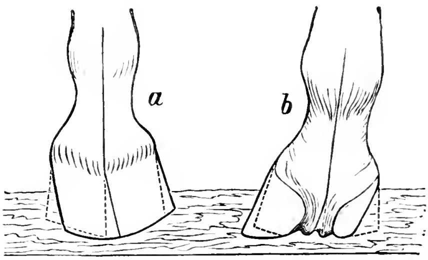



FIG. 164.—*a*, foot of normal limb, and *b*, foot of abnormal limb, in which, by irregular trimming, the 'foot axis' has been distorted. The dotted lines show the proper relations of the hoofs to their respective limbs.

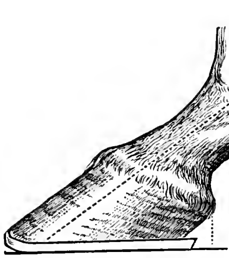


FIG. 165.—Abnormally flat (oblique) hoof.

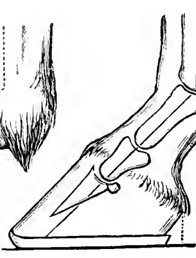


FIG. 166.—Normal hoof.

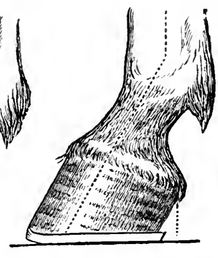


FIG. 167.—Upright hoof.

158, 162, 165 to 167), indicates whether the hoof and fetlock are or are not normally related.

In the normal position (fig. 158) this line runs directly forwards and downwards, in the out-turned toe position obliquely outwards, and in the in-turned toe (fig. 162) obliquely inwards.

Viewing the foot from the side we distinguish a normal position of the foot axis (fig. 166), and may term all variations from this in a forward direction as oblique (fig. 165) and all variations in a backward direction as upright (fig. 167).

Speaking generally, the foot axis, shown in figs. 165 and 167 as a dotted line, should follow a straight course in each of the four feet, provided the limbs are all bearing weight. Any deviation from this straight line, as shown in fig. 168, is abnormal. During rest, the wall of the toe and the foot axis should be almost or quite parallel with each other. It is allowable in shoeing to leave the toe of the foot a trifle more upright than the general axis of the pastern.

The direction of the foot axis is of great importance in the practice of shoeing. The oblique foot (fig. 165) forms an angle of less than 45° with the ground, and, compared with the two other forms, its hoof has a long toe and low heels. In the normal position (fig. 166) the angle is about 45° to 55°, the toe being shorter and the heels higher than in the oblique foot.

Theorists have described the correct angle of the hoof and pastern as 45°, claiming that it ensures equal distribution of the weight of the body between the column of bones and the tendons, but animals so formed are not considered well shaped by the best judges; the pastern is too sloping.

It is clear that, as there is no danger of injury to the bones from shock when the animal is at rest, it would be advantageous could these support a greater proportion of weight than the tendons and suspensory ligament, which would be correspondingly relieved. On the other hand, when, during movement, the limb comes violently in contact with the ground, the major part of the weight should fall on the tendons, etc., and thus shield from injury the bones, which must otherwise certainly be fractured.

General opinion seems to regard the best angle as somewhat less than 50° for front feet and as 50° or somewhat more for hind. The greater length and obliquity of the pastern in fore-limbs compensates for the greater weight and the more violent shocks experienced; length and obliquity being factors eminently favourable to neutralising concussion.

When the angle is above 55° (fig. 167) the height of the heels naturally increases in the same proportion as the length of the toe diminishes. The same conditions rule in hind-feet,

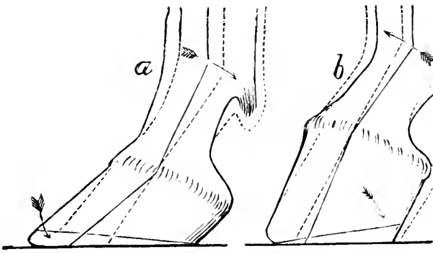



FIG. 168.—Two feet viewed from the side. *a*, with foot axis distorted in a backward direction; *b*, in a forward direction. The arrows indicate the proper position of the fetlock, which is given in dotted outline. In *a* the toe and in *b* the heels require shortening.

FIG. 169.—Peculiar distortion, in which the os pedis becomes upright, while the suffraginis is much inclined.

with the exception, however, that the angle formed with the earth is here somewhat greater.

A peculiar position of this kind is shown in fig. 169, in which the foot axis is bent, the os pedis being much more upright than the suffraginis, the hoof following the direction of the os pedis.

### 3. THE METHOD OF ADVANCING THE HOOF

varies even when the animal is moving on level ground and not drawing a load. In the normal form of the limb the hoof is moved almost straight forwards (fig. 170). The toe points in a forward direction and the hoof is set down flat. But the converse is by no means true, *i.e.*, the foot may be perfectly shaped, the proportions of its various parts absolutely normal, but the formation of the limb, and therefore the style of going, quite defective. Defects of conformation in the limb, though little marked when at rest, often appreciably affect the style of moving. In horses of normal formation the limbs are flexed and advanced in a direction parallel to that of movement or of the longitudinal axis of the body.

When the horse is viewed from behind the hind-limb 'covers' the front, when from in front the fore-limb 'covers' the hind; at a trot the right and left fore and hind limbs respectively are separated to a sufficient distance, and are moved in perfect time; the limbs are neither lifted too much nor too little, so that while there is no loss of time there is also no danger of catching the toe and falling.

The method of *carrying* the limb is not affected by the form given to the hoof, though disproportion in any part of the latter has a marked effect on the *pace*. For instance, as the limb

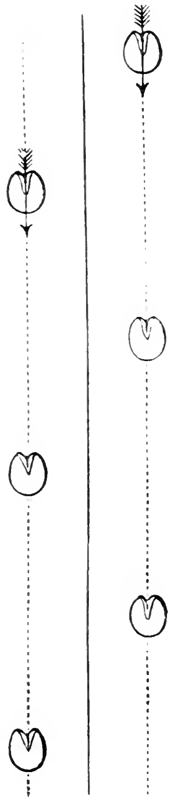


Fig. 170.

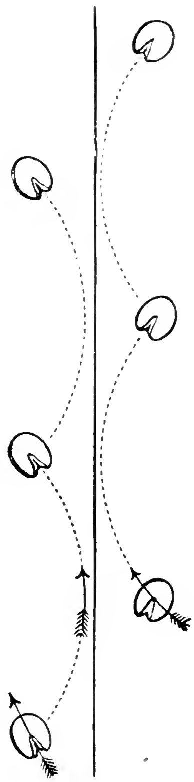


Fig. 171.

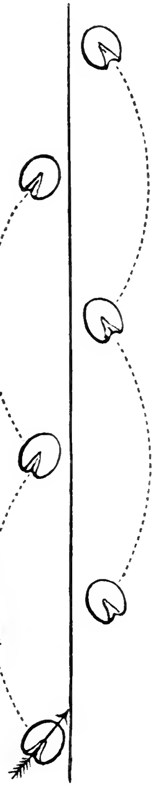


Fig. 172.

swings in the arc of a circle around the toe, as around a fixed point, prior to leaving the ground, the longer the toe is left, the longer does this swinging continue; hence loss of time in raising and advancing the limb. Low heels and a long toe are therefore obstacles to speed.

When the toes turn out, the hoof is moved forwards, inwards, and again outwards (fig. 171) in a circular direction, the outer wall of the toe coming first in contact with the ground and sustaining the greatest part of the impact. The toe here points either directly forwards or outwards. In the in-turned toe form things are reversed, the hoof being carried forwards, outwards, and again inwards (fig. 172). The manner in which the hoofs are moved is shown semi-schematically in figs. 170, 171, and 172. No absolute rule can, of course, be laid down and many deviations occur, resulting partly from peculiarities in direction of individual bones and consequent irregularities in movement, from pace, that is, whether the horse walk or trot, from the way in which the animal's weight is distributed between his fore and hind limbs, and from the position and amount of the load which the horse either draws or carries. The four feet of any one horse seldom correspond exactly in direction; one pair may point outwards, the other inwards, the hoofs being correspondingly advanced. Sometimes a defect in one part of the limb counterbalances a defect in another, so that, although close attention will enable us to classify the conformation and action with which we have to deal, yet judging of gait will always be a matter of difficulty for beginners and for the unskilled.

Deviations from normal conformation are always a drawback to the performance of work. When strongly pronounced, and especially when two or more defects occur in one limb, they greatly predispose to striking, cutting, and to disease of joints and of the foot.

The course followed by the hoof when viewed from one side (figs. 173, 174, and 175) is of less importance to the farrier. In normally formed limbs it is regular (fig. 173). When the fetlock is very oblique, however, the hoof at first traces a sharp curve, which soon becomes more flattened and is prolonged forwards before meeting the earth (fig. 174). In the case of upright fetlocks the lifting and advancing of the hoof is performed in precisely reversed order. The shock to the foot and limb is evidently least in the style of movement shown by fig. 174 and greatest in that shown by fig. 175. As every rider knows, the pace in the former case is easy, in the latter rough and unpleasant.

From the foregoing may be deduced two principles for the practice of shoeing, viz.:—(1) The normal form of the hoof should be preserved or restored, *but with due regard to the conformation of the limbs and to the animal's action.* (2) The functions of the various parts of the foot must be aroused to full activity.

In regard to the first, the *normal* form of the foot is understood to be that which would result were the animal unshod

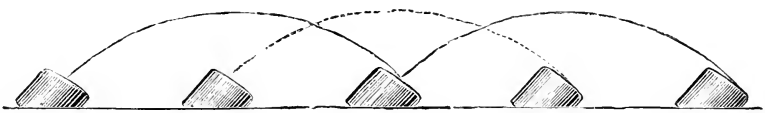


Fig. 173.

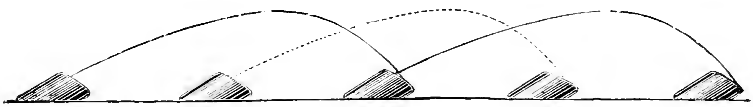


Fig. 174.

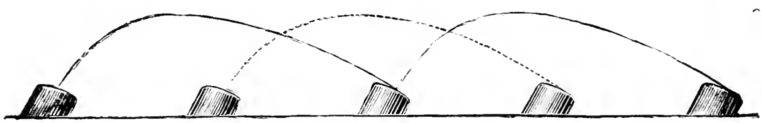


Fig. 175.

and in a state of nature. It need scarcely be said that, given this normal form, the balance of the limb must not be disturbed by inequalities of thickness in different parts of the shoe, but that the hoof surface of the shoe must lie in a horizontal plane.

Respecting the second, it is indispensable that the frog and sole come in contact with the ground. One must not forget that expansion of the foot depends entirely on the action of the plantar cushion, and therefore primarily on frog-pressure.

## 4. Form of the Hoof.

The normal front hoof (fig. 176) shows little difference in the direction and thickness of its inner and outer walls. The outer is slightly thicker and rather less upright than the inner (compare figs. 158 and 159). In consequence, it describes a somewhat larger curve, as is seen on examining the bearing and coronary borders. The height of the heel, in comparison with that of the quarter and toe, is approximately as 1 : 2 : 3 or as $1\frac{1}{2}$ : 2 : 3. The toe forms an angle of about 45° to 50° with the earth (compare with fig. 166), and when viewed from the side its direction corresponds with that of the suffraginis.

When the limbs are straddled (as in fig. 144), the hoof (fig. 177) is always more oblique, because the outer part of the wall is naturally somewhat longer and stands more obliquely in relation to the ground than the inner (compare figs. 160 and 161). The outer bearing margin of the hoof describes a wide curve, the greatest prominence of which is at the point where the quarter joins the heel; the inner, on the other hand, is straighter, consequently the outer division of the hoof is broader than the inner. So long as the hoof is healthy, the limbs of the frog are equally developed. The obliquity of the hoof results from the form of the leg, and must be distinguished from obliquity produced by disease.

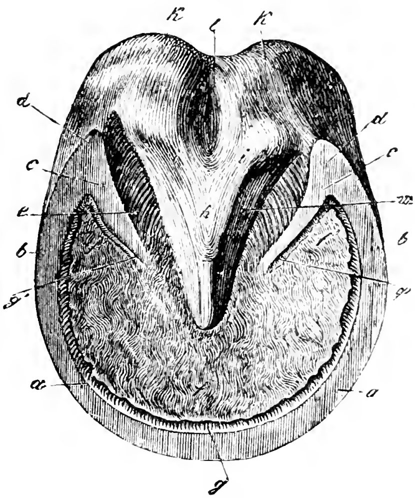


FIG. 176.—Normal right fore-foot.*

When the toes alone are turned out (as shown in fig. 145), the hoof (fig. 178) differs from the foregoing in that the circumference of the bearing margin is less curved at the outer border of the toe and the inner heel than at the inner portion of the toe and the outer heel. In consequence, two deep and two shallow curves lie opposite one another. The toe of the hoof

* The artist has slightly exaggerated the thickness of the wall at the heel. It must not be forgotten, however, that owing to the reflection of the bars, the wall at this point is apparently reinforced, and that, as the wall is worn away obliquely, it *looks* thicker than it in reality is.

points outwards, the foot is not brought level to the ground but with the outer wall of the toe first.

When the toes are turned in (as in fig. 146) a somewhat similar, but less pronounced, form of hoof is developed. The inner wall is less oblique than the outer, as is best seen at the quarters (figs. 162 and 163). The lower outer margin more nearly resembles that of the ordinary hoof, but the wall of the inner quarter and heel describes a somewhat greater curve. Not infrequently the outer heel wall appears contracted. This form of hoof is commonest in horses which bring the foot to

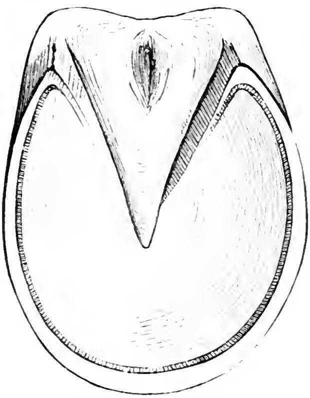


Fig. 177.—Right fore-foot (out-turned toe).

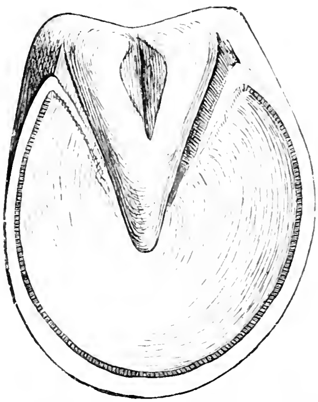


Fig. 178.—Right fore-foot (in-turned toe).

the ground toe first. Front feet are almost invariably round at the toe.

The foregoing remarks as to the influence of limb conformation in determining shape of hoof apply in most respects to hind as well as to fore feet. The hind-foot (fig. 179) is not round, but elongated or oval at the toe. Its greatest width is at the commencement of the posterior third. The sole is usually more concave and the wall, seen from the side, somewhat more upright than the corresponding parts of the front hoof: the angle which the toe forms with the ground varies between 50° and 55°.

At times, moreover, one sees unusually wide or narrow feet, the shape of which is not due to the position of the limbs, but to inborn peculiarities of the various breeds.

The 'wide' hoof (fig. 180) is broad, almost circular: its wall obliquely inclined towards the ground, the sole slightly concave, and the frog strong and massive. The narrow hoof

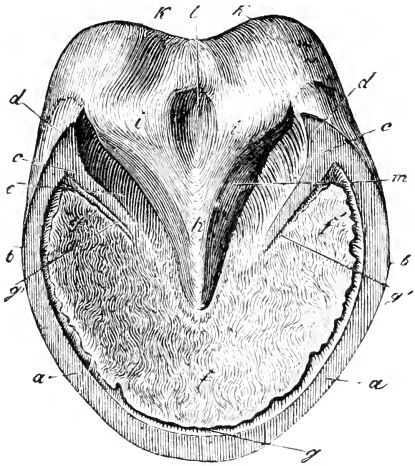



FIG. 179.—Normal right hind-hoof.

(fig. 181) is elongated, has upright quarters, a strongly concave sole, and comparatively a small frog of fine and tough fibres; in the opposite form the horn fibres are usually much larger.

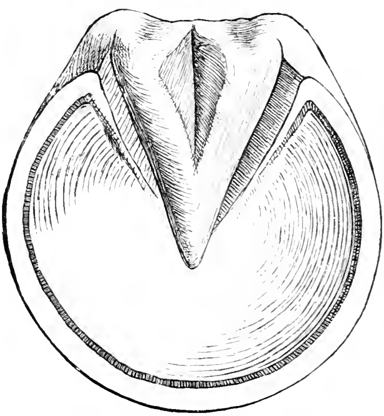


FIG. 180.—Wide 'spreading' hoof.

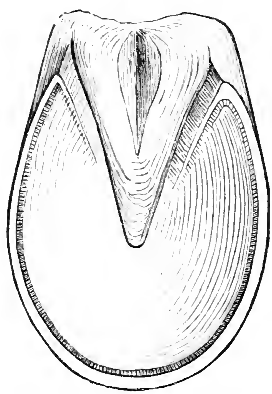


FIG. 181.—Narrow hoof.

In the wide-spreading hoof there is a tendency to separation of the wall and to flattening or dropping of the sole.

Figs. 165, 166, and 167 represent respectively the normal, the oblique, and the upright foot. A few remarks on the forms of hoof belonging to these respectively may here be appropriate. In the first place, the wall of the toe should correspond in direction with the general axis of the three terminal bones of the digit, and just as one speaks of an oblique or upright foot, so one might speak of the corresponding forms of hoof. In the normal hoof the wall of the toe forms an angle of 45° to 55° with the ground (fig. 166). When the angle is less than 45° the hoof may be described as oblique (fig. 165). Such a hoof has comparatively a long toe and low heels. When, on the other hand, the angle is greater than 55°, the hoof is upright (fig. 167), possessing a comparatively short toe but high heels. In the latter the anterior, in the former the posterior, half of the hoof carries the greater weight. The proportion already stated approximately as 1 : 2 : 3 or $1\frac{1}{2}$ : 2 : 3, which should exist between the height of the wall at the heel, quarter, and toe, is naturally disturbed in changes of other parts of the hoof. The above is true of hind as well as of fore hoofs, though in general the normal hind hoof is about 5° more upright than the fore.

The following summarised account from Lesbre and Peuch sets forth, from another standpoint, approximately the same views expressed in the foregoing pages.

The walls of the quarters in fore-feet form an angle of 10° to 12° with the vertical; in hind-feet of 6° to 8°. In fore-

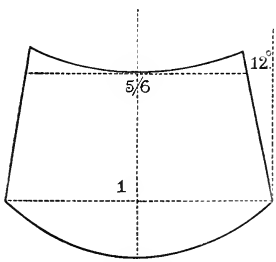



FIG. 182.

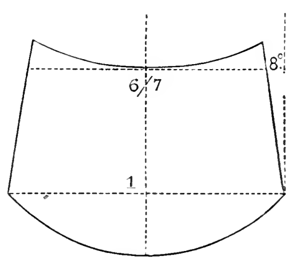



FIG. 183.

feet the coronary circumference is about $\frac{5}{6}$ that of the plantar; in hind-feet about $\frac{6}{7}$. Viewed from the side, the toe of the fore foot forms an angle of nearly 50° with the ground; that of the hind an angle of 55°. The heel is nearly parallel with the toe, and should be at least half as high.

In the fore foot the height of the toe usually equals $\frac{2}{3}$ the length of the sole, and in the hind $\frac{7}{10}$. The length of the sole varies little in the fore and hind feet of the same animal, the apparent difference depending on the narrower shape of the hind-foot.

Compared with that of the plantar margin, the length of the coronary margin in fore-feet is as 9 : 10; in hind-feet a little more.

Viewed from below, the foot is almost as broad as long. In

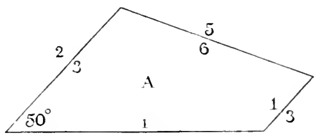



FIG. 184.

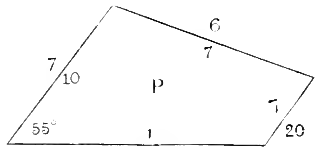



FIG. 185.

contour it resembles the segment of an oval. The sole is thick and arched. The degree of concavity depends on the size of the foot. The frog is strong, firm, and resistant to the pressure of the thumb. When the foot is lifted, it should stand higher

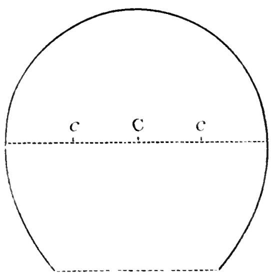



FIG. 186.

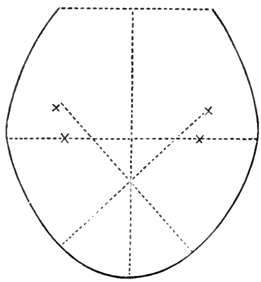


FIG. 187.

than the level of the wall, and therefore, during movement, should meet the ground before the quarters and heels.

The bars, which participate in bearing weight, should be strong and prominent, and should be on the same level as the plantar margin of the wall, at least up to a point opposite the middle of the frog. In some feet the weight-bearing surface includes the lower surface of the frog, all of the sole, and the lower margin of the wall; in others only those portions of the sole bordering on the wall are included in it.

Variations in the direction of the foot axis and in the form of the hoof naturally alter the distribution of pressure in the joints, and when due to faulty shoeing, and especially when exaggerated, are of grave importance. Oblique hoofs, particularly if shod so as to raise the frog from contact with the ground, are apt to show contraction of the heels, whereas in normal hoofs the change either fails to occur or is long delayed, the reason probably being the greater weight thrown on the posterior half of the foot. On account of this increased weight on the posterior portions of the foot, the bars and frog are unable to withstand the tendency of the heels to contract or to be thrust inwards, and if the oblique hoof has also weak heels it is very soon converted into a contracted hoof, the bars growing inwards and corns making their appearance. The horse, especially if he have good action, soon becomes useless for work on hard roads. This form of hoof, when accompanied by out-turned toes and flat soles, is very troublesome. The unequal distribution of weight is the chief evil, a fact which explains why, in horses with out-turned toes, corns are more frequent in the inner, and in those with in-turned toes in the outer heel.

In horses with out-turned toes, unequal distribution of weight is also responsible to a very large extent for the production of sand cracks and separations of the inner wall, and in upright hoofs of sand cracks at the toe.

## 5. Characteristics of the Sound Hoof.

The description of the hoof by no means terminates with consideration of its form. On the contrary, its characteristics vary to such a degree that one might almost venture to say of a hundred horses no two could be found with hoofs which would exactly correspond. They vary almost as men's faces, a fact which explains the differences in size, form, and fitting necessary in shoes. One of the first things the farrier has to consider is whether the hoof is healthy. It may be said, in passing, that healthy hoofs are not so common as is believed. The wall of a healthy hoof, when viewed from in front and from the side, should run in a straight line from the coronary to the bearing margin, so that a straight-edge laid on it in the direction of the horn tubes should everywhere be in contact. It should neither show longitudinal nor transverse splits.

The significance of rings depends on their position and course. Rings running parallel to the coronet are, as a rule, of little importance; they only indicate irregular nutrition, but those which deviate from this course to any great extent, or which are more prominent at one part of the wall than at another, point to disease. Viewed from the ground surface and from behind, the bulbs should appear rounded off, strongly developed, and not displaced. The sole should be concave and show no cracks in the white line. The frog should be large, its cleft narrow, dry, and clean, and its forward prolongations equal in size. The lateral furrows, although fairly fine, should not be too narrow; the bars should run in a straight line forwards and inwards towards the point of the frog. Any deviation towards the heels suggests commencing contraction. The sole should show no red colouring in or about the corners of the heels. The lateral cartilages should be elastic and equally developed.

Finally, in forming a judgment as to its shape and soundness, the hoof should never be regarded alone, but in relation to the limb.

## 6. Wear of the Hoof and of the Shoe.

In the first part of this work it was stated that the hoof grows downwards and forwards at the average rate of $\frac{1}{4}$ to $\frac{5}{16}$ inch per month.

Horn is lost either as a result of friction at the bearing surface or of shelling out of the sole. Two kinds of movement combine to produce this friction; one the forward movement, at the moment when the hoof is brought to the earth, the other the rotary movement, when it is everywhere in contact with the ground. The rate of loss varies with the weight of the animal, the quality of horn, and the roughness and hardness of the ground. On modern hard roads wear exceeds growth, and finally renders necessary some artificial protection. In fore-feet, the foot is brought to the ground more obliquely, and the toe usually wears more rapidly than in hind-feet. It is of importance to remember that, although the point which first reaches the ground may vary in position, the toe is always the last to leave it.

If the farrier in preparing the hoof leaves one point or one side of the wall too high, the portion thus left touches the ground first until the inequality is removed by increased wear. Were the horse under perfectly natural conditions this would be of little importance, but as the shoe prevents the natural remedy, and as the error is often repeated at each shoeing, any injury thus produced is perpetuated. The part left too high grows even more rapidly than the rest, causing the wall to lose its straight direction and become curved. In the specimen shown (fig. 188) the outer wall has for a considerable time been left too high. It will be noted that the rings lie closest together on the low side of the hoof. If the toe is left unduly long it bends outwards; if the heels are neglected they are apt to bend forwards and inwards.

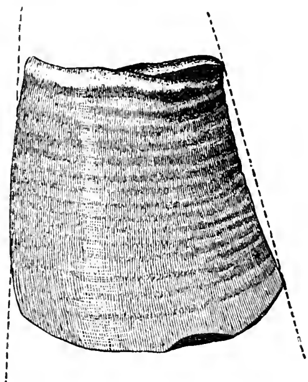


FIG. 188.—Overgrown and laterally distorted hoof.

The hoof, moreover, wears even when shod, though only at points where friction can occur between it and the shoe, that is, at the heels. This wear is favoured by weakness of the wall, bad quality of horn, heaviness of the body, wet weather, faulty shape of the hoof and bearing surfaces of the shoe, and by much work on hard ground. The process itself is not directly visible, but may be detected by making marks on the wall and noting their distance above the shoe. At the next shoeing these marks will be found to have approached the shoe or, in some cases, even to have disappeared. Immobility of the heels, produced, for example, by ossification of the lateral cartilages, diminishes or entirely prevents this wear. The amount worn away between one shoeing and another is certainly not much, but sufficient to require attention under special circumstances. The few experiments that have been made fix the amount thus worn away as from 0 to $\frac{1}{6}$ inch per month. The inner heel usually wears more quickly than the outer. The form of the friction surface resembles an elongated wedge, the base lying towards the back, the point extending forward as far as the heels are capable of movement.

The result of this friction is to reduce the height of the heels; in unilateral friction, to disturb the balance of the foot, to loosen the heel nails, and sometimes to produce pressure on the inner and posterior portions of the sole. As an indirect result we see increased wear of the shoe at the toe or outer quarter.

*Wear of the Shoe.*—To the practical farrier the wear of the shoe affords valuable information. From a theoretical standpoint it should be as regular as possible; when this is the case we know that the horse has usually a free gait, that he is not suffering pain, and that he treads level, while his shoes wear longer and—a great advantage—admit of being made lighter. Such regular wear indicates skill in shoeing, though, of course, it is impossible of attainment where the limbs or joints are already deformed.

Unequal wear is very common and may be variously caused. Thus, the nearer any part of the shoe, such as the toe, the inner or outer quarter, or one or other heel, lies to the centre of the hoof, all other parts maintaining their proper position, the more rapidly it wears; on the other hand, by so fashioning the shoe as to remove any part further from the centre, wear is diminished and in proportion to the distance. The same occurs when the shoe is badly made or nailed on, when it is too wide at one spot or too narrow at another, or when the toe is too long or too short. Even the form of the outer border of the shoe has some influence, the part lying nearest the centre of the hoof bearing a larger proportion of weight than portions further removed.

The shoe wears unequally when the horse treads unequally. An uneven tread may be caused: 1. By faulty trimming, one spot being left too high, or (which is the same thing) the opposite being unduly lowered. 2. By an unsuitable shoe; for instance, one with toe-grip where no grip is needed, a shoe with a narrow toe where the hoof is upright or where thrush exists, a shoe too short for an oblique foot, or a shoe too narrow and too finely holed in the outer branch for a foot with in-turned toe. 3. By well-marked faults in the conformation of the horse's limbs; in this case the entire formation must be taken into consideration. 4. By shortening the stride; this always produces severe wear of the toe. The stride is shortened and the horse treads on his toe when his progress is checked by the curb or by too heavy a load.

Wear of the shoe may be caused principally as the foot either meets the ground or leaves it. In the latter case it is always at the toe, in the former it may be at the toe, at one or other quarter, or at the heels, or it may be distributed over the entire surface of the shoe. Both kinds of wear fall on the toe when this part has been left too long, when the horse is in heavy draught or in fast saddle work, when it is suffering from thrush, contraction of the flexor tendons, spavin, or from any of those conditions in which the action of the fetlock is limited.

The wear produced by bringing the foot to the ground is greatest on the outer quarter when this is higher than the inner, or when the corresponding part of the shoe is too narrow, as well as when the toe is turned out. As, in the last case, the wear produced when the toe leaves the ground is most marked at the inner side, an expert can sometimes diagnose the conformation of the limb from the wear of the shoe. In the following pages the wear produced when the foot comes in contact with the ground will be referred to as descent, falling, or extension wear; that produced as the toe leaves the ground as ascent, lifting, or flexion wear. Descent or extension wear is very seldom seen on the inner limb of the shoe, a fact explained by the way in which the working horse usually treads.

It is, however, seen at the heels in horses which suffer from laminitis or which go on their heels.

This short *resumé* indicates, that from the wear exhibited by the old shoe may be more or less accurately learned the conformation and distribution of weight in the limb, the proper way to pare the hoof, and the position, form, and length to be given to the shoe, all of which are of immense importance in practical farriery. The old shoe is the model from which the new must be formed, not that it should be followed slavishly, but used as a guide to possible improvement. To read its lessons aright demands keen observation and careful reflection.

# CHAPTER II.

## THE PRACTICE OF SHOEING.

### 1. Management and Control of the Horse.

The horse, as a rule, and especially when well treated, is eminently tractable, and if we have frequently to deal with animals which resent the manipulation necessary during shoeing, it is less on account of the horse's vice than of the farrier's bad management. The farrier may fairly require that horses brought to him should be accustomed to ordinary handling. It is scarcely his business to practise horse-breaking, though he occasionally finds some restraint absolutely necessary. Such means must be used, however, with great discretion, unless they are, on the one hand, to degenerate into cruelty, or, on the other, to render the subject worse than before. In handling horses we should endeavour to obtain their confidence, and, therefore, quietness, firmness, a certain amount of strength and courage are required, as well as a knowledge of horses in general. We should try to discover whether the horse is restless from being unused to shoeing, from fear of a repetition of previous ill-treatment, from excess of spirit, from the absence of a companion, or from pain in the feet or joints.

The method of handling older horses, or such as are accustomed to shoeing, is of less importance. As a rule, when properly managed, they lift their feet willingly, and shoeing proceeds without difficulty. It is otherwise, however, in young, raw, vicious, or timid horses, which require special precautions.

The following points should be borne in mind:—

(*a*) The horse should never be tied up with a fixed knot. The best plan is to pass the shank of the halter through a ring, and then twist the free end two or three times around the fixed part, so that, if the horse 'hangs back,' the halter will readily untwist and release him.

(*b*) Horses which are known to resist being quietly shod should not be fastened up, but be held by a reliable assistant.

(*c*) No attempt should be made to hold up the foot continuously until the horse has been accustomed to allow the leg to be handled, except in the case of ticklish horses, which, as they seem to resent firm treatment less than light handling, ought to be grasped firmly.

(*d*) The foot to be shod must never be suddenly grasped, and it is well to accustom the animal first to standing on three legs. In lifting the leg it should be noted whether the animal stands fairly on the other three. The farrier should avoid any unnecessary noise, the work being better performed quietly, rapidly, and with as little inconvenience to the animal as possible. In young horses the limbs should not be kept raised too long; an interval of rest is desirable. The legs of stiff, old horses should not be lifted too high, especially at the beginning of shoeing. When the hocks are very stiff, the limb should not be drawn forwards, but backwards and upwards, care being taken that the animal does not fall.

Vicious horses are better shod in a winker bridle with strong snaffle, by which they can be better controlled. Any attempt at vice should be immediately punished, either by jerking the bridle or by calling to the animal in loud tones. If this is insufficient the horse may be forced to move backwards in soft ground, as this form of exercise soon wearies and reduces it to subjection. In lifting the hind-feet a broad piece of webbing may be fastened to the tail and then passed completely round the fetlock from the outside, emerging again at the back. The webbing is grasped close to the fetlock, the foot drawn under the body and held as above described. This arrangement forces the animal to carry a portion of its own weight, while it effectually prevents kicking. In first applying the webbing it is well to lift the fore-foot of the same side.

Twitches are undesirable and should not be employed, except in carrying out painful operations on the feet. The plan of drawing the hind-limb backwards and upwards by means of a rope is also bad, and sometimes results in rupture of the flexor metatarsi. The 'side-line' consists of a long rope with a fixed loop which is passed round the animal's neck. The free end is passed from without around the fetlock, carried forward, passed through the fixed loop and drawn tight, thus lifting the hind-foot. It is useful in dealing with heavy animals, but must be employed with care, as violent struggling is apt to be followed by heavy falls and serious injury. In dealing with a troublesome animal, it is often sufficient to place him against the wall in charge of the groom, who is instructed to hold his head high, and occupy his attention by patting and speaking to him or by gently playing with the bit.

Some animals, which resist being tied up or even held, will stand quietly if left completely at liberty with the reins passed over the neck.

Others, which are troublesome in a watering bridle, at once become quiet when the eyes are covered.

Certain horses can only be shod when along with a stable companion. Sensitive animals are often so irritated in summer by the attacks of flies that they can only be shod early in the morning or late in the evening.

Finally, some horses, which are quite intractable at the farrier's, can be shod without difficulty in the stable.

Travises or stocks are usually unnecessary, save for shoeing very heavy horses.

In Germany an assistant holds the foot while the shoe is fitted to the foot, but this is unnecessary if, as in England, animals are accustomed from an early age to the feet being lifted. The farrier lays his tools close to the animal's feet. In taking off, say, the left fore-shoe, he grasps the hoof at the toe with the right hand, allows it to descend slightly, passes his left leg around the limb, grips the horse's foot between his knees and places his feet a little apart to give him a firm foothold. In this position the shoe is taken off, the hoof prepared and the shoe nailed on. Once the clenches are turned down he carries the foot forwards, places it on his thigh, nips off the points of the nails, turns over the clenches and finishes the work. The hind-foot is not grasped between the knees, but laid on the thigh, the cannon bone resting more or less on the farrier's hip. The work is finished in a similar way to that of the fore-foot, the hoof being brought forward and placed on the farrier's knee. When, however, the horse is heavy or troublesome, an assistant is of great service and sometimes almost indispensable, while the work can be better done as the foot need not be raised so high.

## 2. Determining the Style of Shoeing.

In judging of the style of shoeing to adopt, the horse must be seen both at rest and in motion, the objects being to form a clear idea of the conformation and action of the limb, of the form and condition of the hoof, of the way in which the horse brings the foot to, and lifts it from, the ground, of the shape and length to be given to the shoe, of the number and position of the nail holes, and of the wear of the old shoe, in order

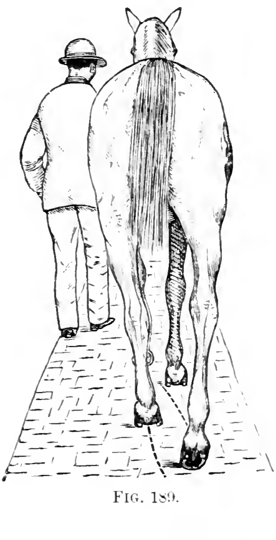


Fig. 189.

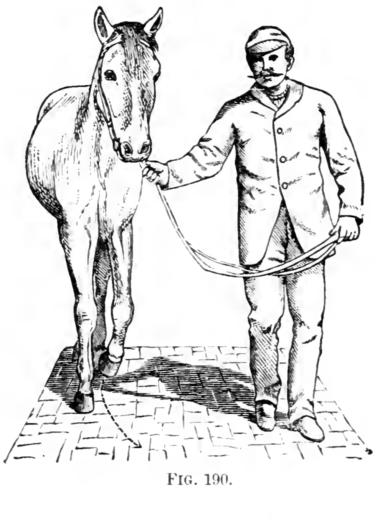


Fig. 190.

that all the peculiarities thus discovered may be utilised to remove or palliate existing defects.

The horse is led away from the observer in a straight line, the hind-limbs being first examined (fig. 189), and on its return the fore-limbs (fig. 190). This is continued until the examiner makes up his mind whether the horse goes normally or not. In the latter case, that is, if the horse goes in some irregular way, one of two conditions may exist, that is, the deviation may be inwards or outwards. The foot and hoof of either limb is then examined, special attention being given to the direction of the fetlock and of the quarters of the hoof, it being borne in mind that the fetlock and hoof should follow the same general line, as otherwise the foot axis will be bent. At the same time the manner in which the hoof is carried and the angle of the fetlock should be noted, both when weight is placed upon it and when it is removed. A few paces at the trot will show whether the animal is lame or not. The conformation of the limbs and the form of the hoof, together with the manner in which it is carried and put down, having been ascertained, the horse is examined at rest, and a mental note made of the hoof and style of shoeing, as far as can be done

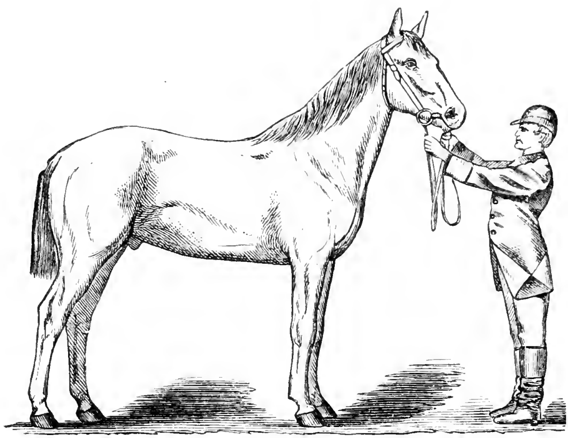


FIG. 191.

by viewing the parts from in front and behind. The appearance of the coronet, the presence of any curvature, of rings or fissures in the wall, and, at the same time, any other defects or peculiarities, such as one hoof being narrower or more upright than another, receive attention.

The examination of the animal at rest and from the side comes next in order. The farrier will note at a glance the weight, height, and length of the body, the position and direction of the limbs and hoofs, whether the form of the hoof corresponds to the direction of the limbs, whether the line of the fetlock agrees with that of the toe wall, and whether the toe and heel walls run parallel; at the same time the general formation of the hoof will be remarked. In the event of the wall exhibiting rings, their relation to one another and to the coronet, whether they cross, etc., should be observed, while the length of the shoe must not be overlooked.

Finally, the feet are lifted and the width of the hoof, the condition of the sole, whether little or no horn is being shed from it and the frog, the depth of the lateral grooves of the frog (which indicates the thickness of the sole), the state of the lateral cartilages and bulbs of the heels, and the presence of cracks or cavities in the horn of the wall will be seen. The form, holing, position, wear, and age of the old shoe must be borne in mind. It will be seen whether the shoe corresponds in form to the hoof, and whether the number and distribution of the nail holes and nails appear good. The shoe may completely cover the bearing surface of the wall or may project on either side and thus give rise to brushing or unequal wear. The distribution of wear is of great importance. Unilateral wear is often seen conjoined with irregular tread and deformity of the wall, especially when this irregular wear has been allowed to continue for several shoeings. As a rule, the side of the shoe thus excessively worn is too narrow and the opposite too wide, or that part of the wall lying above is too high, the opposite too low, or the shoe is applied 'across the foot.' In all such cases the bearing surface at the point of excessive wear is too small.

The object of the examination should be to give the farrier a clear notion of the conformation of the limb, of the gait, of the form of the foot and of the hoof. His object should then be to obviate such defects and supply such wants as he observes.

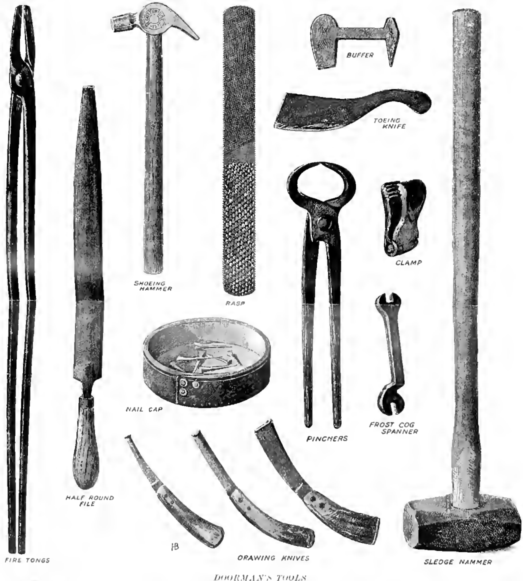
### 3. Removal of the Old Shoes.

In horses with sound hoofs all the shoes can be taken off one after the other, but in handling diseased hoofs this should be avoided. In removing shoes considerable care is required and violence should never be used. If very dirty the hoofs can be cleaned with a brush. The doorman feels for the clench with the point of his finger, places the buffer against it, and with a smart blow of the hammer cuts it without injuring the wall. In order to remove the nails singly the shoe must be loosened. One can either use pincers with a wide mouth, passing below and grasping the entire shoe, in which case the pincers are moved like a lever in the direction of the limb of the shoe, or the buffer may be driven from behind between the shoe and the hoof. The former plan is preferable. Once the shoe is loosened the nails can be drawn separately. When the shoe has recently been put on, or when the horse is troublesome, another method is sometimes employed. Taking the foot on his knee, the doorman cuts the clenches, and, with the pointed end of the buffer, drives down each nail separately, removing it afterwards in the usual way. This plan is also advisable if the feet are very brittle or broken.

### 4. Preparation of the Hoof for Shoeing.

The continuous growth of the horn and absence of wear render paring of the hoof from time to time necessary. A further reason is the provision of a solid bearing surface for the shoe. Trimming must be so carried out that, firstly, the wall when viewed from in front and from the sides corresponds in direction with the common axis of the bones, and secondly, so that at ordinary paces all parts of the bearing surface of the wall meet the ground at the same moment, in other words, that the hoof is set down flat.

Varying with the direction and form of the hoof, quality of horn and character of the work, the foot requires lowering every three or four weeks. If the animal goes for six, eight, or ten weeks, not only does the relation of the hoof to the fetlock become changed, but the gait loses in freedom and certainty, the toe grows too long, an increased strain is thrown on the flexor tendons which favours stumbling, the shoes become relatively too short and too narrow, and are overgrown by the hoof, while corns may be caused by pressure on the angles of the heels. The hoof increases in width, favouring separation between the wall and sole, and the animal may strike itself. Horses whose hoofs have become too long almost always fall lame when much worked, especially on hard roads. In broad, flat feet, and to a certain extent in oblique feet, these bad results occur more rapidly than in those which are narrow and




DOORMAN'S TOOLS

[To face p. 203.]

upright, for which reason flat feet require more frequent attention than upright, whether the shoes are worn out or not. Many owners only send their horses to the farrier when shoes become loose, but, as a rule, new shoes are required every three to five weeks.

As we have now to consider the work which more especially falls within the domain of the doorman we may perhaps be permitted to digress for a moment to give a short description of the doorman's tools. A slight deviation has been made from the original plan of the book; hence the tools used by the doorman in shoe-making as well as in preparing the foot and nailing on the shoe are given here.

The shoeing hammer is used in conjunction with the buffer to cut the clenches, before removing the old shoe, to drive and turn down the nails, and, in many cases, to twist off the points. The buffer is usually made from a piece of worn-out rasp. Some care is required in tempering it so that it may neither be so brittle as to break when struck, nor so soft as to soon lose its edge. The pincers are also made from worn-out rasps. They are used in removing the shoe, drawing down the clenches, and cutting off the points of the nails.

Drawing-knives may be made from old files. Two or three sizes are needed, the smaller being used for completing the cutting out of feet, etc.

A nail cap is best formed of a heavy block of wood surrounded by a rim of leather. The base being heavy there is less chance of the cap being upset. The most widely used rasps are 'Turner's,' 15 inches in length, half file cut and reversible. These are cut by hand, but some very useful machine-cut rasps of American make are now in the market. Toeing-knives are often made from old rasps, though in London pieces of disused sword blade are more commonly used, as they need no preparation. The toeing-knife is very useful when judiciously employed, but in many shops its use is altogether prohibited; it being found that the ease with which large masses of horn can be removed often tempts hasty or careless workmen to use it instead of the drawing-knife, and so to inflict serious injury on the foot.

Of the tools used by doormen in shoe-making the sledge hammer is of the pattern shown, with one flat and one convex face. It weighs about 9 lbs. The fire-tongs are for holding the old shoes which are being worked up as 'heats,' in the fire. When the heat is ready for welding it is grasped with the fireman's tongs and transferred to the anvil. Fire-tongs are often used for beating down the wet coals while forming a 'back.'

The 'clamp' is intended to hold a concave or fullered hunting shoe when being filed out. The shoe is grasped by the jaws of the clamp and the latter inserted in the vice. The jaws are curved so that the shoe is brought into a more convenient position for the workman than if it were inserted directly in the vice.

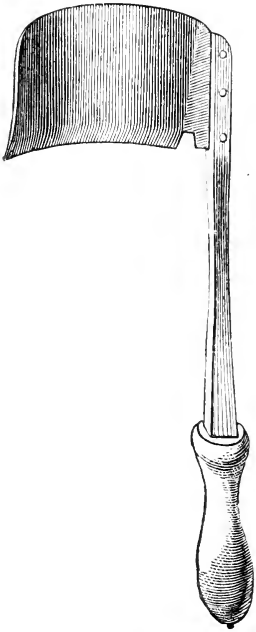


FIG. 192.

In preparing the hoof a good rasp and a farrier's drawing-knife are quite sufficient. Here and there in France the Arabian form of knife shown in fig. 192 is still employed.

After glancing at the limbs, etc., and judging of the relative strength of the hoof to the weight of the animal's body, the hoof is trimmed and any stubs carefully removed. The information already gleaned must be kept in mind when judging whence and how much horn is to be taken away from the sole and wall.

It is not altogether superfluous to ask whether horn *must* be taken away, because cases occur where the hoof is so weak that, if it were possible, we should be justified in adding rather than removing. A faulty shoe can immediately be replaced by a better, but once horn is removed it can only be replaced by a very slow process of growth.

In any case loose portions of horn should be removed, after which the white line is examined, and its condition and relation to the circumference of the wall, which indicate the thickness of the wall itself, noted.

It is clear, of course, that only the wall should be lowered the sole should be freed of loose portions of horn but nothing more. This done, the bearing surface of the wall is lowered until a narrow strip, the width of a straw, on the outer border of the sole, and in contact all round with the white line, forms part of the new bearing surface. This

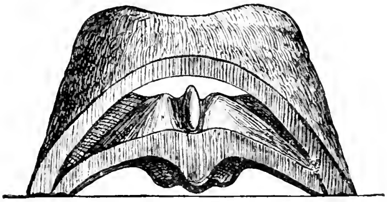


FIG. 193.—Section through normal hoof, showing strength of connection between wall and sole.

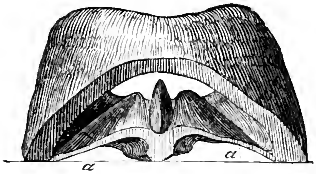



FIG. 194.—Section through hoof with thin sole, showing connection between wall and sole.

avoids weakening the connection between the wall and sole (figs. 193, 194, 195, and 196).

When the sole shows no large cracks, and its outer circumference forms a continuous surface with that of the wall, nothing should, as a rule, be removed. At most the wall is to be levelled with the rasp, and the bars, if curling inwards, slightly reduced. All portions of the wall lower than the margin of

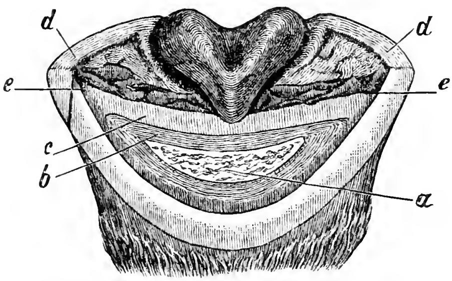



FIG. 195.—Section through normal foot. *a*, os pedis; *b*, sensitive sole; *c*, horn sole; *d*, bearing margin of wall; *e*, boundary between growing horn and that ready to be cast, indicating how far the sole should be pared.

the sole can be removed; if no part projects below this point nothing should be removed. The bearing surface then consists of the thickness of the wall, including the white line, and a narrow strip of the outer margin of the sole. This should be completely levelled with the rasp and only rounded off slightly at the toe.

In case of doubt as to how much to remove, the horn of the sole can be tried with the knife at a spot close to the apex of the frog. Dull colour and small cracks of the horn, together with deep lateral grooves at the sides of the frog, indicate a thick sole. Loosening and shedding of the horn of the sole are due to two causes, the first being growth of the sole. As the sole becomes thicker it is exposed to strain, because it is unable to follow the growing, and hence expanding, circumference of the wall. Secondly, shedding of horn is favoured by alternating moisture and dryness, by the elasticity of the sole, and by its movement during the animal's paces. These factors acting together favour shelling of the sole, and in flat hoofs operate so effectively that a strong sole is rare. In upright feet, however, the sole is usually strong and its margins, at least, perfectly capable of supporting weight.

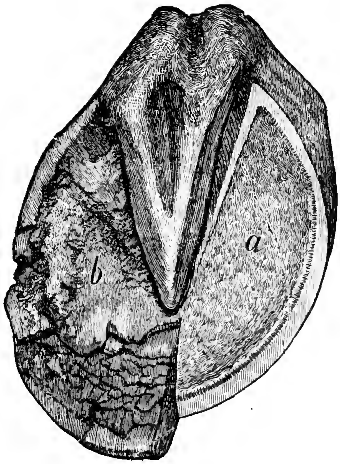


FIG. 196.—Front foot. *a*, prepared for the shoe; *b*, before preparation.

The bars should be spared and their connection with the wall under no circumstances weakened, much less cut through.

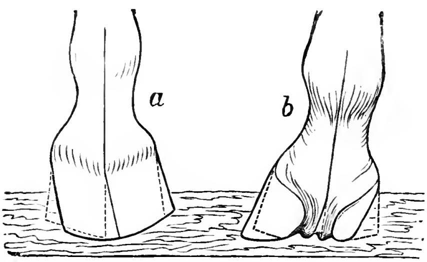


FIG. 197.—*a*, right fore-foot of normal limb; *b*, of turned-in limb, both showing incorrect paring. The correct form is indicated by dotted lines.

It is best to leave them level with the wall or a very little lower, though the extreme posterior parts of the sole should be lowered at least $\frac{1}{12}$ inch. The point where the wall is incurved to form the bars requires particular attention. In sound unshod hoofs the bars run in an almost straight direction, from a spot somewhat behind the point of the frog, backwards and outwards. In shod hoofs, however, they tend to deviate from this course, to converge again at the bulbs, and thus to encroach on the space normally occupied by the frog. Removal of the angle of the bars (*i.e.*, the point at which they join the wall) should never be allowed.

The frog is left sufficiently strong to project below the bearing surface of the heel, a distance equal to the thickness of an ordinary shoe. If weakened, it atrophies, and the hoof contracts. It should, therefore, only be pared when diseased; in other cases loose parts alone are to be removed. It need scarcely be pointed out that, if strong, the frog will soon wear to proper proportions.

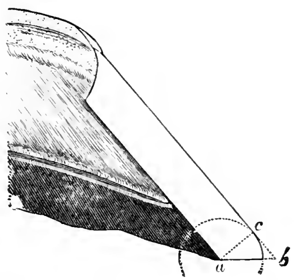


FIG. 198.—Vertical section through wall at toe. *a–c*, absolute; *a–b*. apparent thickness. The curve. *c–b*, indicates the necessary rounding of the toe.

The sharp edge of the bearing margin of the wall should be rounded as shown in fig. 198, but in normal hoofs the general surface must only be rasped if curved or deformed, as sometimes happens on the inner aspect. Rounding the edge prevents splitting and facilitates fitting the shoe.

The foregoing remarks on trimming the wall apply, of course, only to the hoofs of normal limbs; other cases require special attention. When the toes are turned out, the outer wall, if viewed from the front, is longer than the inner and to an extent corresponding with the extent of the defect. When the toes, on the contrary, are turned in, the inner wall is longer than the outer. Before proceeding to trim the hoof, therefore, the position of the feet and the direction of the foot axis should be noted.

Goyau gives the following directions (which have been summarised) for the preparation of the hoof. Imitate the effects of natural wear. Natural wear produces a flat foot of a form best suited to the conformation of the limb it terminates. It shortens and rounds the toe, lowering it to a greater extent than the heels; removes horn only from the anterior part of the sole, leaving the connection between walls and sole of full strength; rounds off the outer edge of the wall more than the inner, and spares the sole, frog, and bars, which shed their superfluous growth naturally. Natural wear gives to the foot the form best suited to the animal's action, and produces a perfectly flat bearing surface from the quarters to the heels.

Finally, Goyau declares that the equilibrium (*aplomb*) of the limb should result as far as possible *from the preparation of the foot and not from varying the thickness of different regions of the shoe.*

Special care should be taken in paring the hoof to bring the wall into line with the axis of the foot (fig. 197).

In dealing with the foot as seen from the side, the question resolves itself into one of the relative heights of the toe and heels.

The axis of the foot must be the guide. In normal feet it is parallel with the wall of the toe (figs. 165–167). If the hoof becomes too long, the intersection of the hoof and foot

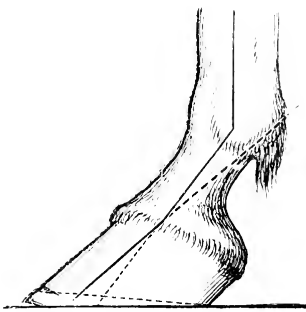


FIG. 199. — Hoof too oblique, horn to be removed shown by dotted line.

FIG. 200.—The same hoof properly prepared.

axes forms an obtuse angle (fig. 199). This renders it more difficult for the load to be moved, and leads to disease of the coronet joint through strain on the ligaments connecting the suffraginis and coronet bones. Shortening the toe compensates for this, and restores the foot to its proper position (fig. 200). There is less injury to the joints when the heels are too high (fig. 201, *b*), because the back of the shoe is then worn away. By shortening the toe or heel the fetlock and foot axes are thus readily brought into line, as shown by fig. 201.

It has been found that excessive lowering of the heels tends to strain of the perforans tendon, while excessive height relieves


SECTION OF HORSE'S HOOF

the perforans at the expense of the perforatus. Excessive length of the toe is therefore more injurious than the opposite condition because of the importance of the perforans.

The bearing of the hoof is normal when all parts of the bearing surface of the wall or of the shoe meet the ground at the same time, and when the toe wall and heel, viewed from the side, correspond in direction with the common axis of the bones of the foot.

It must always be a matter for the judgment of the farrier, when paring the foot, to what extent he shall adopt the indications given by the wearing of the heels or of the toe, but

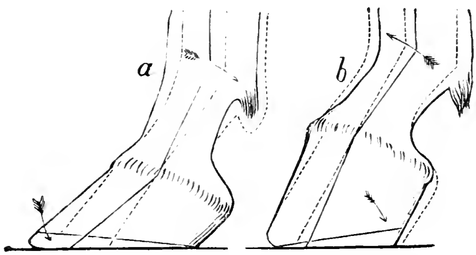



FIG. 201.—Two feet seen from the side; in *a* the toe is too long, in *b* the heels. The dotted lines indicate the correct relations between hoof and pastern.

this much seems quite certain, that wearing of the heels necessitates shortening of the toes, and marked wearing of any part of the shoe *generally* shows that the portion of the wall above that spot needs lowering, or that the shoe is too narrow at that point; but in all doubtful cases a final judgment should be deferred until the horse has been seen in motion.

We say *generally*, because it must be remembered that wear depends not only on conformation but *on pace and the nature of the work performed.* Thus the spavined horse wears most at the toe. The stepping horse and the fast trotter wear at the heels. The saddle horse wears all parts evenly. The draught horse wears the toe excessively. To lower the toe of the spavined horse and of the horse with low heels is good practice, but to do the same with the heavy draught horse, or to lower the heels of the stepping horse, would be a grave error.

Finally, it should be remembered that in changing from flat shoes to shoes with heels, or *vice versa*, the hoof must be properly prepared so as to preserve the relations between the axes of the foot and of the hoof. As each hoof is prepared for the new shoe the latter should be applied and the animal allowed to stand on it, the foot being then examined and compared with its fellow. Only when the position, etc., of the limb appear normal should the shoe be nailed on. The two fore and two hind hoofs should, when in like positions, not only be of similar size, but should be in proportion to the size and weight of the body.

### 5. Working without Shoes.

Working without shoes is only possible when the hoof is strong and the ground soft. Only *loose fragments* of horn should be removed from the frog, thus allowing the weight of the body to be equally distributed over the entire bearing surface of the hoof. The sharp edge of the wall is then well-rounded off with a rasp to prevent pieces breaking out—flat, oblique hoofs being more rounded off than those which are upright. With this preparation the hoofs are much improved by the animal being worked barefoot. From time to time they should be examined and any irregularities of form corrected. It may be necessary to again round off the wall, especially when the feet are very flat, while the heels may require lowering, as they do not always wear as rapidly as the toe.

### 6. General Principles to be Observed in the Choice of the Shoe.

Considerable care is necessary in selecting shoes from stock. In the first place the shoe must be suited to the size and weight of the horse, to the kind of work, to the surface on which the animal is working, and to the form of the hoof. Young horses, as a rule, wear their shoes less, and are more liable to cut or brush if shod heavily than stiff, old animals, and should, therefore, be shod correspondingly lighter, as should horses in easy draught and those whose work lies on soft ground. Even for paved roads heavy shoes are to be avoided, especially when the pace is faster than a walk. Sufficient strength should, however, be given to ensure the shoe wearing from three to four weeks, and it may be necessary to secure greater durability by inserting a piece of steel at the point of greatest wear.

In order to allow of frog pressure the shoe must be formed as thin as is consistent with durability and with the preservation of its form. Excessive weight injures the action and exhausts the animal. This, of course, does not apply to the training of horses, where heavy shoes are often used to teach the animal to lift his feet and thus increase his 'action.' When we remember that during fast work the foot is lifted about sixty times per minute, the amount of energy wasted in ten to twelve hours will be seen to be very great.

Flat or 'dropped' soles require more 'cover' than strong feet with well-arched soles, but a certain amount must always be given. In Paris the cover is usually reduced to a minimum —and with the worst possible results to the feet. As wear is rapid in large towns some compromise must be made between thickness and cover, because were both given the shoe

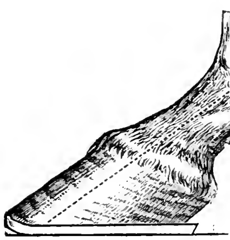


FIG. 202.

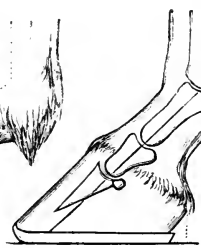


FIG. 203.

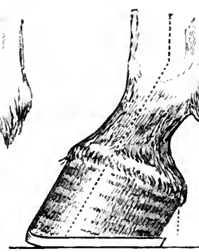


FIG. 204.

would be too heavy. Very broad shoes increase the risk of slipping.

Special attention must be given to the length of the shoe. All shoes become too short after a time, and should, therefore, be selected of sufficient length to completely cover the bearing surface of the wall and in most cases to project a little.* The exact excess of length depends both on the form of the hoof when viewed laterally and the style of shoe, but as a general rule oblique hoofs require longer shoes than upright. When the foot is upright and the shoe flat, $\frac{1}{4}$ inch is quite

* An exception may perhaps be made in favour of hunting shoes, but even here the heel is often prolonged, being narrowed and turned upwards, so that the point is embedded in the wall of the heel.

sufficient, but can be increased to $\frac{1}{2}$ or $\frac{3}{4}$ inch, in some cases, indeed, to $1\frac{1}{4}$ inches, according to the size and weight of the horse. Long shoes throw greater weight on the anterior half of the hoof; short ones have an opposite effect.

In heavy draught horses the heels may be so long as to meet a vertical line dropped from the bulbs of the heel, but for light horses, working at a trot or gallop, this would be quite inadmissible, on account of the danger of shoes being trodden on and torn off.

This question is worthy of careful consideration. When the foot is on the ground the length of the heels can have no special influence on the direction of the pastern, etc. The foot rests on the shoe as it would on the ground. But at the moment preceding that of bringing the foot to the ground the length of the heels is of great importance. The foot just

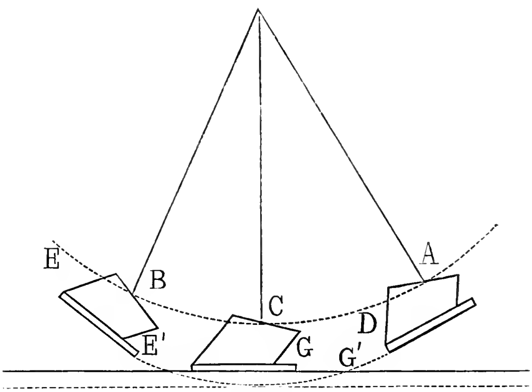



FIG. 205.

before it touches the earth is not parallel to the general surface, but forms a slight angle with it. That is to say, that at the moment of putting down the foot the animal raises the toe and lowers the heels. Then he slightly draws back the foot, and brings it parallel and in contact with the ground. This movement can be noted by viewing the horse either from in front or from the side. In a horse trotting towards the observer the toe is often lifted, just before being set down, sufficiently high to allow of the ground surface of the shoe being seen. This only applies to fore-feet.

The foot being lifted at A (fig. 205) passes into the position shown at B by describing a modification of the arc D E. From the position B it passes backwards to assume the position C, describing the curve E′ G′. It is, therefore, clear that if the heels of the shoe are longer than the hoof the prolongation will describe a curve which will cut the ground surface. In other words, at the moment the hoof is brought to the ground the heels of the shoe will make contact much earlier than the toe, and the foot will come to rest at E′ instead of at G. It will at once be seen how injurious this is, especially to the heels.

Calkins are just as harmful as long heels for front feet. To those who doubt this, we may commend the practical test of applying a pair of front shoes with heels, say, 1 or 1½ inches longer than the feet, or with calkins 1½ or 2 inches high. On making the horse trot, a peculiar shoulder action will be observable and the horse will go as though affected with laminitis. The foot seems to be brought to the ground as shown in B, fig. 205.

In hind-feet lengthening the heels is not accompanied by these disadvantages, but, within limits, tends to increased speed.

In America a practice prevails of lengthening the heels of

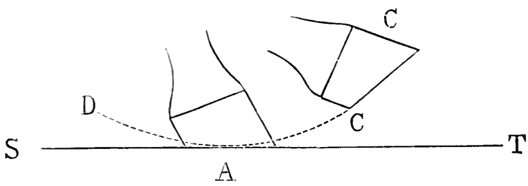



FIG. 206.

trotting horses' hind shoes with this object, although the *rationale* of the process is not recognised. The following is a possible explanation.

Before actually coming to the ground the horse's foot assumes the position C (fig. 206), with the sole directed more or less forwards. During the next instant it describes the arc of the circle C D and is firmly planted on the earth.

If, however, the heels of the shoe are prolonged, although the hoof still tends to describe the curve C D (fig. 207), the heel C, describing a parallel but larger curve, will touch the earth at A′. The increase of the stride will then equal the distance

A to A′. Although this may be very little on each occasion it becomes an important quantity when multiplied several hundred times, and quite suffices to convert a losing into a winning race. The exertion and risk of strain are naturally greater, but are of little importance when contrasted with the gain.

Heavy horses with turned-in toes go best in rather heavy shoes with broad outside quarter, fitted rather 'full' and with

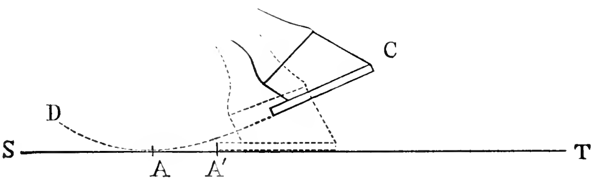



FIG. 207.

nail holes punched somewhat coarser than usual. This gives a broader bearing surface outside.

It is scarcely needful to say that, in choosing a shoe, the position and direction of the nail holes must be taken into account, as well as its form, a point of great importance in shoeing defective feet.

Viewed from the ground surface a well-made front shoe is seen to be rounded in form, almost as broad as long, the two branches of approximately equal length, the inner, however, being somewhat less round.

The cover is almost the same throughout, the toe and quarters, which sustain the severest wear, being rather broader than the branches; the nail holes are suitable in size and number to the class of shoe and placed so as not to be injured by drawing the clip; the two toe-nails are in a line with each other, at equal distances from the centre of the toe, and punched somewhat obliquely; the last nail holes should be opposite the centre of the shoe (antero-posterior measurement); the outer nail holes are punched a little 'coarse,' the inner at about the same distance from the margin of the shoe as those of the toe. All the nail holes should be equally spaced, quadrangular, and clean-punched, the counter-sinks being sufficiently deep to allow nearly the whole of the nail head to enter.

Viewed from the side the hoof surface is flat, except under very special circumstances, as when the toe is 'rolled,' and the shoe of the same thickness throughout. The fore shoe should only carry calkins when a toe-piece *of equal height* is used.

Viewed from above, the nail holes of the inner quarter and inner toe should be seen to open nearer the margin of the shoe than those of the outer quarter.

A well-made hind shoe should be of oval shape, the branches of the same length, the inner, however, being straighter than the outer, the toe should exhibit more 'cover' than the branches, the heels should be finished square, the toe should show no nail holes, the nail holes of the inner side should be punched finer than those of the outer, and the last nail hole of one side should be approximately opposite that of the other. The other characteristics are similar to those of the fore shoe, save that the toe (in draught horses) is thicker than the heels.

Calkins, even when of equal height, entail certain disadvantages. Thus they lift the frog clear of the ground and place it out of action: entering the ground unequally they tend to strain the joints; in turning or in the stable they are apt to be set down on the coronet of the opposite foot and cause dangerous wounds. Their power of checking slips rapidly decreases with wear. They are quite out of place when used to raise naturally low heels, and in no way prevent strain of the tendons (as is often supposed), because the tendons themselves are then of a length corresponding to the flatness of the foot. Furthermore, they cause the foot to rest continually on an *inclined* surface. Though employed for all classes, they are most useful on the hind shoes of heavy cart horses, where they favour the action of the tendons during draught and ensure a firm foothold on slippery ground.

In shoeing horses with turned-in toes the increased wear of the outer limb of the shoe is compensated by making the 'web' somewhat broader. Upright feet require a shoe with web of the same width at quarters and toe, or somewhat broader at the toe.

As the weight of the shoe has considerable influence in determining the style of going, animals with little action are sometimes shod with a heavy shoe, and in those having a tendency to brush or strike it may be desirable to weight the toe or quarter as afterwards referred to. The exact amount to apply requires careful judgment.

In choosing a new shoe the old one is usually the best guide. Some farriers use simply a straw on which they mark the length and breadth. During the early part of the present century a large number of instruments were invented for this purpose, with the object not only of showing the length

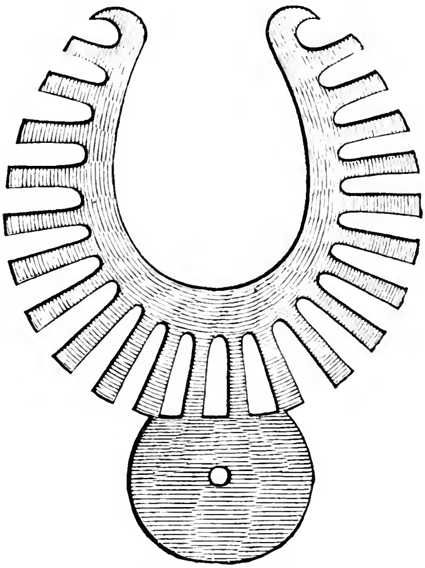


FIG. 208.—Ewerlöff's Podometer.

and breadth, but the exact circumference of the hoof, and one form is still regularly used in the French army. Most were unpractical; the only one of any value was that suggested by the Swedish officer, Ewerlöff, in 1876 (see fig. 208). It consists of strong tin and is cut into teeth as shown. In using it the instrument is laid on the hoof, the shape of which is marked on it with chalk. 'Podometers,' however, are now never used in England.

## 7. Choice of the Shoe for Specific Uses.

We shall now consider the shoes more commonly employed in each of the classes mentioned on p. 147. The general principles to be observed in shoeing each class (such as hacks, hunters, race-horses, etc.) will first be given and will be followed by descriptions of specific shoes for the uses indicated.

## 1. HACKS.

As saddle horses are seldom used for more than a few hours per day, they require light, closely fitted shoes, which afford sufficient protection to the feet without endangering 'cutting' or 'overreaching,' and without in any way impeding freedom of action. At the same time, it is very bad policy to unduly

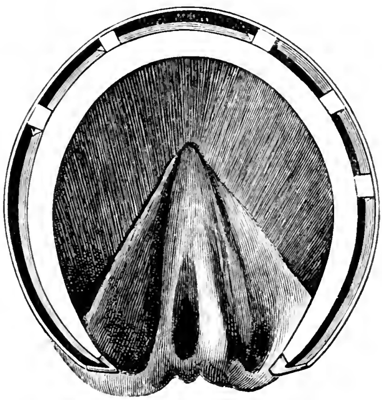


Fig. 209.—Fullered front shoe for hack. As in several of the following figures, the foot has been cut out so that bars appear unduly prolonged.

reduce the 'cover' of the shoe, as is often done in order to produce a neat appearance, because a certain quantity of iron is necessary to give durability, and as the 'cover' is reduced the thickness of the shoe must be proportionately increased. Carried to an extreme, this narrowing of the shoe is a grave evil.

In preparing the foot, the heels should be left as strong as possible, because, under the rider, the pastern descends and the major part of the weight is thrown on the back of the foot, leading, in weak heels, to the production of bruises, corns, etc. Where the heels are low and spreading, the heels of the shoe may be fitted rather fuller than usual and somewhat prolonged. The hind shoe should be of equal height inside and out, the inner branch fashioned almost straight from the inner edge of the toe to the posterior third of the foot and made rather narrower than the outer, or a feather-edged shoe may be applied. This has the advantage of preventing injury to the coronet of the opposite leg either in work or in the stable.

The clip should be at the centre of the toe, which should be well rounded in front. The heels may project $\frac{1}{4}$ to $\frac{3}{8}$ inch. In general, the shoes of the hack resemble those of the hunter, next described, though, as the pace of the hack is slower and the efforts he makes less violent than those of the hunter, the excessive precautions taken in the case of the latter are unnecessary.

## *SPECIAL SHOES FOR HACKS.*

### FULLERED FORE SHOE (Fig. 210).

*Made from $\frac{1}{2}$ inch × $\frac{5}{16}$ iron.*

This shoe is suitable for animals with small, upright, 'boxy' feet, or for small hunters, cobs, and ponies. It should not be used where the feet are flat or weak. The shoe is made 'wrong way on,' and thus wider at ground than at foot surface, and therefore gives show cobs, etc., the appearance of having large well-developed feet, even when this is not the case. The inside edge is filed out, and as the 'cover' is narrow, the shoe gives the foot an appearance of extra width. Filing out the inner edge also lessens the chance of the horse 'forging,' the noise of which is often very distinctly heard when the animal is trotted on grass. The shoe shown, being intended for a defective foot, has eight nail holes, but might be made with six; and if required, the last quarter nail on the outside might be placed further back. To give extra durability, the shoe may be made of steel.

HACKS.

FIG. 210.—Fullered fore shoe for hack. Made from $\frac{1}{2}$ inch × $\frac{5}{16}$ iron.

[To face p. 218.

Fig. 211.—Fullered seated fore shoe with thick heels. Made of $\frac{7}{8} \times \frac{3}{8}$ inch iron.

*To face p.* 219.]

## FULLERED SEATED FORE SHOE WITH THICK HEELS (Fig. 211).

*Made of $\frac{7}{8} \times \frac{5}{8}$ inch iron.*

This shoe is used chiefly for horses suffering from strain of tendons, ligaments, etc., the tension on which it relieves, allowing the animals to work with less pain. In larger sizes it is also very useful for cart horses with strain of the sub-carpal ligament. Occasionally such a shoe is applied to the lower of two carriage horses which work together, so as to bring it more on a level with its fellow; but this is scarcely a legitimate use of the shoe, though sometimes resorted to by dealers. The disadvantages of the shoe are that it lifts the heels from the ground and thus prevents frog pressure, a condition soon followed by atrophy of the frog, thrush, etc.; that it is apt to press unduly on the heels, and, especially in weak feet, to cause corns, and that, by throwing increased weight on the toe, it favours the production of sand-crack, or aggravates it if existent.

As a rule, thick heels are contra-indicated in front shoes, particularly in shoeing horses with flat or dropped soles. The farrier is often asked to thicken the heels of shoes for horses which wear at that point, but the request should not be complied with.

In making this shoe, the toe is first thinned and the heels afterwards thickened ('upset') by a few blows delivered in the direction of the web of the shoe, whilst the latter is held in the vice. It is difficult to 'upset' the heels on the anvil itself.

## 2. HUNTERS.

The ground surface of hunting shoes must be formed with due regard to the prevention of slipping and the minimising of suction in deep ground. This is obtained by dishing out the ground surface, the dished portion terminating just in front of the heel at a sharp angle. The greatest care should be taken to prevent overreaching, and all hunting shoes should be of particularly good construction, neither too broad nor too heavy.

The concave shoe herewith illustrated is a very favourite hunting shoe. It possesses the advantage of being light, giving a good foothold, and, owing to the slope of the heels, which may if necessary be slightly embedded in the horn of the wall, it presents no projections on which the horse might tread or

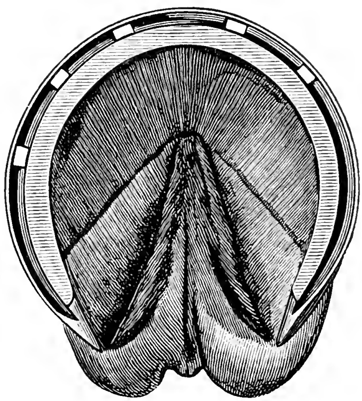


FIG. 212.—Fullered front shoe for hunter.

which might be caught in heavy ground or when 'landing' over a fence. The concave shape causes the shoe to enter the surface of the ground at each stride and is said to facilitate its withdrawal.

For animals with strong walled feet and thick, well-arched soles this shoe is probably the most suitable. When, in addition, the sole is thin and flat more cover is indispensable, and the shoe shown in fig. 212 is to be preferred. A certain breadth is indispensable to prevent the shoe 'spreading' when half worn through and so cutting the opposite fetlock or coronet. Abroad, many hunters are shod with leathers, the sole being protected with a thick 'stopping' of tar and tow, and in France the use of a soft copper plate, applied precisely like a leather pad, has even been recommended.

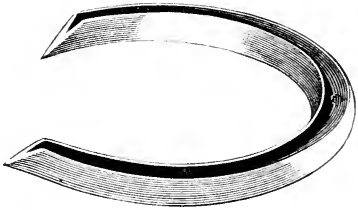


FIG. 213.—Lateral view of concave front shoe for hack or hunter.

The hind shoe usually has a low calkin outside and is 'knocked-up' inside. The inside branch must be fitted very closely and its outer wall (*i.e.*, the wall nearest the opposite shoe) should slope slightly downwards and inwards. Care must be taken to remove any rough edges from either the shoe or margin of the hoof, especially if the animal 'goes close.'

FIG. 214.—Hind shoe for hunter. The toe is rounded and set back to prevent overreach. The sole has been pared so as to cause the bar to appear as if extending to the point of frog.

The toe should be square and fitted close; the clips placed on either side of the toe. The heels should be as nearly as possible of the same height, though, as the hunter usually travels on soft ground, a slight inequality in this respect is less injurious than in animals working on hard roads.

As hunters are very liable to overreach when landing over a fence their hind shoes require special care in fitting. The toe must be fitted straight, be well rounded both inside and out and set back slightly behind the margin of the toe wall. The portion of the shoe which inflicts the wound is usually the back, not the front margin of the toe of the shoe. The reason of horses overreaching is often to be found in the toe of the front foot being left too long and the heels being lowered. This renders it more difficult for the muscles of the fore-limb to lift the body-weight; hence the animal does not 'get away' quickly in front and the hind foot overtakes the fore, inflicting a wound. The remedy here is to shorten and round the toe of the fore-foot and to spare the heels.

## TEMPORARY SHOES.

During manœuvres or a run with hounds a horse not unfrequently casts a shoe, and, to prevent injury and breakage of the hoof, some special contrivance becomes necessary.

To meet such emergencies shoes have been invented which can be easily applied and which dispense with the use of nails.

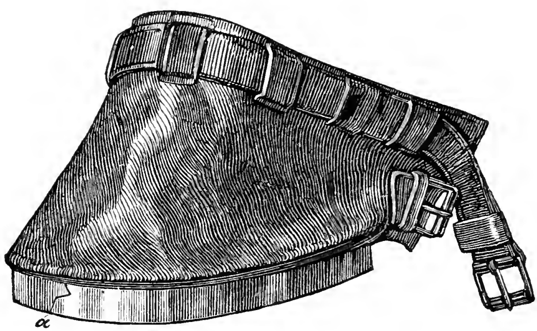



FIG. 215.—Temporary shoe with leather boot and straps. *a*, hinge.

Several have been patented, but the most practical is that figured. It consists of a light shoe hinged in the centre and provided with a kind of leather boot, which fits over the hoof and is fastened by straps. The illustration (fig. 215) shows its form and construction very clearly.

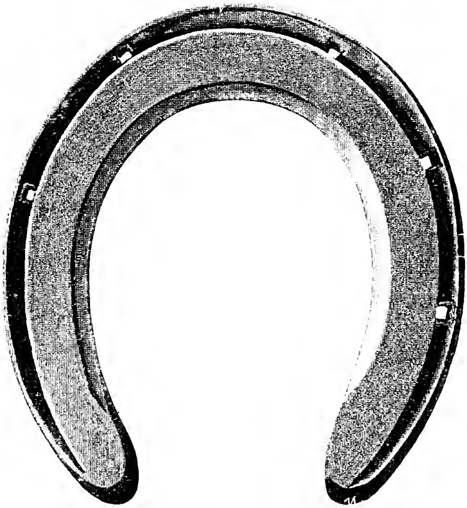


FIG. 216. - Fullered seated fore shoe. Made of $\frac{7}{8} \times \frac{1}{2}$ inch iron.

FIG. 217.—Concave partially-fullered, 'dub-toed' fore-shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

*To face p.* 223.]

## *SPECIAL SHOES FOR HUNTERS.*

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### FULLERED SEATED FORE SHOE (FIG. 216).

*Made of $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

This shoe is useful for hunters with fleshy soles, or for animals with wide feet and slightly-dropped soles. It should not be seated out much on the foot surface. Many animals forge in going, but on account of their feet being weak, and on account of the difficulty of 'boxing-up' a concave shoe to any great extent at the quarters and heels, they must be shod with a fullered shoe, as this can be fitted comparatively 'full' at the heels. To prevent the square toe of the hind striking the inside margin of the fore shoe, and thus producing noise or tearing off the shoe, this fullered shoe is filed out around the inside of the toe and *quarters*. The more marked the sound, the more should the quarters be filed out. The shoe is most useful for hunters which are exercised on roads, though on account of its giving an appearance of strength to a really weak foot, without at the same time proving heavy, it is often used for show purposes. For ordinary work, as on carriage horses which require cover, and which forge slightly, this shoe might with advantage carry seven instead of five nail holes.

### CONCAVE PARTIALLY-FULLERED 'DUB-TOED' FORE SHOE (FIG. 217).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

This shoe is indicated for 'stale' hunters, broken-kneed horses, animals which catch the toe and trip, and in some cases for horses with contracted flexor tendons. Before fitting the shoe, the toe of the foot must be well-rounded with the rasp.

In making the shoe, about two and a half inches of the toe are left solid (*i.e.*, is not fullered). This portion is somewhat thinned down, and is rolled round on the beak of the anvil, the *outside toe* being most curved, as this is the part which generally comes first in contact with the ground. It is very important that the fullering cease well behind the toe, both to give greater strength at this part, and also to prevent any interruption of the regular curved form of the toe. Were the fullering continued round the shoe, the back wall of the groove would present a sharp angle, liable to catch in the ground and cause the horse to stumble to an even greater extent than occurs with an ordinary shoe.

If considered necessary, a toe-clip can be drawn, though the rolling of the toe usually gives a sufficient hold on the foot.

## CONCAVE FULLERED, FEATHER-EDGED FORE SHOE (Fig. 218).

*Made of $\frac{3}{4} \times \frac{1}{2}$ inch iron in concave tool.*

This is a useful shoe for horses that cut, brush, or strike. By chamfering the inside toe and quarter a much greater foot-bearing surface can be preserved than was possible in the old-fashioned feather-edged shoe. The inside limb and heel of the shoe do not then sink into the corresponding portions of the foot, and the risk of producing corns, or, in the case of a weak foot, splitting away a greater or less amount of the wall is avoided.

The two inside toe-nails being stamped, the inner toe and quarter can be fitted finer to the foot and the risk of striking lessened. Should the horse brush badly, a single nail hole can be stamped at the inside toe, close to the clip. For a horse which crosses his legs in going, or is 'tied-in at the elbows,' this shoe answers exceedingly well, and may replace the ordinary feather-edged shoe.

## STAMPED FORE SHOE (Fig. 219).

*Made from Charlier steel $\frac{7}{16}$ inch square.*

This shoe is useful for hunters or hacks with strong, 'boxy' feet. Horses which forge or cut when provided with shoes of

Fig. 218.—Concave fullered, feather-edged fore shoe. Made of $\frac{3}{4} \times \frac{1}{2}$ inch iron in concave tool.

Fig. 219.—Stamped fore shoe. Made from Charlier steel $\frac{7}{16}$ inch square.

[To face p. 224.

ordinary cover often cease to do so when shod with this shoe. It is useful both for fore and hind feet, and should always be kept perfectly flat, as shown. The heels are sloped off obliquely to prevent their coming in contact with the elbows when the horse lies down, and producing 'capped elbow.'

Where the horse brushes, the outer margin of the inner limb of shoe should be chamfered down before stamping the inside toe-nails. This prevents the parts burring over and forming a saw-like, cutting edge which might otherwise inflict severe injury on the opposite limb.

Chamfering down, however, causes the heads of the nails to overhang the edge of the shoe when the latter is nailed on; these overhanging portions must therefore be afterwards filed or rasped level with the edge. Another point worthy of note is that, owing to the difference in hardness, iron nails have a tendency to sink when inserted in steel shoes, and so to allow the clenches to rise. The constant hammering of the feet on the ground drives the nail further and further home, the head and neck gradually yielding.

This shoe is too light, and wears too short a time for work on roads; its use is therefore chiefly confined to animals exercised on grass.

## CONCAVE PARTIALLY-FULLERED HIND SHOE (FIG. 220).

*Made in concave tool from $\frac{3}{4} \times \frac{1}{2}$ inch iron or (preferably) from old shoes.*

This shoe is intended for a hunter that cuts his fetlock joints and, at the same time, overreaches. It is level on the ground-surface, is fullered on the outside, and two nails are stamped at the inside heel. Clips are drawn at the outside toe and inside heel. The inside edge is chamfered down, and hot rasped off.

The shoe must be fitted *straight* across the toe, which must be well set back, and the inside toe fitted very fine. The clenches of the heel nails inside must be well drawn down on the pincers, and the heads of the nails rasped off level with the shoe.

## CONCAVE PARTIALLY-FULLERED HIND SHOE (FIG. 221).

*Made of $\frac{3}{4} \times \frac{1}{2}$ inch iron in concave tool.*

This shoe has the inside chamfered down, and two nail holes stamped at the inside toe. It is useful for horses that cut or brush their hind fetlock joints. Having a calkin on the outside heel, it gives the horse a good grip of the ground. As the calkin enters the ground, the balance of the foot is not disturbed to any appreciable extent, and in this case its advantages far outweigh its drawbacks.

The illustration does not show them, but clips can be drawn at the toe and outside quarter, or on either side of the toe, as is usual among hunters; the former method is preferable, as it prevents the shoe driving back. It is also of great advantage when the horse cuts 'between hair and hoof,' as it allows the inside toe and quarter (*i.e.*, the parts with which injury is most often inflicted) to be fitted very close. In such case a single inside nail hole near the toe-clip is preferable to the two

# HUNTERS.

FIG. 220.—Concave partially-fullered hind shoe. Made in concave tool from $\frac{3}{4} \times \frac{1}{2}$ inch iron or (preferably) from old shoes.

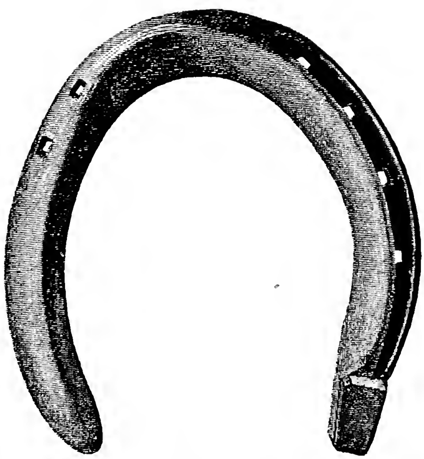

FIG. 221.—Concave partially-fullered hind shoe. Made of $\frac{3}{4} \times \frac{1}{2}$ inch iron in concave tool.

[*To face p.* 226.

shown. By keeping the toe solid (*i.e.*, not fullering it) the chance of overreaching is lessened, and its results when occurring are rendered less grave.

Chamfering, or rasping down the inner limb, is done in the vice whilst the shoe is hot. It minimises the risk of this part of the shoe striking the opposite limb, and prevents the bearing surface of the shoe wearing with a ‘burr’ or saw-like edge. Like that previously described, the above shoe has a great advantage over ordinary feather-edged patterns in that it presents a broad bearing surface to the foot, in which it does not tend to become embedded.

## CONCAVE PARTIALLY-FULLERED HIND SHOE (Fig. 222).

*Made in concave tool from $\frac{3}{4} \times \frac{1}{2}$ inch iron or from old shoes.*

This is a useful shoe for a horse that cuts and drives back or 'spreads' his shoes. It is for a narrower foot than that preceding and is made by a different workman, as is apparent from the shape and fullering.

The shoe has a toe and quarter clip and a calkin outside. When single calkins are not higher than the knocked-up portion of the opposite limb of shoe, they do little harm, and for certain kinds of country are probably an advantage, inasmuch as they minimise the tendency to side-slips. These concave feather-edged shoes, with the inside chamfered down, are tooled out to the heel on the inside; the chamfering is done on the anvil afterwards. As this draws down the parts (*i.e.*, makes them longer), it is necessary, in turning the shoe, to leave more iron at the outer than at the inner side, otherwise a portion has to be cut off after the inside is finished, thus wasting material.

## CHARLIER HIND SHOE (Fig. 223).

*Made from Charlier steel $\frac{7}{16}$ inch square.*

This is a companion shoe to the Charlier fore shoe described elsewhere. Being light and level on the ground surface, it is useful in cases of cutting, and for a similar reason it often checks or prevents forging. Horses which kick much in the stable and get their shoes off are often shod in this way, as the heels of the shoe can be sloped off, and the chance of their catching in boards, etc., minimised.

Clips may be drawn at the toe, at each side of the toe, at the toe and quarter, or toe and inside heel. Owing to the light section of iron, some care is needed to prevent the outer edge of the shoe bulging when nail holes are being stamped.

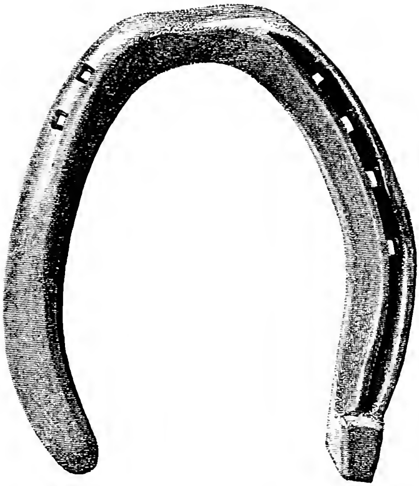

FIG. 222.—Concave partially-fullered hind shoe, made in concave tool, from $\frac{3}{4} \times \frac{1}{2}$ inch iron, or from old shoes.

FIG. 223.—Charlier hind shoe, made from Charlier steel, 7-16th inch square.

[*To face p.* 228.

## 3. RACE-HORSES.

The chief points to be aimed at in shoeing race-horses are to secure lightness and a rough ground surface, though lightness must never be pushed to such a point as to endanger the breaking or bending of the shoe. These requirements are best met by a slender steel shoe with a deep continuous fullering round the entire ground surface, dividing it into two sharp borders. To prevent the shoe bending, however, the nail holes should be continued somewhat farther back than usual, and the racing plate shown, though excellent in other respects, would probably be improved by a sixth nail hole. Since the introduction of steel (for sections, see page 131) it has become possible to produce much lighter shoes

FIG. 224.—Racing plate. As in several of these illustrations, the foot has been so prepared as to cause the bars to appear with unusual distinctness.

and even to increase the cover (a sensible advantage) without adding weight. The section shown on next page is for iron, and is still sometimes used.

For training, light fullered shoes, about six to eight ounces in weight, are used. The hind shoes are flat. These are exchanged on the day preceding the event for racing plates weighing about four ounces. The reduction in weight is extremely important when one remembers how frequently the limbs are lifted, especially as the shoe is placed at the extremity of the limb, and is therefore acting on a lever of great length.

The plate is fitted short and close, the heels are rounded off and prolonged upwards, fitting into a niche formed in the wall of the heel, so that the union between the heel of the foot and that of the shoe shows an unbroken line, the inner margin of the shoe is concave, and the wall of the inner branch, looking towards the opposite shoe, rounded off. Plates

FIG. 225.

for front feet are occasionally provided with a low, strong calkin to prevent side-slip. In some parts of France it is customary to invert the seating of the hoof surface, *i.e.*, to make the inner margin of the hoof surface a little higher than the outer, so as to fit close to the sole instead of leaving a space, the object being to prevent the toe of the hind foot catching in that of the fore, an accident which is liable to be followed by a terrible fall.

The hind shoe is usually furnished with a calkin outside to prevent side-slip, and a plain heel within. The toe is rounded off and set well back, a portion of horn being allowed to project in front. The clip is placed at the centre of the toe, both in front and hind plates. By setting the shoe back in this way the danger of overreaching is diminished and its consequences rendered less grave, while the action of the limb is favoured as the tendons are enabled to act at a better angle.

FIG. 226.—Racing plate (fore). Made from $\frac{5}{16} \times \frac{3}{8}$ inch iron.

FIG. 227.—Concave fullered fore shoe (for steeplechasing). Made from $\frac{5}{8} \times \frac{3}{8}$ inch iron.

*To face p.* 231.]

## RACING PLATE (FORE) (Fig. 226).

*Made from $\frac{5}{16} \times \frac{3}{8}$ inch iron.*

This is an old-fashioned plate, such as was used thirty years ago when horses were taken to race-meetings in the ordinary light shoes in which they did their work. The shoes were taken off and the plates substituted at the stables close to the meeting.

The plate shown is made in a very small concave tool, the groove in which is provided with a ridge at the bottom so as to form the fuller, as the section of iron is too light to be fullered in the ordinary way. A similar device is useful in making small pony shoes, say 3 to $3\frac{1}{2}$ inches. Pony hind shoes are sometimes made in the same tool, but it is preferable to use a special tool, without the ridge, for these, as, when the fullering is continued around the toe, the front of the shoe presents a knife-like edge, capable of inflicting severe injury on the fore foot should the animal overreach.

## CONCAVE FULLERED FORE SHOE (FOR STEEPLE-CHASING) (Fig. 227).

*Made from $\frac{5}{8} \times \frac{3}{8}$ inch iron.*

This shoe is useful for steeplechasers or hunters exercised on grass or harrowed land, but is too light and wears too quickly for animals exercised on macadam roads. It is intended for medium-sized feet, viz., from $4\frac{3}{4}$ to $5\frac{1}{2}$ inches. The section is usually given in a concave tool. Owing to its thinness it permits the frogs to come well in contact with the ground, and acts as a preventive of thrush, contraction of the foot, and wiring in of the heels. It is therefore indicated for upright boxy feet with signs of commencing disease.

## 4. TROTTING HORSES.

In theory, the trotting shoe should be as light as possible, but inasmuch as trotting courses differ materially from the ordinary race-course, increased durability is necessary. The

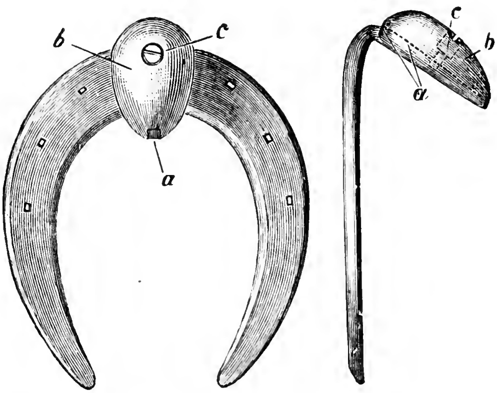


FIG. 228.—Steel fore shoe for trotter with toe-weight. Total weight, 15 ounces. *a*, projection on which the weight *b* is slipped and fastened by screw *C*.

best shoe is broad at the toe, the cover diminishing markedly towards the heels. The broad toe prevents the hoof sinking

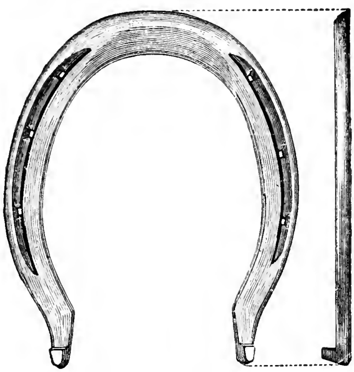

FIG. 229.—Steel hind shoe for trotter, one-third natural size. Weight, $5\frac{1}{4}$ ounces.

in sandy or moist soil. The hoof surface is flat, the heels rounded and bevelled off; there is only a slight clip; the six nail holes are sunk in a deep fuller extending completely round the shoe; the last nail holes approach rather closer to the heels than in the ordinary shoe. The weight is about five to six ounces.

The hind shoe is narrower than the fore; the heels are prolonged as shown, and terminate in small three-cornered calkins; sometimes they project an inch or even more beyond the heels and are of unequal length, the outer being the longer. This arrangement is believed to make the animal 'gain ground.' There are six nail holes and the fullering is broken at the toe. The clip, when present, is placed considerably to the inside of the centre of the toe, which is carefully rounded.

In training, the Americans use heavier shoes and affix

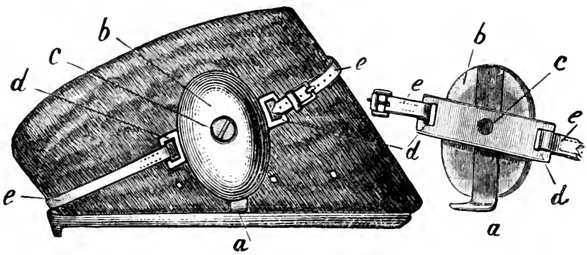


FIG. 230.—Hind hoof shod with weighted shoe. *a*, hook which slips between hoof and shoe to fasten weight; *b*, brass weight; *c*, binding screw; *d*, eyelets for straps.

weights to the feet, which, in the front feet, are fastened to the toe, in the hind, to the outer side. These are of brass or lead, somewhat oval in shape and of hemispherical section, weighing from $1\frac{1}{2}$ to 6 ounces. Sometimes they are even used in racing. In front shoes they are usually fastened by screws to a prolongation rising from the toe (fig. 228).

In the case of hind-feet the weight is fixed in one of two ways, the more common being by means of a strap (fig. 230, *e*) passed round the hoof. In order to assure solid attachment of the weight a hook (*a*) projects below, fitting into an opening between the bearing surface of the hoof and the shoe. The second method is by means of an angled strip of brass, affixed by two screws to the lower outer surface of the wall, which has been excavated for it (fig. 231). The ordinary weighted shoes are made broader opposite the point where the extra weight is required (figs. 232 and 233). Such weights play an important part in training trotters. Their use depends on the experience that many animals, even with good action, go better in front with a moderately weighty shoe. American trainers consider that the toe-weight prevents the animal wasting its

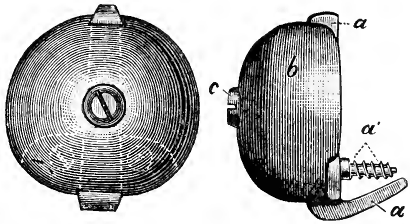


FIG. 231.—Weights seen from front and side. *a*, iron carrier fastened by means of screw *a'* to the lower border of wall; *b*, weight; *c*, binding screw.

strength in upward action, thus driving the toe deeply into the ground, and leads to the limb being further advanced. The improvement is stated to be from two to five seconds per English mile. Such weights are, however, still more useful

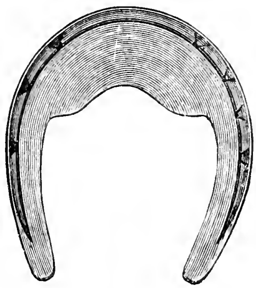

FIG. 232.—American toe-weighted shoe.

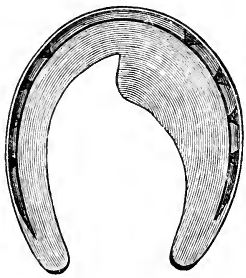

FIG. 233.—American quarter-weighted shoe.

for horses with defective action; animals, for example, which go too close behind usually improve in a surprisingly short time when provided with weights on the outer surface of the hoof.

# TROTTERS.

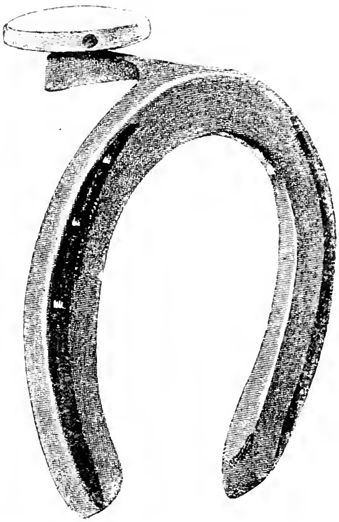

Fig. 234.—Partially fullered fore shoe (for trotters). Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

*To face p.* 235.]

## PARTIALLY FULLERED FORE SHOE (FOR TROTTERS) (FIG. 234).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

This shoe is another form of the trotting shoe before illustrated. It is said to cause the horse to increase the length of his stride; but owing to its not being used in this country, the authors are unable to offer any opinion as to its efficacy.

The piece of iron welded to the toe in place of a clip is tapped with a thread; the toe-weight is of bell-metal, and has a hole drilled through to allow the insertion of an iron rod for screwing the weight home.

## 5. CARRIAGE HORSES.

The carriage horse, being heavier, having larger feet and wearing harder than the saddle horse, requires a stouter shoe and more cover, especially at the toe of the hind-foot. For front feet a very common form of shoe is that shown in fig. 235. The fuller is deep and extends from heel to heel; there are from five to seven nail holes, depending on the size of

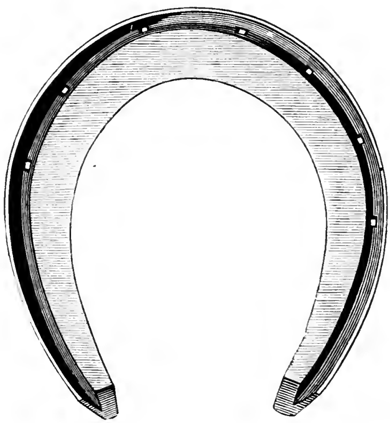

FIG. 235.—Fullered front shoe for carriage horse. Ground surface.

the shoe, the last of which should not be placed behind the centre of the outer quarter; at the toe the cover is ample and diminishes progressively towards the heels, which should bevel off from above downwards and forwards and should not extend more than $\frac{1}{4}$ to $\frac{3}{8}$ inches beyond the wall of the heel. The clip is at the centre of the toe; occasionally it is omitted.

The foot surface presents a horizontal margin of sufficient width to cover the wall and a narrow rim of the sole; the seating is wide at the toe and diminishes in width as it approaches the heels, $\frac{3}{4}$ to 1 inch in front of which it terminates.

Machine-made shoes of the Rodway pattern (fig. 240) are largely employed for carriage horses, for which they are very suitable. While giving sufficient cover and an excellent foothold, they are comparatively light, and, as now made, durable enough for most purposes. In Scotland, a similar shoe is still made by hand, the double fullering being produced with a special crease. In England, the machine-made Rodway shoe has almost entirely superseded the hand-made.

Concave shoes are useful for horses which forge, and can also be applied to animals having strong feet and well-arched soles which are required to present a specially smart appearance. In the hand-made pattern the dishing of the ground surface occasionally ceases an inch or less in front of the heel, but the

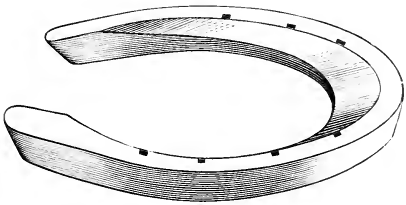

FIG. 236.—Fullered front shoe for carriage horse. Foot surface.

machine-made shoe, being fashioned from rolled bar, is necessarily dished throughout. The foot surface is perfectly flat, *i.e.*, without seating, though it is well to slightly round the extreme inner edge next the sole.

'Tips' are referred to on page 256.

A number of useful machine-made carriage-horse shoes are now on the market. For the smaller class of animals with strong feet and well-developed soles, the light shoe of Charlier steel is useful, as it allows the frog to come to the ground and ensures a good foothold. It is also of value in preventing cutting, too frequently a consequence of heavy or ill-fitting shoes which tire the animal. The application of this shoe is nevertheless restricted; its narrowness concentrates almost all the weight on the wall, into which it sinks, while it affords no protection to the heels. Further, its lightness is opposed to durability and unfits it for really hard-worked horses.

The Rodway shoe has already been mentioned. Shoes made of corrugated or pattern iron give an excellent foothold, but can only be used on strong feet, as the position of the nail holes cannot be so carefully selected as in other shoes and fitting is more difficult. Such shoes are also more liable to break than those of ordinary pattern, and have never come into very extended use.

The machine-made fullered fore shoe presents no essential difference from the hand-made shoe above described. The manufacturers now supply hand-made shoes of this pattern which have the advantage of lasting somewhat longer, and of permitting a clip to be drawn with greater ease, than the machine-made article. They also make similar shoes with

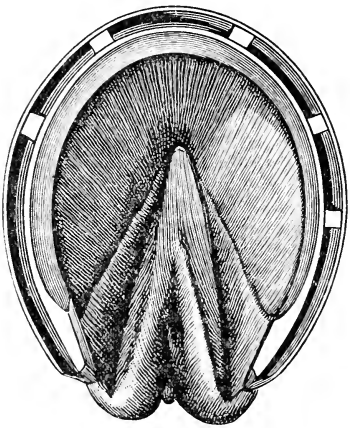

FIG. 237.—Concave fore shoe for carriage horse. Ground surface. (The bars appear somewhat too prominent owing to the preparation of the foot.)

inside feather-edge for horses which cut and brush. These will be more particularly referred to under the head of 'Cutting and Brushing.'

Unlike those of the hack, the carriage horse's hind shoes are generally provided with calkins of equal height, the inner being somewhat less wide and rounded on the margin facing the opposite hoof. Sometimes the inner calkin is replaced by a wedge or knocked-up heel, though this is undesirable unless the animal goes very close or rests one hind-foot on the coronet of the other in the stable. Two calkins give a much better foothold. The shoe most commonly used has a calkin outside and wedge heel inside.

For carriage horses with good action the ordinary shoe has two calkins of equal height, the inner slightly smaller than the outer, seven nail holes, which extend back considerably beyond the centre of the quarter and are sunk in a deep fuller, and a broad, solid, and therefore durable toe. The cover is approximately equal throughout. The inner heel is well rounded off. There is usually a clip at the toe. This has the advantage over clips on either side of the toe of allowing the inner branch of the shoe to be fitted very close, and of still further avoiding the risk of cutting. As the pace is much slower than that of the hunter, there is less danger of overreach, and rounding the toe, giving two side toe-clips, and setting back the shoe are unnecessary. To give additional security, an outside quarter-clip may be added.

The foot surface is perfectly flat and broadest at the toe, becoming gradually narrower as it approaches the heels. The inner branch of the shoe is slightly narrower than the outer.

Wedge heels are used to increase wear and diminish the danger of 'treading' the coronet when the horse is in the stable. There is little real difference between the shoe with two wedge heels and that with an inner wedge heel and an outer calkin, though, as the calkin gives a somewhat better foothold than the wedge heel, the latter shoe is preferred by many.

With the object of preventing injury, many horses are shod with a 'feather-edge' inside. The shoe is then nailed around the outside and at the toe, and may carry a toe and outside quarter-clip. The 'feather-edge' should be of the same height as the outer calkin and be bevelled away from above downwards and well rounded off. This kind of shoe is always 'set under' a trifle and the horn of the quarter and inside of toe rasped away so as to leave no sharp edge capable of inflicting injury. As the nails are disadvantageously placed, the plain stamped shoe (which gives more support to the individual nails and can be more easily, and more perfectly, fitted) is to be preferred to the fullered shoe. The feather-edged stamped shoe has one great mechanical disadvantage: the inner border forming a plane, polished surface gives practically no grip on the ground, the calkin then forms the only *holding* portion of the shoe and there is a constant tendency for the foot to rotate round this as around a fixed point. Although competent authorities deny that any evil results in practice, it seems to us that the use of such shoes, at least on wood and asphalt pavements, must expose the limb to severe and unnecessary strains.

It has been found that many horses, which 'cut' when shod with any form of preventing shoe, go perfectly well with a flat shoe, of which the inside branch is bevelled from above downwards. A well-developed frog is almost indispensable, however, when this shoe is used, in order to secure foothold, though the difficulty may be partly overcome by the employment of india-rubber pads.

It is scarcely needful to say that, for horses which cut, the use of hind shoes with a calkin and a flat heel lower than the calkin, though common, throws a great strain on the articulations, and should only be resorted to when all other methods have failed.

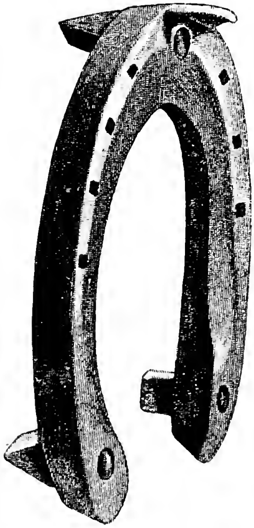

FIG. 238.—Fullered fore shoe (seated and tapped for screws). Made from 1 × ½ inch iron.

FIG. 239.—Ground surface of above shoe.

*To face p.* 241.]

## *SPECIAL SHOES FOR CARRIAGE HORSES.*

### FULLERED FORE SHOE, SEATED AND TAPPED FOR SCREWS (FIGS. 238, 239).

*Made from* 1 × $\frac{1}{2}$ *inch iron.*

Shoes when tapped and screwed have a wide range of usefulness. Though primarily intended to check slipping on frozen streets, screwed shoes are now frequently used all the year round in London, sometimes in conjunction with india-rubber pads, for the purpose of assuring a firm foothold on asphalt, wood, etc. Even show horses are sometimes shod with them if the showyards have become hard from prolonged drought. The screw at toe of shoe is useful in hilly country.

The fullering of the shoe should not extend round the toe nor right up to the heels; half-an-inch being left solid in which to punch the screw hole prior to tapping.

The spikes or blanks can be removed when the horse is resting, corks being inserted in the screw holes to exclude grit. As the edge of the holes becomes 'burred over,' however, even with this precaution, a plug-tap is needed to clear them before reinserting the screws. A common plan is to use very low blanks when the horse is not at work. This preserves the screw holes. To prevent one foot injuring the coronet, etc., of the opposite foot when the horse is turning, the inner heels are often provided with blanks, the sharps being reserved for the outer heels.

## 'RODWAY' FORE SHOE (Fig. 240).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch rolled 'pattern' iron.*

This shoe is made from 'Rodway' iron by hand. It is very largely used in London to minimise slipping on bad roads, for which purpose its use may be conjoined with that of india-rubber pads or screws. In the country it is scarcely durable enough, and its continued use on any but the strongest feet is apt to be followed by injury, in consequence of the need for frequent renewal.

It has many important advantages for town work: it affords a fair amount of cover; its thinness allows of the frog coming to the ground; its lightness lessens the chance of the horse cutting or striking, while its double grooves give an excellent grip of the ground. In light work it wears from three to four weeks, a sufficient time to permit the necessary growth of the hoof. Some care is required in heating and turning the special iron, to prevent the regularity of the grooves being destroyed, especially at the toe. The iron should only be red hot, and should be 'pulled' round on the beak iron rather than hammered.

## THIN HEELED FULLERED SEATED FORE SHOE (Fig. 241).

*Made from $1 \times \frac{5}{8}$ inch iron.*

This shoe is suitable for animals with thrush, weak or wiry heels, bent knees, navicular disease, and in some cases for 'corn' and separation at the heels. It may also be used for upright boxy feet, with a tendency to contraction; but in this case the heels of the foot must be well lowered before applying the shoe.

In some cases it is an advantage to 'cradle' the shoe, *i.e.*, to thin both toe and heels, leaving the quarters of the full thickness of iron, and thus giving a rocking motion to the foot during progression.

FIG. 240.—'Rodway' fore shoe. Made from $\frac{7}{8} \times \frac{1}{2}$ inch rolled "pattern" iron.

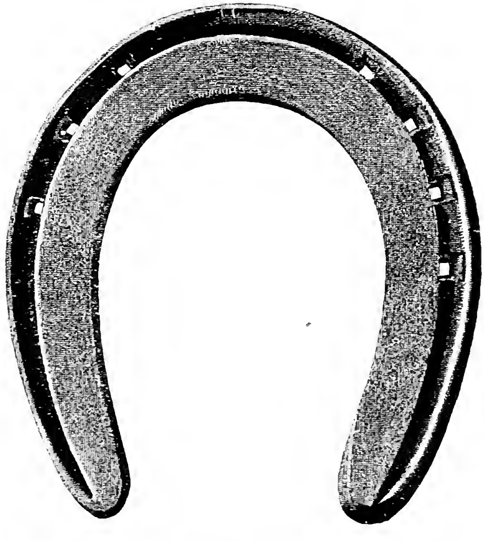

FIG. 241.—Thin heeled fullered seated fore shoe. Made from $1 \times \frac{5}{8}$ inch iron.

[To face p. 242.

CARRIAGE HORSES.

Fig. 242.—Fullered fore shoe (dished on ground surface). Made from $1 \times \frac{1}{2}$ inch iron.

*To face p.* 243.]

## FULLERED FORE SHOE (DISHED ON GROUND SURFACE) (FIG. 242).

*Made from* 1 × ½ *inch iron.*

Young horses, when first broken to harness, are apt to forge. For such as contract this habit, but have weak, spreading feet, to which narrow-webbed shoes would be inapplicable, the present shoe is indicated. It is also useful for hunters exercised on roads, and for riding and driving horses. Its 'cover' and flat foot surface cause the pressure due to the animal's body-weight to be distributed over a wide surface of the foot, extending, in fact, towards the centre of the foot beyond the white line.

Should the foot be very 'fleshy' and the sole thin, the inside edge of the foot surface of shoe may require to be slightly rounded off or 'eased,' to prevent undue pressure at this point. Where the shoe is used for hunters, the heels must be sloped away obliquely, and the shoe fitted close at the heels to prevent its being trodden off.

## 6. OMNIBUS HORSES.

Until very recently most omnibus horses were shod in front with a plain stamped shoe, of equal thickness throughout, but broader at the toe and outer quarter, where the chief wear falls, than at other points. To avoid unduly loading the toe, the increased breadth is chiefly secured by increased seating out. The ordinary shoe has seven nail holes, four outside and three inside; the last outside nail hole is placed at about the centre of the quarter. We believe that of late years the London General Omnibus Company has adopted a machine-made fullered front shoe, which has been found easy to fit and apply, and the use of which is steadily extending. Machine-made shoes are less durable than hand-made, however, and most private shoeing firms continue the use of hand-made stamped shoes for 'bus horses, especially for hard wear.

The hind shoe is of good breadth and thickness at the toe and outer quarter where wear is usually severe. To secure durability, many hind shoes are made from 'old stuff,' one and a half or two shoes producing a new shoe, or a piece of steel is welded into the toe. The inner branch of the shoe is slightly narrower than the outer, and usually terminates in a wedge heel to lessen the danger of 'treading' the opposite coronet. For horses that cut, the inner branch of the shoe bears one or two nail holes close to the toe-clip, is fashioned rather straight from the back of the toe as far as the last part of the quarter, and fitted very fine.

The horses of the Compagnie Générale des Omnibus de Paris are shod with steel shoes of a much lighter pattern than is usual in England. Both fore and hind shoes are thick at the toe and become thinner towards the heels. Each has six nail holes distributed at equal distances around the toe and is available for either a right or left foot. The system is said to work very satisfactorily, but we cannot help thinking trouble must arise in the shoeing of diseased or weak feet.

FIG. 243.—Stamped hind shoe (for omnibus work), with two calkins. Made from old shoes.

FIG. 244.—Stamped hind shoe (for omnibus work), with calkin and wedge heel. Made from old shoes.

*To face p.* 245.]

## *SPECIAL SHOES FOR OMNIBUS WORK.*

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### STAMPED HIND SHOE (FOR OMNIBUS WORK), WITH TWO CALKINS (FIG. 243).

*Made from old shoes.*

The toe being the seat of greatest wear in by far the majority of cases, this omnibus hind shoe should have a thickness at that point of $\frac{5}{8}$ inch. To give the necessary durability in cases where wear is exceptionally severe (in 'toe-biters,' as the working farrier terms them), a piece of steel may be welded into the toe. When the horse drags the toe, a short, thick toe-clip is drawn, in which the steel is worked round. This protects the point of greatest wear.

Clips can be drawn at the toe, the toe and outside quarter, or at the outside and inside quarters: the latter arrangement is of service when it is difficult to keep shoes on.

The shoe shown is for feet varying from $5\frac{1}{4}$ to $6\frac{1}{4}$ inches in width.

Since the wide adoption of foot brakes on omnibuses, many horses in this service are shod with flat shoes behind. Many persons still prefer calkins, however, as giving horses a better foothold when descending hills and turning corners.

### STAMPED HIND SHOE (FOR OMNIBUS WORK), WITH CALKIN AND WEDGE HEEL (FIG. 244).

*Made from old shoes.*

This shoe only differs from the preceding in having a wedge heel inside in place of a calkin. The wedge heel is greatly to be preferred when a horse is in the habit of resting the heel of the hind shoe on the coronet of the opposite foot while in the stable, or when an animal, in consequence of skin irritation, scratches its hind-legs with the heels of the shoes. In such cases the wedge heel can be cut off obliquely, leaving a sloping surface, much less likely to inflict dangerous wounds than is the square-sided calkin.

The size and thickness of the shoe are similar to those of that preceding.

## STAMPED FORE SHOE FOR OMNIBUS WORK (Fig. 245).

*Made from* $1 \times \frac{5}{8}$ *inch iron.*

This is the shoe commonly used in London for omnibus work, though machine-made fullered shoes are also largely employed. It should be fitted quite full at the quarters, and well 'boxed up' to the foot, *i.e.*, the upper outer edge should be rasped round so as to present a slanting surface about $\frac{1}{16}$ inch in breadth extending round the outer and upper margin of the shoe. This minimises risk of the shoe being torn off. The heels should be fitted fairly long, care being taken, however, that they are not so prolonged as to endanger the shoe being trodden off.

The foot surface of this shoe is seated.

## OMNIBUS HORSES.

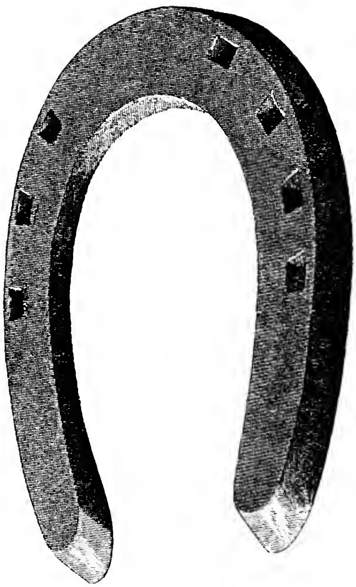


FIG. 245.—Stamped fore shoe (for omnibus work). Made from 1 × ⅝ inch iron.

[To face p. 246.

## 7. CART HORSES.

Owing to the position assumed in hauling heavy weights, the cart horse wears most heavily at the toe and outer quarter. These points must, therefore, be strengthened to the utmost without unduly increasing weight, whilst the less worn parts must be of a strength corresponding to the degree of attrition. A careful examination of the old shoe will soon show what parts require to be strengthened.

The front shoe is generally of equal thickness throughout. The cover is greatest at the toe and diminishes towards the heels. There are seven to eight nail holes, those on the outer rather more widely spaced than those on the inner side. To increase the solidity and wear of the shoe nail holes are sometimes omitted from the parts where friction is greatest. The toe-clip is, if anything, somewhat towards the outer side of the toe.

The hoof surface presents a plain rim sufficiently wide to cover the wall and about $\frac{1}{4}$ of an inch of the outer margin of the sole. The seating terminates 1 to $1\frac{1}{2}$ inches from the heel, which is well rounded and which should project $\frac{1}{2}$ to $\frac{3}{4}$ of an inch beyond that of the foot when the shoe is affixed. Although in London the front shoe is usually flat it is customary in many parts of the country, especially in Newcastle, Liverpool, and Scotland, and on the continent, to raise the heels by the use of low calkins or, short of this, to considerably increase the thickness of the heel itself. This will be referred to in the succeeding pages.

The hind shoe is thickest and broadest at the toe; the inner branch is narrower than the outer, is fitted close to the foot, and the inside nail holes extend back to a less distance than the outer; there are two calkins of equal height, the inner somewhat narrower than the outer, and two clips, one at the toe and one at the outer quarter. The calkins should not much exceed in height double the thickness of the shoe at the quarter. Horses which 'tread' the opposite coronet may be shod with an inside wedge heel. Calkins favour the muscular action of the limb and greatly assist the animal in descending hills. To help the animal in starting, Pader suggested placing the calkins much further forward than usual. The upper surface of the shoe is perfectly flat and only the inner margin is slightly rounded off. Cart horses seldom overreach or cut in their ordinary work, so that no special precautions are needed on this account.

The Scotch cart-horse shoe is usually straighter in the branches than the English shoe, the calkins are broader from side to side but not so long, and the quarters are fullered.

*Shunting horses*, employed for moving railway trucks, should be shod very close and short and the heels of their shoes bevelled to prevent the shoes becoming fixed in points or sleepers; calkins are absolutely contra-indicated.

*Pit ponies* require similar precautions.

CART HORSES.

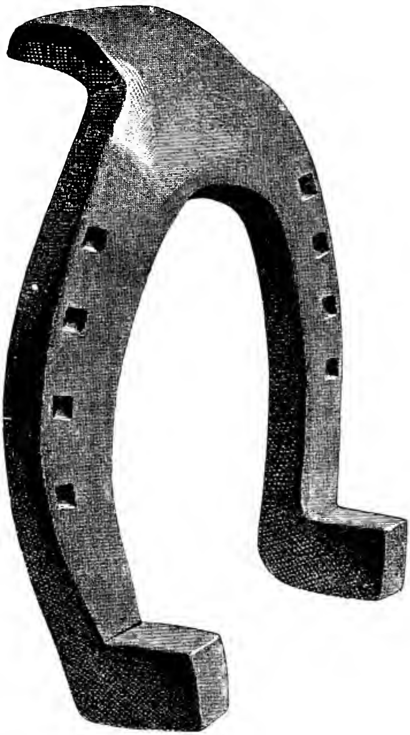


FIG. 246.—Cart horse hind shoe for town work. Made from old shoes.

*To face p.* 249.]

## *SPECIAL SHOES FOR CART HORSES.*

### CART HORSE HIND SHOE FOR TOWN WORK (FIG. 246).

*Made from old shoes.*

Being made from 'old stuff' this shoe is more durable than if made from new iron. It has a thickness at the toe of $\frac{5}{8}$ inch. The clip is drawn at the toe, or at toe and outside quarter. The calkins should be square, short and strong, not higher in fact than is necessary to ensure a secure foothold. Calkins are of considerable importance to the town cart horse, because, as a rule, the strain of checking the load on inclines falls entirely on the horse, foot-brakes being fitted only to certain of the four-wheeled vehicles and to few of the two-wheeled. Furthermore, they are almost indispensable to the animal in backing a load.

The shoe illustrated is for feet of 6 to 7 inches in width.

Though less durable, cart horse hind shoes can be made from new iron. A useful size is $1\frac{1}{4} \times \frac{5}{8}$ inches.

Front shoes made from $1\frac{1}{2} \times \frac{5}{8}$ inch iron should be fitted rather long, very full at heels and well 'boxed up.' They usually require an outside quarter clip to prevent their being driven across the foot.

## CART HORSE STAMPED FORE SHOE FOR SHOW PURPOSES (Fig. 247).

*Made from* $1\frac{1}{2} \times \frac{3}{4}$ *inch iron.*

To give an appearance of strength to defective, weak, or shelly feet, and to improve the appearance of fairly good feet, the shoe is made 'boxed up' (as it is termed) 'the wrong way on.' In less technical language, the outer wall of the shoe is given such a bevel that when the shoe is nailed on it appears as a continuation of the wall of the foot; *or*, the circumference of the shoe is greater at the ground than at the foot surface. This makes the foot, when lifted for inspection, appear wider.

This shoe is unsuited for ordinary work on account of its favouring cutting, especially when somewhat worn; the inner ground edge then 'burrs over,' forming a sharp saw-like margin, and may inflict ugly wounds on the opposite coronet or fetlock.

Owing to its shape, the nail holes must be so stamped as to appear very 'coarse' when viewed from the ground surface. *Vide* illustration.

## CART HORSE STAMPED HIND SHOE FOR SHOW PURPOSES (Fig. 248).

*Made from* $1\frac{1}{2} \times \frac{3}{4}$ *inch iron.*

This shoe is made and used in precisely the same way and for the same purpose as the foregoing. The heels may be level, as shown, or wedged, according to whether it is desired to give a natural bearing or to raise the heels.

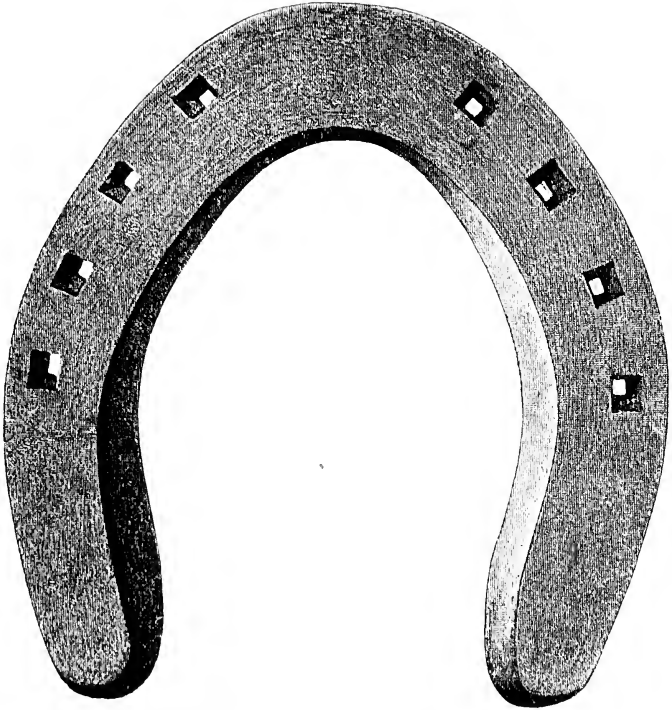


Fig. 218.—Cart horse stamped hind shoe (for show purposes). Made from $1\frac{1}{2} \times \frac{3}{4}$ inch iron.

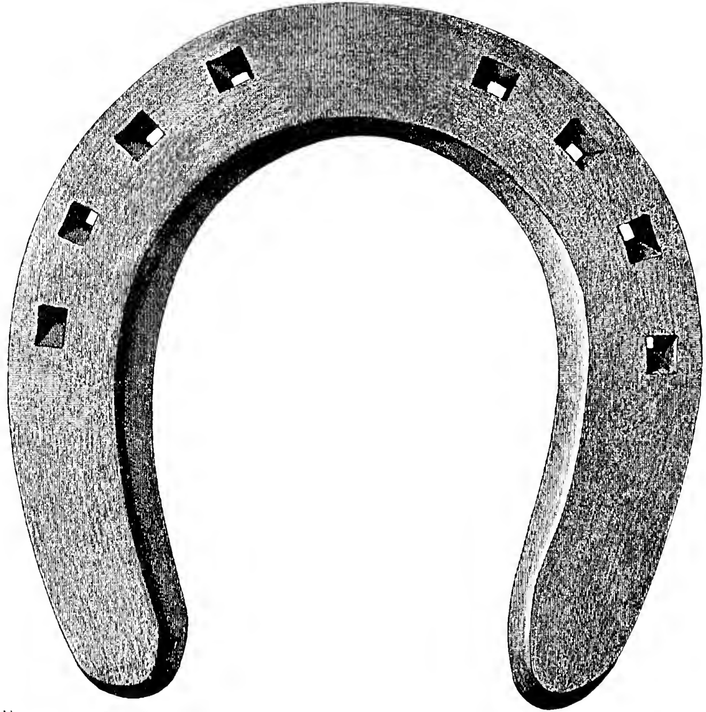


Fig. 217.—Cart horse stamped fore shoe (for show purposes). Made from $1\frac{1}{2} \times \frac{3}{4}$ inch iron.

[To face p. 250.

*To face p.* 251.]

FIG. 250.—'North Country' stamped hind shoe. Made from $1\frac{1}{2} \times \frac{1}{2}$ inch iron.

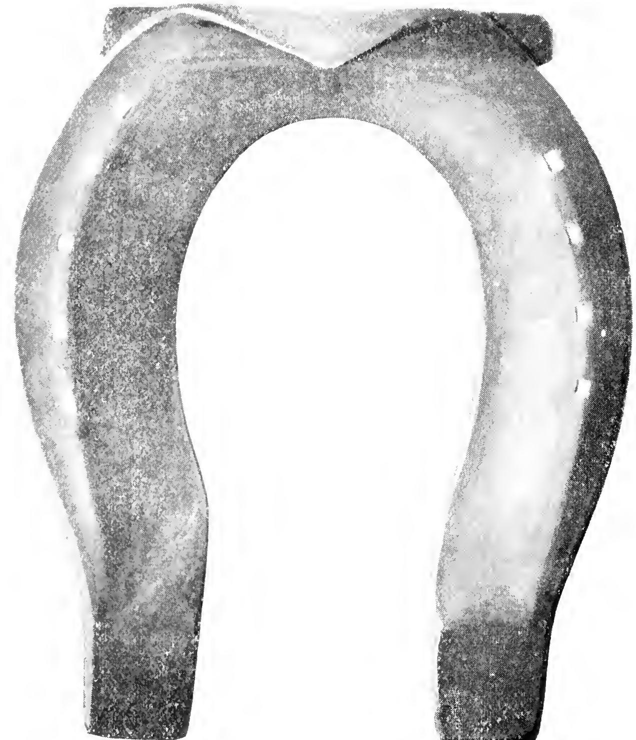


FIG. 249.—'North Country' stamped fore shoe. Made from $1\frac{1}{2} \times \frac{1}{2}$ inch iron.

## 'NORTH COUNTRY' STAMPED FORE SHOE (FIG. 249).

*Made from* $1\frac{1}{2} \times \frac{1}{2}$ *inch iron.*

This shoe has strong low calkins and a long toe-piece welded or 'shut-on' across the toe; the toe-piece extends about $\frac{3}{8}$ inch on either side of the toe. It is used throughout the North: in fact, wherever steep inclines paved with granite 'setts' are to be found. The toe-piece drops into the interval between two rows of stones and gives a firm foothold for starting a load, while the calkins enable the horse to hold back his load in coming down hill and assist him greatly when backing. The toe-piece and calkins being of equal height do not disturb the natural level of the foot, though they necessarily lift the frog from the ground.

The shoe (*vide* illustration) is well seated out to prevent pressure on a weak or 'dropped' sole.

## 'NORTH COUNTRY' STAMPED HIND SHOE (FIG. 250).

*Made from* $1\frac{1}{2} \times \frac{1}{2}$ *inch iron.*

This is the hind shoe corresponding to that just described and is similarly fitted. With regard to the toe-piece, a few words may be said as to the process of welding or 'shutting-on.' The shoe must be finished and the clip drawn preparatory to welding. A light rod of iron having been selected, the end is drawn down so as to form the intended toe-piece and the part half cut through but not detached, as the bar is intended to form a handle for manipulating the toe-piece. The toe-piece and shoe are then heated together to a white (welding) heat, care being taken to keep both free from dirt and not to melt the clip from off the shoe; (this may easily happen if the clip is allowed to come in the direct line of the blast). The toe-piece and bar should be so hot as to 'sizzle' when withdrawn from the fire. The toe-piece is adjusted in position on the shoe, and with one or two light blows is welded. Some farriers stamp a hole in the shoe and draw out a tang on the toe-piece with which to fasten the two together before heating. The first described is, however, the most workman-like method.

## STAMPED FORE SHOE FOR FARM WORK (Fig. 251).

*Made from $1\frac{1}{4}$ or $1\frac{1}{2} \times \frac{1}{2}$ inch iron.*

As the amount of wear at farm work is comparatively light, the above section of iron is found quite sufficient for horses with feet up to 7 inches in width. The shoe is slightly seated and has 8 nail holes, and is fitted rather full at the heels. The heels of the shoe, however, must be kept shorter than is usual for town work, as there is a greater chance of the shoe being torn or trodden off in heavy ground. Marked seating-out is also to be avoided, as it increases the suction experienced under similar circumstances. A toe-clip is usually sufficient except when the outside heel is very wiry, in which case three nail holes fairly close together should be punched at the outside toe and a quarter clip drawn just behind the last. The shoe should be fitted wider than usual at the outside heel. In exceptional cases it may even be necessary to punch 5 nail holes inside.

## STAMPED HIND SHOE FOR FARM WORK (Fig. 252).

*Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.*

On account of its having no calkins, this shoe is often termed the 'farmer's flat.' The absence of calkins is in every way an advantage, because farm horses seldom have loads to back, and when they are turned out to grass together there is less chance of their injuring one another by kicking. The thinness of the shoe allows of its being bent cold, a point of considerable importance when it is remembered that farm horses are often shod at the stable.

To lessen the chance of nails breaking in animals which stamp or kick in the stable, an outside quarter clip or even outside and inside quarter clips may be fitted.

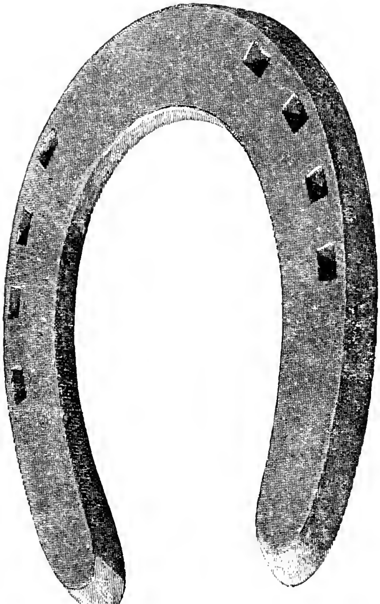


FIG. 251.—Stamped fore shoe (for farm work). Made from $1\frac{1}{4}$ or $1\frac{1}{2} \times \frac{1}{2}$ inch iron.

FIG. 252.—Stamped hind shoe (for farm work). Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.

[*To face p.* 252.

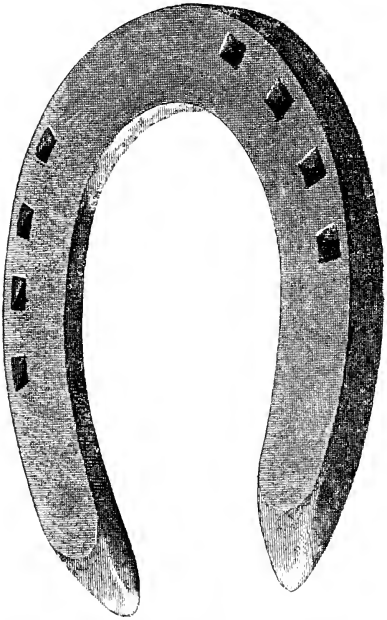


FIG. 253.—Stamped fore shoe (for railway shunting horses). Made from $1\frac{1}{2} \times \frac{5}{8}$ inch iron.

FIG. 254.—Stamped hind shoe (for railway shunting horses). Made from $1\frac{1}{2} \times \frac{5}{8}$ inch iron.

*To face p. 253.*]

## STAMPED FORE SHOE FOR RAILWAY SHUNTING HORSES (Fig. 253).

*Made from* $1\frac{1}{2} \times \frac{5}{8}$ *inch iron.*

There being a great risk of shunting horses' shoes catching in sleepers, rails, 'points,' etc., or of their being torn off by the hind-feet, special precautions are required in making and fitting them. The heels must be fitted very closely to those of the foot and be sloped off very obliquely on the ground surface. With a special view to prevent the heels of the shoe catching in 'points,' it might be of advantage to form the quarters and heels slightly concave. Shunting horses being much exposed to the risk of 'picking-up' nails whilst working in railway yards, it is generally advisable to shoe them with leather soles as a protection.

The shoe shown is suitable for foot 6 to 7 inches wide.

## STAMPED HIND SHOE FOR RAILWAY SHUNTING (Fig. 254).

*Made from* $1\frac{1}{2} \times \frac{5}{8}$ *inch iron.*

For reasons stated above, calkins or wedge heels are inadmissible on the hind shoes of shunting horses. The heels of the shoe are rounded and sloped off obliquely on the ground surface and are fitted very short, closely following the contour of the foot.

The above shoe is suitable for feet 6 to 7 inches wide.

The following systems of shoeing exhibit special features, which lead us to consider them separately:—

## 8. THE CHARLIER SHOE.

In or about 1854 Messrs Mavor of London and Duluc of Bordeaux suggested the use of comparatively narrow, thick shoes to prevent slipping on greasy pavements. Mavor directed his shoe, which was without fullering, to be fitted warm and in such a way as to be slightly incrusted in the foot.

In 1865 Charlier introduced a system, in which a narrow, deep band of iron, without fullering, was sunk in a groove encircling the entire ground surface of the hoof. To secure frog and sole pressure the ground surface of the shoe when applied was on a level with that of the foot. Charlier claimed to afford the necessary protection to the wall without in any way diminishing the natural elasticity of the foot or impeding its expansion.

The Charlier shoe corresponds exactly in shape to the form of the hoof, is deeper than broad, of equal thickness throughout or slightly less broad in the inner branch.

The hoof surface is a trifle narrower than the ground surface; the upper and inner margin is rounded off. There are from six to eight oval nail holes punched obliquely so as to obtain the best (possible) hold of the wall. The heels are rounded, of the same length as those of the hoof and inclined to correspond with the direction of the wall.

In preparing the foot, the special guarded knife shown in fig. 257 is used to form the groove in which the shoe is lodged. The sole and frog remain untouched save when partially loose fragments require removal.

As stated, Charlier claimed by this method of shoeing to permit expansion of the foot, to restore diseased feet to their normal shape, to favour development of the frog, and to prevent or cure contraction of the heels, sandcrack, corns, etc.

These claims have in large measure been rejected, and, in point of fact, the Charlier system of shoeing has of late years largely gone out of fashion in England. There are several reasons for this. The deep groove cut to accommodate the shoe weakens the union between sole and wall and, except in specially strong feet, approaches dangerously near sensitive structures. In this connection it must not be forgotten that horn, even in thick layers, is a yielding substance (so that the untouched wall will gradually be affected by constantly maintained pressure), and that, though a considerable thickness of sound horn separates the shoe from the nearest vascular structure, evil results may follow, though tardily.

The inventor recognised this and advised that the groove be not sunk beyond the point to which the sole would be pared in ordinary shoeing. Unfortunately, with so shallow a groove the frog no longer comes to the ground, because, on account of its want of cover, the shoe has to be very much thicker than the ordinary form. And this raising of the whole foot is ill-compensated by the increased thickness of the sole, etc., especially when compared with modern shoeing, in which the sole is spared and therefore retains all its strength.

Again, if the heels of the shoe be sunk deeper into the hoof in order to preserve frog pressure, an increased load is thrown on the tendons, with undesirable results.

In frosty weather the horse shod with Charlier shoes slips badly; not so badly, perhaps, as the horse with ordinary shoes, but infinitely more than one with cogs or screws or even rough heels. And the Charlier system admits of no effective roughing, so on this score it certainly has no advantage.

When first introduced a great deal was said of the lightness of the Charlier shoe. Now, though very narrow, this shoe is necessarily made very deep, and therefore heavy, not only to resist wear but to prevent it opening under the weight of the body, because, weight for weight, a broad thin shoe offers infinitely greater resistance to this spreading movement than a narrow deep shoe. The increase in depth is so considerable that for small feet the Charlier shoe has little advantage over the ordinary form. In large feet, on the other hand, it has a marked advantage.

As the shoe surrounds the foot like a ring, one of two things must occur when the animal is in fast work: either the shoe must totally prevent expansion of the heels, or the force of expansion must be so great as to drive the heels of the shoe asunder. We believe it is the pain caused by this constant effort of the foot to expand, and the equally constant constriction by the shoe, which is largely responsible for the low, shooting action which horses thus shod soon acquire. Pain is greatest when expansion is greatest. Expansion is greatest when pressure on the posterior parts of the foot is greatest; pressure on these parts is greatest when the foot descends most nearly perpendicularly to the ground, hence the animal avoids raising the foot high and brings it to the ground as obliquely as possible.

Preparing the foot, fitting and nailing on are delicate operations; the shoe is ill-adapted for defective or diseased feet, wear is comparatively rapid; when partly worn, the shoe is liable to spread, and, owing to complications, the system is more costly than ordinary shoeing.

We do not deny that the Charlier system, when introduced, had many good points; it taught the farrier to spare the sole and bars, it drew attention to the need of frog pressure, and it showed the advantages of light as opposed to heavy shoes. At the present day it is still useful as a front shoe for ponies and hunters with small narrow feet, for animals which slip on smooth pavements, and for those with commencing contraction of the foot; but to the reputation of a panacea, formerly awarded it, the Charlier system has forfeited all claim.

## 9. TIPS.

The tip covers the toe and a portion of the quarters and only protects the anterior half of the hoof against wear. There are two kinds; firstly, the ordinary tip, and secondly, the modified or Charlier tip.

The advantages of this method of shoeing consist in the light weight of the shoe, which in the case of ordinary tips is about five to seven ounces and in Charlier four to seven ounces; but principally in the fact that the posterior half of the hoof comes directly in contact with the ground, giving more frog-pressure, diminishing slipping, moderating the shock to the limb, and favouring circulation in the hoof, thus producing a more rapid growth of horn and increasing the strength of the foot, while allowing of the freest possible expansion and contraction. Tips are very useful for hunters 'turned up rough.' Nevertheless, they have certain disadvantages. Thus they are not sufficiently durable and do not protect the hoof enough for hard work. They last, as a rule, from ten to twenty days, but this is scarcely enough to permit sufficient growth. They are most useful for young horses in light work in which the foot, when viewed from in front, is of normal shape, and when viewed from the side does not appear oblique. They are more useful for front than for hind feet, though an exception may be made when the hoof, faultless in form, is provided with a strong wall and the horn is of good quality.

(1) The ordinary tip has a breadth at the toe of from $\frac{5}{16}$ to $\frac{3}{4}$ inch, and a thickness of $\frac{3}{8}$ inch. Towards the extremities, the inner angles of which should be rounded off, it becomes thinner. The extent to which the thickness should be diminished posteriorly depends on the strength of the horn in the foot in question. In weak hoofs the ends of the tip should be thin and fitted full, though even then the correct relation

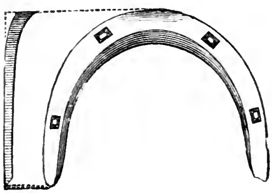


FIG. 255.—Ordinary tip.

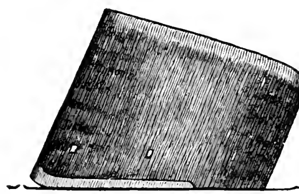


FIG. 256.—Upright hoof shod with a tip.

between the position of the hoof and that of the fetlock cannot always be attained. In strong feet, on the other hand, it is sufficient if the extremities are left $\frac{1}{4}$ to $\frac{5}{16}$ inch in thickness. The ground surface of the tip requires no fuller and can be dished out. As a rule four or five nail holes are sufficient.

This method of shoeing is most easily carried out when the feet are strong. The bearing surface of the wall is only lowered in the usual way at the points to be covered by the tip, that is, the toe and part of the quarters. The ground surface of the finished tip, which is to some extent embedded in the anterior half of the hoof, must lie in the same plane as the ground surface of the heels. Where the horn is very strong and the anterior half of the hoof requires to be much lowered, the remaining horn in the posterior half may project below the shoe. In such case it should be reduced to a level with the shoe by the aid of the rasp.

When shoeing weak feet the first and chief consideration is the form of the foot as seen from the side. As the tip is not then embedded, it is apt to raise the toe and by throwing the

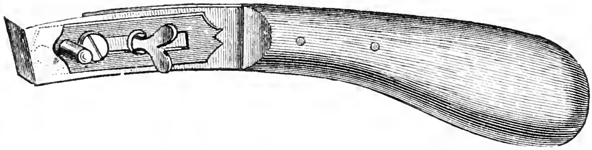


FIG. 257.—Special knife with stop used in preparing the groove for Charlier tips.

hoof out of line with the axis of the foot to injure the animal's action. The horse is liable to stumble and fall or to go lame, especially when ridden on hard ground. To meet peculiarities in the formation of the limb, the form of the hoof, the style of the tread and wear, the tip may, in exceptional cases, require to be modified, one branch to be longer than the other, or both branches to be lengthened.

An offspring of the Charlier shoe, and one which preserves many of its best features, is :—

(2) *The Charlier tip*, which consists of a thin half shoe, not *exceeding in breadth that of the wall* into which it is sunk,

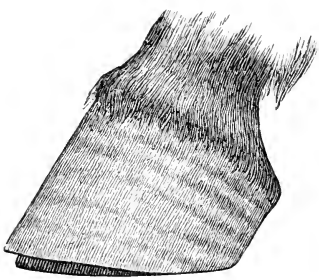


FIG. 258.—Hoof prepared for Charlier tip.

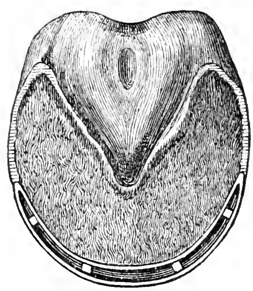


FIG. 259.—Hoof shod with Charlier tip.

usually fullered and exhibiting from four to five nail holes. The outer margin is either perpendicular or slightly sloped outwards and the inner upper margin well rounded off; the nail holes are punched as near the middle as possible and are 'pitched in,' otherwise they are apt to split the wall. The length varies somewhat, though perhaps the best results are obtained when the ends of the shoe do not extend further than the middle of the quarter; sometimes one branch extends to the heel, the other stopping short at the middle of the quarter (three-quarter tip). The groove for the tip is made by first rasping away the edge of the hoof and then using the special Charlier knife (fig. 257). It is very important to obtain accurate fitting.

Should a Charlier shoe or tip be lost, lameness readily follows from pressure on the sole, and unless the hoof be exceptionally strong it becomes very difficult to affix an ordinary shoe.

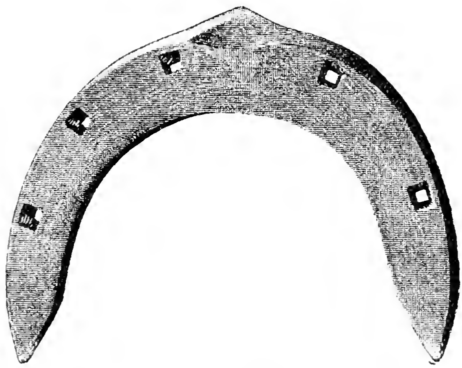


FIG. 260.—Stamped fore tip. Made from $\frac{3}{4} \times \frac{3}{8}$ inch iron.

The Charlier tip is most useful for upright 'blocky' feet with wired-in heels and atrophied frogs, in which its use is often followed by remarkable improvement in a comparatively short time. As in the case of the Charlier shoe its use demands much care, skill, and judgment.

Tips are of much value for horses turned out at grass, or doing light work. They permit the frog to come to the ground, promote greater physiological activity of the horn-secreting structures, thus increasing the growth of horn, produce a large healthy frog, often cure thrush, and when contraction of the foot is taking place are of great service. In the latter case, the heels should be well lowered before applying the tip. Tips, again, are useful for horses worked on asphalt and wood pavement, as they permit the frog to come to the ground and check slipping.

The quarters of the tip must be fitted 'full,' otherwise the foot is apt to suffer, the horn spreading over the tip and splitting off. The tip illustrated is broader than usual. It is intended for a rather weak, fleshy foot, with thin quarters.

## 10. SIR F. FITZWYGRAM'S SHOE.

The web of the shoe is not wider than the weight bearing surface and is of even width until it approaches the heel, where the inner margin exactly follows the course of the bars, on which it rests. The ground surface of the shoe is dished evenly from without inwards, corresponding in shape to the

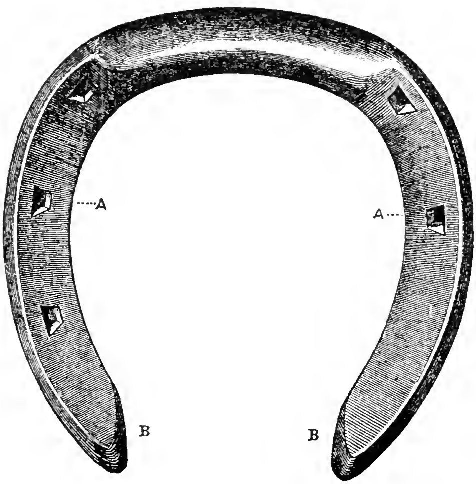



FIG. 261.—Sir F. Fitzwygram's shoe.

concavity of the sole. There are five nail holes, three outside and two inside. About half the width of the toe is thinned on the beak of the anvil and rolled upwards, forming a kind of broad clip extending almost from the beginning of the inside quarter to a corresponding point on the outside. In fitting, the toe of the foot is rounded to a similar extent.

The hoof surface of the shoe is perfectly flat.

This method of shoeing is not absolutely novel, for rounding of the toe has always been recognised as an advantage and forms part of both the German and French systems of shoeing. In the former it is termed 'Zehenrichtung,' and in the latter 'Ajusture.' It is only in the degree to which this rolling is carried and in the peculiar dishing of the ground surface of the shoe that the novelty of the above method consists

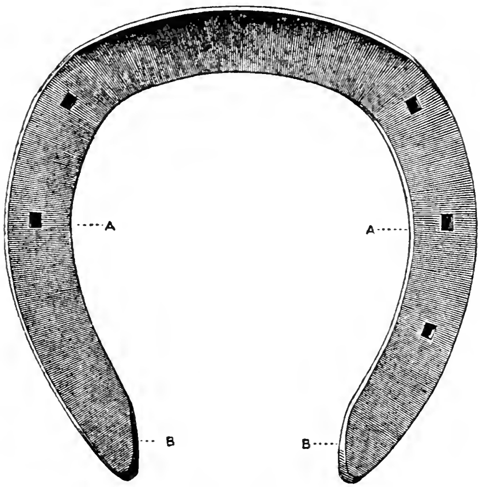


FIG. 262.—Sir F. Fitzwygram's shoe.

For strong, fairly healthy feet, for high blocky feet with a tendency to contraction, disease of the frog or corns, for navicular disease, and for hunters 'stale' in their action and liable to stumble, we regard the Fitzwygram shoe as excellent. It is somewhat difficult to make and fit, however, and does not suit horses with flat or 'dropped' soles or those with large spreading feet and thin defective crust.

## 11. THE TURKISH OR ORIENTAL SHOE

Is said to have been used by the Arabs since the year 622 A.D. It consists of a flat plate of iron, very broad at the toe and narrowing towards the heels (which are welded together) in such a way as to enclose a round or triangular space, through which access may be had to the frog. The shoe (fig. 263) with rounded aperture is common in Turkey, that with triangular aperture in Africa. The hoof surface is wider than the ground surface, so that the upper outer margin slightly overhangs the lower. There are six to eight round nail holes equally spaced in the quarters, but none at the toe. The shoe is fitted cold, the horn being allowed to project a trifle beyond the shoe at the quarters, and to a considerable extent at the toe; the heels of the shoe are bent upwards so as to protect the bulbs of the

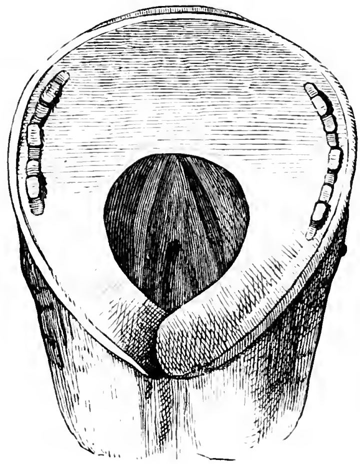


FIG. 263.—Oriental shoe.

foot. After nailing on, the hoof is trimmed to the shoe by means of a large knife. The nails have large strong heads with lateral projections, the object of which is to give increased foothold. As these projections meet when the nails are driven home, they also tend to mutually support each other. The neck of the nail is round, the shank, however, square, and the point tapering. The point is not wrung off after driving, and there are no clenches, but the projecting portion is formed into a spiral, which is gently beaten flat on the wall of the hoof. As the iron of which the nails are composed is of excellent quality, this method permits of the same nail being used more than once.

The Oriental shoe, as opposed to that used in Europe, takes a bearing over a large portion of the sole and is not bedded on the wall alone. The nail holes not being countersunk, the shoe being thin and the nails not fitting with absolute accuracy, a certain degree of expansion is possible. Whether the excellence of Arab horses' feet be due to Oriental shoeing is largely open to question, but the method at least teaches one useful lesson, viz., the ability of the sole to bear weight and, under favourable circumstances, the positive advantage of imposing weight upon it.

## 12. SPECIAL GROOVED SHOES WITH ROPE INLAID.

These shoes are of cast Bessemer steel, and present on the ground surface a broad deep channel filled with a piece of tarred rope (fig. 264); the hoof surface resembles that of an

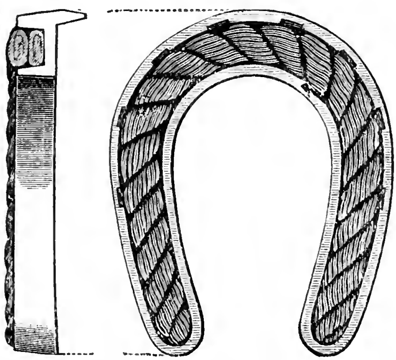


FIG. 264.

ordinary seated shoe. The rope is removed before fitting and replaced after the shoe has been nailed on. The advantages of these shoes are their lightness and their power of diminishing slipping on stone, wood, and asphalt pavements; they do not prevent falls, however, in wintry weather. To some extent they diminish shock.

Owing to their method of manufacture they will not bear heating to a high temperature, nor much alteration in shape, and therefore are only of value for sound, well-formed feet.

They are widely used in the large towns of Germany, especially as front shoes.

They have the further disadvantages of being difficult to nail on (the nails can only be driven home by means of a punch), and the fact that the thickness of the shoe prevents the frog touching the ground. They are apt to crack and readily bend when half worn through, to prevent which they are now frequently made in the form of bar shoes.

Steel bars with wood inlaid are made in Copenhagen. A groove on the ground surface contains a firmly compressed ring of wood. They are exceedingly light and correct in construction, but are very noisy, and as they cannot be warmed, their use is confined to cases where they exactly fit the hoof.

Shoes with rubber inlaid are made by a number of firms. In certain cases the shoe is cast, in others it is rolled. In the latter the nails are driven through the rubber; in the former, however, the rubber is inserted after the shoe is nailed on. Rubber is neither so cheap nor so lasting as rope.

### 8. Changing from one Style of Shoeing to Another.

It is sometimes found desirable to vary the style of shoeing, a horse which has been accustomed to flat shoes, for instance, being shod with tips, or with calkins, or again with toe-pieces. In making such change it is of great importance to note the way in which the foot is brought to the ground, and the direction of its axis. Whatever the form of the new shoe, the horse should tread level. Horses working on hard streets require the greatest care under such circumstances, for even a slight change, if continued, may seriously injure the action. Throwing the horse on its toe seems to be more serious than the opposite condition. The direction of the foot axis is of equal importance with the tread. Where the foot grows rather oblique (fig. 202), as happens when the shoe becomes worn, the animal has difficulty both in standing and going on hard ground, but when the opposite condition occurs this difficulty is wanting. It is, however, best to always seek a normal tread and a normal position of the foot axis.

Bearing this in mind, it is easy to see that a change from shoes with calkins to those without may be injurious, and in fact is injurious, if the toe be not shortened to such an extent as to restore the foot and hoof axes to their normal relationship. In the event of the horn being too weak to permit of thus lowering the toe, the shoes should at least be somewhat thicker at the heels.

The following sometimes occurs:—The owner of a horse shod with calkins hears of the advantages of flat shoes, and without further notice has his horse's shoes removed and replaced with flat shoes. He finds, however, the horse goes worse than formerly, and blames flat shoes accordingly. The cause of this tied-in gait, and the tripping and stumbling, is to be sought in the low heels. Removal of the calkins has disturbed the relations of the hoof and foot axes, and has produced another kind of tread, in which the toe comes first to the ground. Had the farrier been guided by the conformation and tread, and had he found it impossible to shorten the toe, owing to want of horn, he could either have objected to the change, or, at least, selected shoes with thick heels, which would not have destroyed the balance.

## 9. The Shape and Fitting of the Shoe.

Shaping and fitting the shoe, like preparing the hoof, are most important parts of the farrier's duty. Fitting can be performed with the shoe either hot or cold. In this work skill and the ability to 'carry the form in his eye' are absolutely necessary.

Hot fitting has the advantage of allowing faults in the shoe to be rapidly corrected, as well as producing very perfect coaptation between shoe and foot in the shortest possible time. A hot shoe should never be applied to the hoof for more than ten to thirty seconds, otherwise serious injury, such as burning the sole and causing inflammation of sensitive structures, may be done.

Cold fitting certainly avoids these disadvantages, but never produces such complete contact between shoe and hoof, nor can the peculiarities of the hoof or of the gait be so exactly compensated for, as in hot fitting. Nevertheless, under certain circumstances, as in war, etc., it may be advantageous. It is impossible to give detailed directions to meet all circumstances. Flat shoes must be fitted somewhat differently to those with calkins and toe-pieces, and variations have constantly to be made to meet special requirements.

In fitting the shoe it should be brought to a bright red heat. If irregularly heated, the hammer often produces distortion in other parts than those to be altered. The nearer either limb of the shoe approaches the middle line of the hoof, the greater the wear on it and the greater the weight thrown on that particular half of the hoof, while at the same time the bearing surface is reduced. The converse is equally true, though the results of all such peculiarities are more marked on the outer side of the shoe. The same principle applies both to the toes and limbs of the shoe. Needless to say, the distances through which such modifications are possible can be measured only in sixteenths of an inch. It is always necessary to keep the inner limb of the hind shoe comparatively narrow, and the calkin (if present) well rounded off, both to avoid the shoe being trodden on and to prevent striking.

It should also be remembered that it is an advantage and preserves the wall to provide the broadest possible bearing surface between the shoe and the hoof. The breadth of the bearing surface of the shoe must necessarily correspond to that of the wall, the white line, and the narrow rim of sole before indicated. In flat, oblique hoofs, therefore, with oblique walls, the bearing surface must be broader than in others.

All defects on the bearing surface, in the nail holes, etc., must be removed in fitting, clips must be drawn, and the shoes made to correspond exactly to the contour of the foot. The bearing surface, especially at the back of the shoe, must be absolutely horizontal, its breadth being regulated by that of the hoof. When it slopes inwards that very injurious contraction of the hoof which always occurs to a certain extent as a result of shoeing will be promoted. In the region of the nail holes, on the contrary, a slight slope is not only harmless, but indeed favourable. Generally speaking, a shoe should be a plane, so that if laid on a flat surface all portions of its hoof-bearing margin will be in contact with it. The only exceptions are shoes with a rolled toe and special shoes, such as those for laminitis.

Some front shoes are rounded at the toe (fig. 265); as a rule, this rounding off should commence at about the centre of the toe and be carried upwards to a distance equal to half the thickness of the iron. This corresponds to the form produced by natural wear, and is said to facilitate the last portion of the stride. The truth of the statement is, however, somewhat doubtful. At the best the toe should only be 'rolled' when the horse wears excessively at that point. A rounded toe, though possibly of use to heavy horses in slow work, prevents the horse obtaining a firm 'grip' of the ground, is awkward to form and to fit, makes it difficult to produce a satisfactory clip,

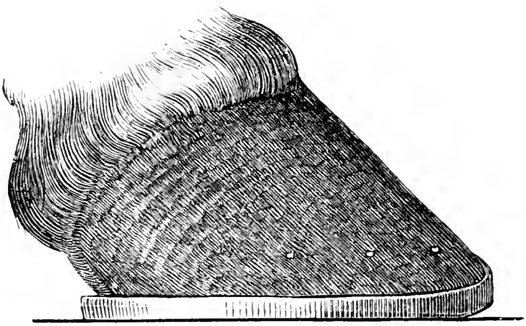


FIG. 265.

and allowing, for the sake of argument, that it facilitates turning and other movements in a small space, certainly decreases the animal's speed. Those who claim that it reproduces the form assumed by the unshod hoof, forget that the shoe in nowise reproduces the hoof, and that the bearing of the unshod hoof is altogether different from that of the shoe.

(*a*) *Fitting Shoes to Normal Feet.*—After selecting the shoe, giving it the proper form, and drawing the clips, it is applied to the hoof at a dull red, in order to see whether it fits. Errors in shape, etc., are then corrected, and any points on the hoof which have been left too high are lowered by rasping away the burnt horn. Provided the parts have been correctly trimmed and the shoe holed, the depression for the toe-clip can then be made, though only sufficient should be cut away to enable the clip to lie close.

The shoe fits, (1) when its outer border corresponds with that of the bearing surface of the wall throughout the toe and quarters, from which points it becomes rather wider as it runs backward, so that at the heels it projects on either side from $\frac{1}{24}$ to $\frac{1}{12}$ inch; (2) when the nail holes correspond to the white line; and (3) when it lies in absolute contact with wall, white line, and a narrow zone of the sole as wide as a straw.

The width of the shoe can be judged best by grasping the fetlock with the left hand, allowing the hoof to fall slightly, and viewing the parts from above and behind.

With the exception of the narrow zone indicated, a space of $\frac{1}{8}$ inch should exist between the shoe and sole, due partly to the spring of the sole, partly to the seating of the shoe. A narrow space should also separate the extremities of the heels from the frog.

A good general rule is to fit the shoe to the hoof, but in such a way as to produce the best possible form of hoof. Faults in the shoe should never be compensated by altering the hoof. In dealing with hoofs already deformed we should seek gradually to give the shoe such a form as the hoof had when healthy, a principle derived from the experience that the hoof after a time takes the form of the shoe.

As soon as the shoe is cool, the nail holes are again punched from the ground surface and the outer border of the shoe is rasped round. This rasping gives a smart appearance, and removes any sharp points or roughness. To prevent cutting, the edges of the inner side of the shoe should receive special attention. In filing up the shoe only one part should be grasped in the jaws of the vice at once, or otherwise the entire shoe may be bent.

(*b*) *Shoes for irregular Conformations.*—In cases where the foot or limb is abnormal, it is no longer sufficient to fit the shoe to the hoof, but an attempt to improve the position of the limb must be made, in order to secure proper distribution of weight and to ensure better support; the more defective the formation the more necessary does this become.

As already mentioned, the hoof of a turned-in foot differs in shape from that of one which is turned out. The distribution of weight is also different, and some change in the width of the posterior portion of the limb of the shoe, therefore, becomes necessary. In shoeing turned-out feet the inner limb of the shoe must be rather wider than the outer; in turned-in feet the opposite. How much cannot, of course, be exactly stated; it depends on the amount of deformity, and on whether the shoe is flat or has calkins and toe-grips. In well-marked out-turned toes the inner part of the toe should be rather flattened, allowing even the wall to project in order to prevent striking. In turned-in toes the shoe is fitted so that the inner limb exactly corresponds to the inner circumference of the hoof, the sharp edge of which should be rounded off rather more than usual. At the same time the outer limb from the toe backwards should be fairly broad (fig. 266).

In dealing with contracted or broken feet both branches of the shoe should be so shaped as to correspond with the stronger

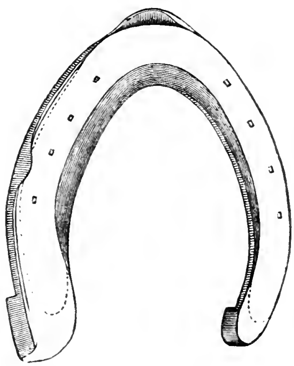


FIG. 266.—Left hind shoe for horse with turned-in toes. The outer branch is seen to be wider than the inner. The dotted lines indicate the bearing of the hoof.

or better preserved side of the hoof. The shoe will then project to a certain extent beyond the broken or contracted wall. It is, of course, often difficult or dangerous to allow the edge of the shoe to project *at the inside of the toe or quarter*, but there is no danger in giving extra width at the heel, because the horse seldom or never cuts with this part. Should the shoe be *fitted to the foot* in such cases, the weakened portion of the wall sustains more weight than it would were it sound (so that a smaller surface has to carry a greater load), with the inevitable consequence of greatly aggravating any existing evil. The guiding principle must be to give the greatest width where the greatest weight falls, the shoe being regarded as the base of support and, therefore, requiring to be a little broader below that portion of the hoof which carries the greater weight.

(*c*) *The Fitting of Shoes for Rapid Work.*—In addition to following the directions laid down in the section 'Choice of the Shoe,' it is necessary, in shoeing hacks, coach and race horses, which work at a trot or gallop, to fit the shoe everywhere as closely as possible. It should, therefore, represent a prolongation of the horny wall. The inner limb requires particular attention, and must lie close, with its upright surface inclined slightly inwards. To prevent the shoe cutting, being torn off, or catching in obstacles, it should not exceed in length what is absolutely indispensable.

(*d*) *Fitting Shoes for Heavy Draught Horses.*—Heavy draught horses require a broad bearing surface; consequently, the restrictions as to width and length of the shoe are less imperative in them than in other animals. One sometimes sees hoofs which, without being diseased, have yet suffered severely in previous shoeings. The heels of the shoe should then be fashioned wider than the hoof, for if only the bare width is allowed the level tread will be destroyed, especially when toe-pieces and heels are employed. Heavy draught not only shortens the stride but tends to cause turning in of the toes, in consequence of which the outer limb of the shoe is generally exposed to heavy wear and the hoof becomes deformed. To diminish this, to favour regular wear of the shoe, and to give better support, it becomes necessary to fit the shoe fuller than usual on one side, especially when the toe is turned inwards, or it may even be necessary to form the web somewhat broader (fig. 266). The extent is determined by the degree to which the wall has become inclined, but on the outer side it is always safe to increase the width of the shoe until its outer edge comes vertically below the coronary margin. If, for example, the coronet is wider at the outer heel (that is, greater in circumference) than the bearing margin, the outer edge of the shoe from the last nail hole backwards may be kept so wide that a perpendicular line let fall from the coronary margin will meet it (fig. 267). The inner web, on the other hand, must be as narrow as possible. The new shoe should be broader at the point where the old shows greatest wear and may also be fitted fuller, *i.e.*, be rather more bowed outwards. The nail holes should be correspondingly coarser.

This obviates the need for bending outwards the outer heel. The width of the web must depend on the style of tread and on the wear of the old shoe. Sometimes the bearing surface of the outer heel is not completely covered by the shoe and is then apt to be compressed. The remedy is to widen the web. We advise the adoption of a perfectly level, that is, horizontal,

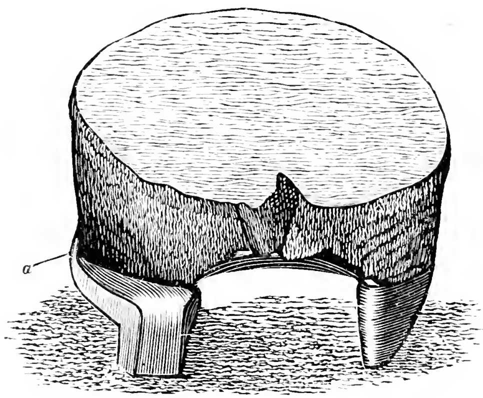



FIG. 267.—Left hind shoe for horse with turned-in toes and contraction of outer quarter and heel. The shoe has feather edge and (*a*) quarter-clip.

bearing surface for contact with the wall, because it allows the foot to expand to the greatest extent, and because experience teaches that the hoof is thus best conserved. Dominik has suggested another method, which, however, in our opinion is unpractical, namely, to trim the bearing surface at right angles to the general direction of the wall and give the shoe a corresponding form. The upper surface of the shoe, therefore, in general appears concave, shoes for flat hoofs being most markedly seated, those for upright hoofs less so. The system, however, has met with little acceptance.

## 10. The Nails.

Of late years great progress has been made in the manufacture of horse nails by machinery. The first requisite for making a good nail is iron of the best quality. In form, the nail should resemble a slender wedge, its width being twice its thickness.

To meet the requirements of everyday work ten sizes are required. The nail should never be thicker or longer than is absolutely necessary, and more than one size is often required

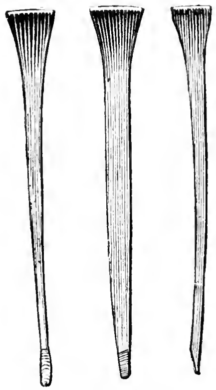


Fig. 268.

Hand-made nails.

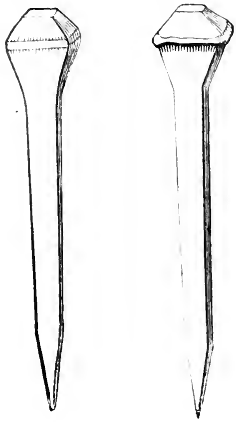


Fig. 269.

French nails.

Fig. 270.

Machine-made nail.

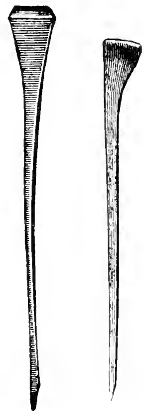


Fig. 271.

Badly-formed nail; head and shank defective.

in the same hoof. Every nail makes a hole, and the smaller the hole the better for the hoof. Although it is indispensable to secure the shoe firmly to the hoof, this does not depend on the use of large nails alone, and should a strong nail split the wall it becomes less secure than a weak nail in a sound wall. It is rare that the loss of a shoe can be referred to the use of weak nails. Much more frequently the shoe does not fit or the nail holes are faulty in form, direction, or size.

Hand-made nails require preparation to enable them to penetrate easily and in the proper direction through the horn wall. This preparation, termed 'pointing,' can only be satisfactorily undertaken after ascertaining the form and condition of the wall. The nails should be smooth and regularly formed, but should never be hammered more than is absolutely necessary, for, *cæteris paribus*, the softer they are the better. The amount of hammering they should receive depends, therefore, to some extent on the hardness of the wall.

As the nail is required to take a straight and not a curved course through the horn, its inner side, that is, the part turned towards the laminæ, should be somewhat curved outwards, in order to provide against the known fact that straight nails always pass in a curved direction through the wall, and then not only fail to remain firm but are very liable to injure the horn and even the soft structures.

The point is finished with a short triangular surface obliquely inclined to the general direction of the shank (figs. 268 and 270). A short point causes the nail to emerge low down on the wall, whereas an oblique point results in it taking a longer course and emerging higher. No fixed rule can be given in regard to the niceties of pointing, because different forms of wall, and to some extent nails of different thickness, require different lengths of point.

The point, however, should never be curved. Its outer side must invariably be straight, and the point, though sharp, must not be thin, still less excessively fine.

At the present time machine-made nails, highly polished and ready for driving, are almost exclusively used. Of extreme regularity, they are cheaper and more easily driven, though less tough than the old-fashioned nail.

### 11. Nailing on the Shoe.

Before affixing the shoe the farrier places it once more in position to see whether it fits accurately and whether it is in every respect suitable. So far as nailing on is concerned, the shoe fits when, firstly, all the nail holes correspond in position to the white line, and secondly, when each hole has been punched with due regard to the direction of the corresponding part of the wall. Any errors must be corrected before nailing on commences.

Nailing on is intended to unite the shoe with the hoof firmly and lastingly, and to effect this with the least possible injury to the horn and without wounding or pressing on sensitive structures. As each nail, on account of its wedge form, tends to drive the shoe towards the side to which the point is directed, the latter should be placed as nearly as possible in the centre of the nail hole: lateral displacement of the shoe is then less likely to occur, and after driving two or more nails it is scarcely possible, the horn yielding rather to the nail. When slight displacement has occurred after driving the first nail, it can be remedied by attention in inserting that of the opposite side, but if two or more have been driven, or displacement is considerable, the nails should be withdrawn and redriven.

It is of comparatively little moment which nail is first driven, though, as a rule, one or other of the toe nails is selected and the nailing on continued from this point.

To protect the wall and avoid injuring sensitive parts, nails should be driven only so high as to grasp firm horn. For light shoes $\frac{3}{4}$ to 1 inch and for heavy $1\frac{1}{4}$ to $1\frac{3}{4}$ is sufficiently high, measured from the upper margin of the shoe. Many farriers, thinking to show greater skill or to attain greater security, drive all nails as high as possible without reference to the style of hoof or shoe. This is a grave error, for, quite apart from the dangers of punctures and 'binding,' the hoof is soon penetrated by so many nail tracks that in time it becomes difficult to discover a solid part. The less the horn has been split and injured by numerous thick or high driven nails, the better will be the hold of a well-fitted shoe. Special skill in the farrier is shown when few or no old holes can be found in the hoof.

In driving, the nail is held as long as possible between the fingers to ensure its taking the proper line. The two principal indications are furnished by what the Germans term the *Gang und Klang*, that is, the manner in which the nail advances, or rather the sensation its progress imparts to the workman's hand and the sound it gives forth. Each blow should be sufficient to drive it from $\frac{3}{16}$ to $\frac{1}{4}$ inch forward. As soon as the sound becomes clearer and the nail drives with more difficulty, the farrier knows that the point of the nail has entered the outer hard sheath of the wall, and, therefore, is in the proper direction. A moment later he detects, by means of the second and third fingers of his left hand, which rest lightly on the wall, the point at which the nail will emerge, when he releases his hold on the nail, and drives it fully home. The force to be applied depends on the hardness of the horn and the size of the nail.

Nails which penetrate $\frac{3}{4}$ inch and still go 'soft,' or which cause the animal to flinch, should at once be withdrawn. Immediately the nail is driven home its point should be turned over.

It looks well, and is a mark of good workmanship, for the nails of each side to appear at an equal height in the wall,

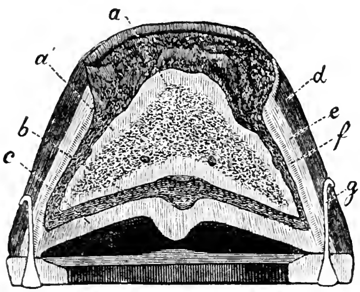



FIG. 272.—Cross section of a sound and well-shod hoof, showing the position of the nails. *a*, pedal bone; *b*, sensitive sole; *c*, horny sole; *d*, horn wall; *e*, dark-coloured outer layer of do.; *f*, laminal sheath; *g*, nails.

though this is by no means absolutely necessary; certainly it is much more important that they should be driven so as not to injure the hoof. If more than six nails are driven to an equal height, injury may result, as the nails then come closer together.

When all the nails have been driven the hoof is supported by the left hand, and with a few powerful blows the heads are sunk securely in the nail holes. The shoe is thus firmly fixed to the hoof, the third condition mentioned above. The nails being firmly driven, the pincers are held under the turned-down points, which are completely bent and brought in close contact with the hoof by light blows on each in succession. This is done not to cause the nails to hold more firmly in the hoof, but only to facilitate nipping off the points and clenching.

Each nail as it emerges from the hoof causes the outer sheath of the wall to bulge slightly, and, therefore, in order to form the clench the point of the nail is removed close to the horn, there being little fear of its proving too short. As far as possible twisting or other movements which might loosen the nail should be avoided.

After nipping off the points the horn below the exposed part of the nail is lightly rasped to form a groove, the end of the nail being either left of full strength or only slightly thinned. The clenches are then turned down with a few light blows of the hammer. It is sufficient if the 'turn down' of the clench is the same depth as the nail is broad, or in other words, if the part of the clench showing is square.

Finally, any horn projecting beyond the edge of the shoe is rasped away, and the edge of the hoof slightly rounded off by inserting the edge of the rasp between the lower margin of the

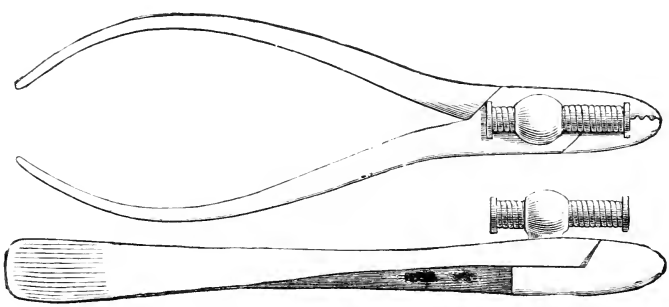


FIG. 273.

hoof and the upper part of the shoe, though if the fitting be properly performed this should only be needful at the inside of the toe. Under no circumstances should that part of a sound hoof above the clenches be rasped. The hoof is now put down, the old nail holes can be filled with wax if desired, or, as is usual, brushed over with some 'dressing,' and the horse walked and trotted to see how he goes.

In hoofs injured by the use of too many nails, or weak in horn, the nail holes must, of course, be appropriately distributed in the shoe, so as to take advantage of the soundest parts. With this precaution, and by employing high clips, even the worst of feet can generally be shod. In special cases 'bar' clips (giving a hold on the bar as opposed to the quarter or toe) have even been successfully employed.

Occasionally a nail when driven may splinter or break, and portions of it remain in the hoof, defying all efforts at extraction with ordinary pincers. To meet such special cases forceps have been invented (fig. 273) but have never come into general use. The forceps enable the portions to be more easily grasped and removed, the adjustable screw serving as a pivot. Similar forceps might be of value to veterinary surgeons in certain operations.

## 12. Examination of the Horse after Shoeing.

The animal is first walked to see how he treads, and trotted to see whether he goes lame. Next the farrier should glance at the limbs from in front to see that the foot axis neither inclines inwardly nor outwardly, and from the side to see whether the horn of the wall is in the same line as the axis of the bones. A slight uprightness of the wall, however, is not always a disadvantage. The heels will be of a height corresponding to the formation of the hoof. Next he notes whether the horn of the wall runs in a straight line from the coronet to the bearing surface. The straighter all portions of the wall appear the better.

At the same time, any defect in form and position of the shoe is seen. Above each nail should be a small opening, for this shows that the nail has been turned over of full strength in clenching. The clenches should be situated in sound horn, approximately at the same height, equally spaced, and sunk level with the wall. The clips and the length and breadth of the shoe are next noted. The toe of the hind shoe is broader and thicker than the quarters. The clips should be of equal form and size, and their length and width proportioned to the form of the hoof and to the weight upon it, as well as to the work required of the horse. The clip of the front shoe should be in the centre of the toe; that of the hind a trifle towards the inside. When (in hind shoes) there are two quarter-clips, each should be at the same distance from centre of toe. Finally, each foot is lifted and the position of the nail holes noted. The form of the shoe, the relations of the nail heads to the holes, and the relation of the shoe to the sole and frog are seen. The sole, bars, and frog should be strong, and the frog should project sufficiently to touch the ground. The shoe should take a level bearing throughout.

In front shoes the nail holes should be distributed chiefly in the anterior half; in hind shoes, on the other hand, they may extend as far as the posterior third. The nail heads should fill the countersinks and should either not project at all beyond the ground surface of the shoe or only about $\frac{1}{12}$ of an inch. The inner and under margin of the shoe should never be sharp nor project towards the middle line, *i.e.*, towards the opposite limb. The inner and upper margin should not touch the horny sole, nor should the heels lie in contact with the frog.

After this examination, which is performed very rapidly, all old nail holes are filled with wax and, if not seen to before, the entire hoof and sole rubbed over with hoof 'dressing.'

## 13. Disadvantages of Shoeing.

Shoeing has certain immediate bad results, which the farrier must be acquainted with, in order to be able, as far as possible, to minimise them. Many farriers and owners are unaware of how these are produced, and are satisfied to refer them to defects in form and length of the shoe, etc., in accordance with their particular, often erroneous, theories. With the knowledge, however, that shoeing completely alters the relations of the hoof to the ground, in fact places the hoof in an entirely unnatural condition, the reasons for injury are more easily understood. The body-weight is now no longer supported by the entire lower surface of the hoof but rests almost entirely upon the wall, which again rests upon the shoe.

The following are some of the disadvantages. (1) The sole and frog are almost entirely relieved from the counter-pressure of the ground; in consequence they lose their function, and in common with the posterior parts of the foot tend to shrink. At the same time, an excess of weight is thrown on the wall, checking its growth, exposing it to severe internal strain, and in too many cases leading to contraction and deformity.

(2) The hoof grows continuously. When shod, however, wear ceases—save, perhaps, in the posterior sections, where, in consequence of elasticity, a slight loss occurs—and the hoof becomes too long and too high. This alters the relation of the hoof to the limb, impedes movement, tires the animal, favours stumbling and falling, and may even produce disease of joints and tendons.

(3) Shoeing removes the hoof from direct contact with the ground and, therefore, from the moisture it would otherwise receive. The horny capsule becomes dry, hard, and unyielding, it tends to contract and to press on the contained soft structures, thus cramping action and even producing lameness.

(4) The nail tracks weaken the hoof, and accidents, leading to serious results, may follow the carelessness or want of skill in workmen.

All these results occur earlier and in more pronounced form in fore-feet, because these bear a greater proportion of weight and are more exposed to the drying process. Such changes do not appear, however, with like rapidity nor to a similar extent in all hoofs. Experience shows that when animals are severely worked the limbs often suffer far more than the hoofs in consequence of shoeing. The dogma that of 100 lame horses 90 are lame in the feet is unsupported by statistics. Between the years 1879 and 1891 the Veterinary School in Dresden received 10,727 lame horses. Of these 3333, that is 31·07 per cent., were lame in the feet, but as lame horses sometimes make more than one visit the percentage may be even lower. In the Practical School of Farriery at Dresden in 1884 the number of well-marked diseased feet noted was 6·53 per cent.; the percentage of horses lame in the feet was even lower. The statistics of the Military School of Farriery in Berlin show that between 1877 and 1880 the percentage was 40·06. In London, though no precise statistics are available, the number of horses lame in the feet is probably not higher than 30 to 40 per cent. The diminution in cases of foot lameness has been very marked since the introduction of wood paving and machine-made nails. Speaking generally, the feet which most often become diseased are those attached to limbs of irregular conformation, lameness being due not so much to shoeing as to irregular distribution of weight.

With regard to the injurious effects of shoeing it has justly been said, "*Shoeing is an evil when ill practised.*"

## 14. Effects upon Hoofs and Limbs produced by Work on Paved, especially Stone-Paved, Streets.

While draught is facilitated by the hard, smooth surface of modern streets, concussion and slipping are increased, and are productive of very serious effects in the feet and limbs of all draught animals. The gain, therefore, of very smooth hard pavements is somewhat less than would at first appear.

So far as the preservation of the hoofs and joints is concerned the most favourable ground is that which admits of the shoe entering slightly, thus modifying the shocks incidental to rapid movement and the slipping produced when the foot comes to the ground, as well as restoring to the sole and frog the counter-pressure necessary for healthy growth. A soft yielding surface, in which the hoof sinks deeply, entails great exertion and rapidly produces fatigue. Very hard ground, on the other hand, causes shocks, slips, and falls in proportion to its roughness and hardness. Granite setts and asphalt are the most injurious of all pavements, because they absolutely prevent the feet impressing them, because the horny sole and frog become functionally inactive on account of the absence of counter-pressure, and because the sensitive structures and joints are apt to become bruised and inflamed, producing a peculiar shuffling and unsymmetrical gait.

While granite blocks are worse than macadam or gravel, the evil becomes immensely exaggerated when the surface is much curved. Streets thus paved present an ever increasing danger for horses, a danger produced by the hardness and smoothness of the surface and by the faulty or diagonal setting of the individual stones. Slips and falls are then frequent, as owners in large towns know to their cost, but the disease processes produced in the joints, by trotting heavy horses on granite paved streets of excessive curvature, are less well recognised. In consequence of the form of the roadway the horse, where-ever he happen to be, almost always treads unequally, the outer margin of the right hoof and the inner of the left coming first in contact with the ground. This inequality of the ground not only causes anxiety, insecure gait, slipping, and falling, but more or less marked compression, if not contusion, of the articular surfaces of that side on which the hoof first comes in contact with the ground; whilst on the opposite side strain of the articular ligaments occurs. When we think how often horses suffer in their gait by faulty preparation of the feet in shoeing when going on perfectly level ground, it will be clear that on such curved surfaces or on rough hard streets these strains in and about the joints must be very much greater.

On soft ground the unequal tread is of little or no importance, because the part of the hoof which first touches the earth buries itself to a corresponding extent. On hard streets, however, the accommodation occurs at the expense of the joints. Faults in shoeing have often been blamed for the excessive wear of horses' legs, but the foregoing will show this view to be in large measure unjust.

# CHAPTER III.

## FORGING AND CUTTING.

### 1. Forging.

Forging is due to faulty action, in consequence of which the toe of the hind shoe strikes the heel or under surface of

Fig. 274.—Right fore shoe with rounded inner edge (forging shoe).

the fore shoe. In most cases the toe of the front shoe is the point struck. The sound is very unpleasant, while the action itself may be dangerous, as the bulbs or sole of the fore-

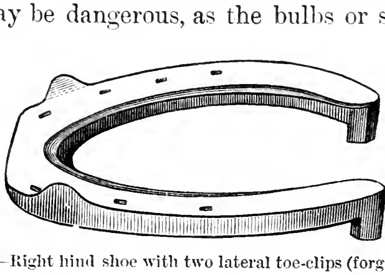


Fig. 275.—Right hind shoe with two lateral toe-clips (forging shoe).

foot or the toe wall of the hind-foot may be damaged, the shoes loosened, or the front shoe become locked with the hind, and the animal thrown down.

The causes are either faulty conformation or defective and careless shoeing; some animals only forge when tired or when badly driven. Horses which 'stand over,' *i.e.*, whose fore-limbs incline backwards, and whose hind-limbs are placed too far under the body, or, in other words, animals with comparatively short bodies and long limbs, are specially predisposed. Bad shoeing is often the cause, the fore shoe being unduly long and the toe of the hind shoe too prominent, but in most cases forging is caused by the toe of the fore shoe being too long and the heels too low. Such a shoe impedes the movement of the fore-limb, the long toe delaying the lifting of the foot from the ground. The fore-foot, therefore, remains under the horse too long, and is overtaken by the hind-foot.

The remedy is to avoid making the shoe longer or wider than the hoof. The heels of flat shoes should also be bevelled off obliquely from behind forwards, as should calkins, if used. When the horse strikes the lower surface of the fore shoe at the toe, the fault can often be prevented by rounding off or seating out the ground surface.

In horses that forge, the front shoe should be formed so as to represent merely a prolongation of the hoof.

The hind shoe should be shortened at the toe, and the lower anterior wall well rounded off. Quarter-clips are preferable to a toe-clip, and unless the horse 'goes on his toe,' the shoe must be fitted so that three-quarters of the thickness of the toe wall projects in front of the shoe. The nails must be well driven home, and should project as little as possible. The sound of forging can sometimes be prevented by inserting a fragment of leather or thick rubber between the shoe and hoof at the toe, so that $\frac{1}{4}$ inch projects. This comes in contact with the front shoe, and prevents the objectionable noise.

Charlier shoes in front are often a complete cure.

## SPECIAL SHOES FOR HORSES THAT FORGE.

### FULLERED HIND SHOE FOR HARNESS HORSE WHICH FORGES AND WEARS WALL OF HIND-FOOT (FIG. 276).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

Horses that forge sometimes wear away the toe of the hind-foot to a very considerable extent, owing apparently to the front of toe of the fore foot striking that of the hind in mid-air. The point worn varies in position, being sometimes low down, near the shoe, sometimes close to the coronet. The shoe illustrated is intended to prevent wear close to the ground surface. A long, broad, stout clip is drawn (with the *face* of the hammer), which protects the point of impact. The heels of the shoe are flat or may be slightly thinned.

In this connection it may be pointed out that 'forging' is not always caused in one way; sometimes the toe of the hind-foot strikes the inner margin of the fore shoe, sometimes the toe walls of the fore-foot. It is for the latter condition that this shoe is intended.

### DIAMOND-TOED FULLERED HIND SHOE FOR HARNESS HORSE (FIG. 277).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

As a preventive of forging, few shoes are more efficient than the diamond-toed. The heels of the shoe are thinned down to about $\frac{3}{8}$ of an inch. It may be laid down as a general principle that (hind) shoes with calkins, as compared with flat shoes, and flat shoes as compared with thin heeled shoes, favour forging. Horse-dealers often object to this shoe as drawing attention to a defect, and it may then be replaced by a shoe

Fig. 276.—Fullered hind shoe for harness horse which forges and wears wall of hind foot. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

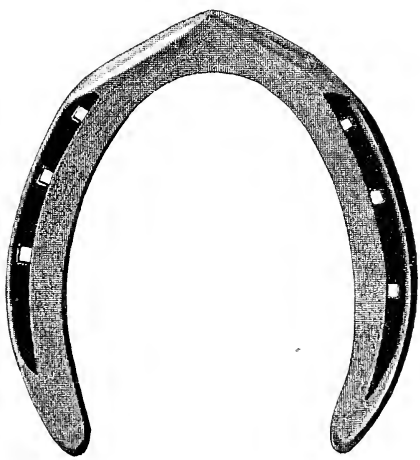


Fig. 277.—Diamond-toed fullered hind shoe (for harness horse). Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[*To face p.* 284.

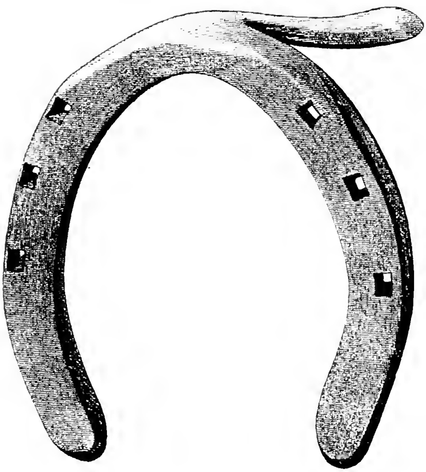


FIG. 278.—Diamond-toed hind shoe with 'toe spur' (for harness horse which forges and wears wall of hind foot). Made from old shoes.

*To face p.* 285.]

square across the toe and clipped on either side of the toe, though this affords no protection to the toe of foot, which often becomes worn away. For hard-working horses nothing succeeds better than the diamond-toed shoe.

Clips may be drawn at the toe (the apex of the diamond), at either side of the toe, or at the toe and outside quarter.

In preparing the foot the horn at the toe must be spared so that it overhangs the sides of the toe of shoe. Should the hind foot still overtake the fore, it is then the *horn* and not the shoe which makes contact, and the noise is materially diminished. The heels of the foot should be lowered, the toe left fairly long.

To enable the shoe to be kept as light as possible it is often fashioned from steel.

## DIAMOND-TOED HIND SHOE WITH 'TOE-SPUR' FOR HARNESS HORSE WHICH FORGES AND WEARS WALL OF HIND-FOOT (Fig. 278).

*Made from old shoes.*

Occasionally the wall of the hind-foot is worn away quite close to the coronet, as explained in the foregoing note. The sensitive structures may even be exposed and bleeding result. The shoe illustrated is intended to prevent such injury. It consists of a diamond-toed shoe with an upward prolongation or spur accurately fitted to the contour of the wall at the injured spot.

The spur is made from half-round iron $\frac{3}{8}$ inch in width, and is of sufficient length to reach nearly to the coronet. It is 'shut-on' or welded to the shoe when the latter is completed. The spur must be very carefully shaped to the wall, otherwise it increases the noise, and its appearance is very unsightly.

The heels of the shoe should always be thin. Unless for some special reason, such as the existence of sprain of the subtarsal ligament or of the flexor tendons, it is considered desirable, by giving calkins, to relieve the tendinous structures of a portion of their load.

A light concave fore shoe should be used in conjunction with the 'spur' shoe. If the fore-feet are weak or fleshy, and a shoe with good cover is indispensable, it should be dished on the ground surface.

## 2. Cutting or Striking.

A horse is said to strike or cut when the coronet, fetlock, or other part of the limb is touched by the foot of the opposite side during movement.

A graduated series of injuries is recognised: 'brushing,' when the hair is roughened or soiled with mud; 'cutting,' or 'interfering,' when the skin is cut through, and bleeding ensues; 'striking,' or 'buffing,' when the fetlock is struck and bruised with the flat of the opposite foot, but without a wound being produced. The terms, however, are employed in different senses by different persons and in different parts of the country, so that the above definitions must be regarded as relative only, not absolute.

Injuries are thus produced on the inner side of the coronet, of the fetlock joint, or sometimes, in front limbs, as high as the knee. The last condition receives a special name, 'speedy-cutting.' Lameness is a common result.

The injury may vary from mere roughening of the hair and slight abrasion of the epidermis to severe bruising, etc., causing well-marked lameness. The periosteum may become inflamed, leaving thickenings and exostoses; sometimes septic material obtains entrance, and causes violent inflammation of the subcutaneous connective tissue, with abscess.

The causes of striking may be referred either to faulty shoeing of the striking foot or of the foot struck, to fatigue (from whatever source arising), to swellings about the coronet or fetlock, to the conformation of the limbs, or to the use to which the horse is put. Horses with well-formed limbs do not strike if properly shod; those with turned-in toes occasionally strike, but horses in which the limbs appear turned in as high as the fetlock, and above that point recede from one another, very frequently strike. Bouley states that with turned-out toes the striking point is usually towards the back, with turned-in toes towards the front of the foot, but this is not absolutely correct. When one trace is longer than the other, when the horse (especially if young and fresh) becomes tired, and when the shoes are much worn, striking is very apt to occur.

To minimise or prevent this fault, the examination of the limbs, the gait, and the shoeing, as before indicated, must

FIG. 279.—Examination of horse that strikes. The animal shown has two defects: its feet are too closely placed and it crosses the feet when moving.

be thorough (fig. 279). Four chief points have to be borne in view: the formation of the limbs, the inclination of the fetlock joint of the limb which is struck, the style of tread, and the part which inflicts the injury. The more closely the fetlock joint approaches the centre of the body, the less the 'clearance,' and, consequently, the greater the chance of striking. This is usually produced by too low an inner wall; in such case the cause is to be sought in the foot which is struck. It must always be remembered, however, that when the limb is deformed, *i.e.*, when the toe is turned in or out, the foot will not be of normal shape, and to attempt to render it so is a grave error which will probably exaggerate the condition. An uneven tread is apt to result in an irregular method of advancing the foot; this favours striking. Before proceeding to special measures, it is generally desirable to try the effect of a perfectly flat shoe and level bearing. In the majority of cases this will stop cutting. The point which strikes can usually be precisely located, as it is either whitish or smooth, or at least free of dirt; sometimes it is reddened with blood. In the absence of such indication, the hoof or the point struck may be whitened, and the horse trotted. The colouring matter will then be transferred from the hoof to the fetlock, or *vice*

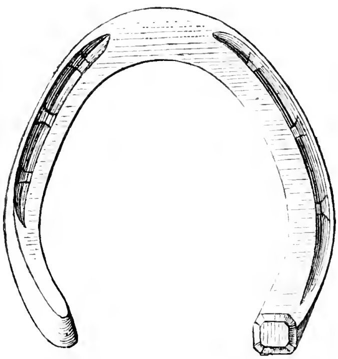


FIG. 280.—Cutting shoe, ground surface.

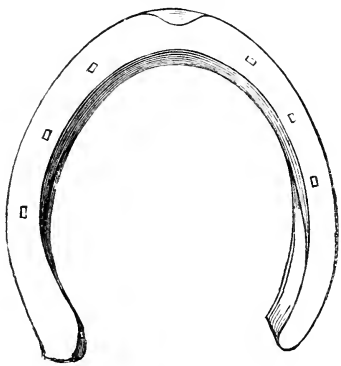


FIG. 281.—Cutting shoe, foot surface.

*versa*, and the exact points which come in contact clearly indicated.

When the cause is too broad a hoof, projecting clenches, twisting of the shoe on the foot, it is only necessary to amend the shoeing, but when faulty conformation is in question, the striking point must be discovered, the hoof diminished in size, its bearing surface altered, the shoe opposite it straightened and so applied that it lies well within the margin of the hoof. The hoof should project to the extent of about one-third the thickness of the wall. When striking is excessive, it may be necessary to use a shoe holed and nailed only on one side ('blind-sided shoe').

'Anti-cutting' shoes, or shoes in which the inner limb is diminished in width and deepened, forming a 'wedge heel' (fig. 282), are useful where the toe is turned in, especially if the inner wall of the foot cannot be induced to grow sufficiently fast in spite of careful attention. The greater depth lifts the otherwise displaced hoof into its proper position. In each

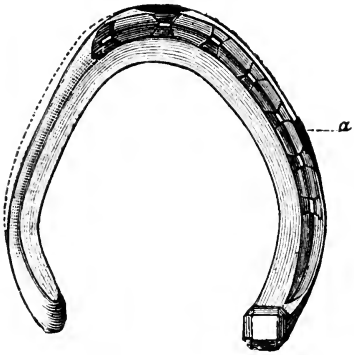



FIG. 282.—Cutting shoe for left hind-foot. *a*, position of clip. The dotted line shows the outline of the wall of the hoof.

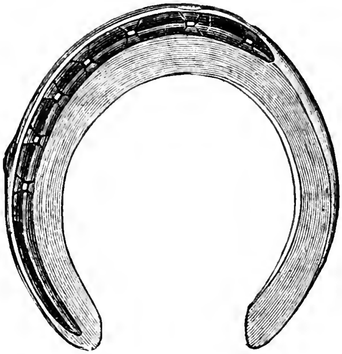


FIG. 283.—Cutting shoe for right fore-foot, holed on one side only.

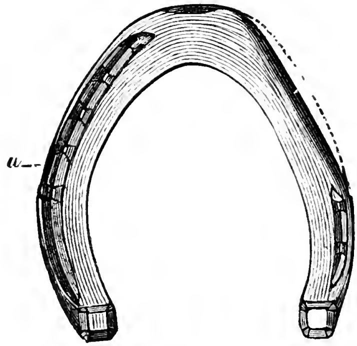



FIG. 284.—Cutting shoe (right hind) for horse that cuts with the toe. *a*, quarter-clip.

case the shoe should be so fitted that the hoof overlaps slightly at the striking part.

When the horse strikes with the inner surface of the wall, and when, consequently, injury is apt to occur from the clenches projecting as the shoes wear out, shoes holed only on one side are employed (figs. 282 and 283) both in front and behind. The style of tread must determine whether such shoes should be made with low heels or not. It seems plain, however, that when a horse with turned-in toes strikes himself in spite of being shod with anti-brushing shoes, the heels are either too high or altogether harmful.

For horses with turned-out toes anti-cutting shoes are seldom of much benefit. These animals usually cut with the inner part of the toe or quarter close to the toe; sometimes with the heel. Consequently, the shoe, whether provided with heels or not, should have a straight margin without nail holes, should be very narrow and very carefully rounded off in a downward direction at the striking point (fig. 284). The hoof should also extend beyond the shoe. The other parts of the inner margin of the shoe may, and sometimes

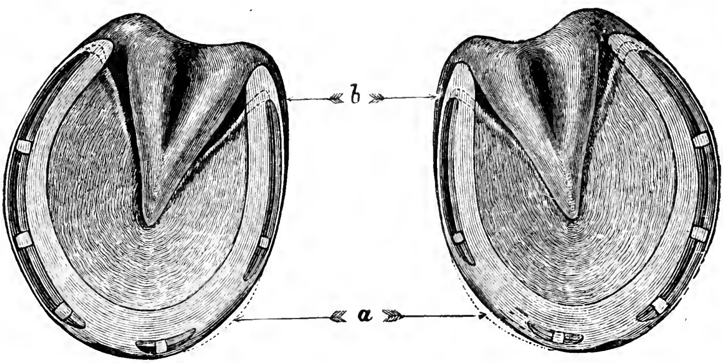



FIG. 285.—Shoes for horse that turns the toes out. *a*, the part of hoof that strikes; *b*, the inner limb of shoe is seen to be longer and broader than the outer.

even must, be wider than the hoof at the heels. It is sometimes advisable to make the inner heel higher than the outer.

The width of the outer branch also requires special attention; towards the heel it should be narrow and closely follow the direction of the wall, while it must be kept short, for a long, projecting outer heel favours the inward thrusting of the fetlock joint by throwing the weight on the inner half of the hoof. It thus facilitates striking. It need scarcely be remarked that the clenches should sit close without projecting.

To prevent the shoe shifting its position a side clip (*a*) must be fitted. Neither the shoe nor the hoof should exhibit any sharp or projecting edges on the inner side, and any prominent nail heads must be removed. The remedies for striking produced by local swellings, weakness, overwork, or unequal length of the traces are self-apparent. In some cases shoeing can only diminish striking and the injured part must always be protected by a well-fitting boot. Other means of protection are the insertion of a fragment of leather between shoe and hoof which projects to the extent of $\frac{1}{8}$ or $\frac{1}{4}$ inch and is kept well greased. The contact of the leather with the part struck is less injurious than that of the hoof or shoe. Special pads are made for this purpose, consisting of a small, elongated, rounded portion and a flattened expansion, through which the nails are driven. The rounded part projects at the sides of the foot and serves the same purpose as the leather. Thick rubber rings are occasionally used, being slipped over the hoof and allowed to rest just below the fetlock. Yorkshire boots (of doubled blanket) are also employed as temporary protection.

Delpérier recently described a very ingenious way of preventing the horse cutting. He used gaiters extending from the upper part of the coronet to below the knee, and found that, by tightly lacing these, the action of the limb was somewhat limited and that *marked abduction occurred.* His experiments extended over two years, and he was able by this method to completely prevent cutting in a horse which had resisted all other methods of treatment.

The American weighted shoe is sometimes of value, and is certainly worth a trial in inveterate cases.

A last method is to insert in the hollow of the heel a moderate sized pad fixed in position by means of a strap. This limits the flexion of the limb in a similar way to Delpérier's gaiter and induces a degree of abduction proportioned to the amount of interference with flexion. A very little difference in movement is sufficient to entirely prevent injury, and this system has been favourably reported on by a large number of observers. The pad does not cause the animal to appear lame or to go unevenly, as the opposite limb is moved in sympathy with the one to which it is applied.

The tendency to strike is diminished in direct proportion to the simplicity and lightness of the shoe.

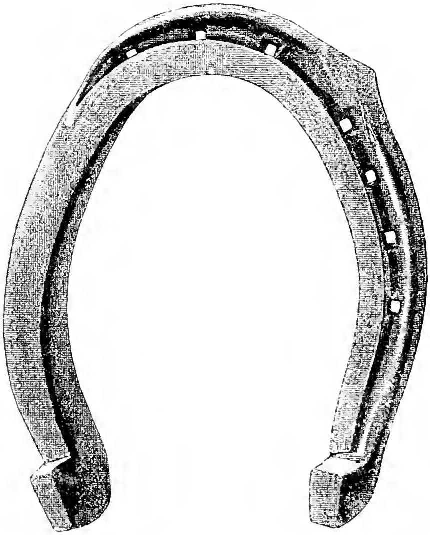


FIG. 286.—Fullered feather-edged hind shoe (with two calkins).
Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

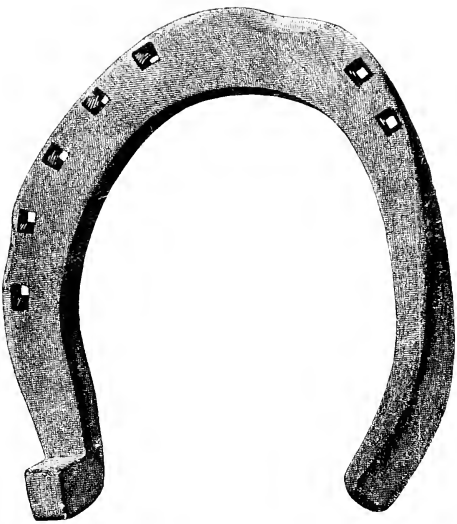


FIG. 287.—Feather-edged stamped hind shoe (with two nails inside toe).
Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

*To face p.* 293.]

# SPECIAL SHOES FOR HORSES THAT CUT.

## FULLERED FEATHER-EDGED HIND SHOE (WITH TWO CALKINS) (FIG. 286).*

*Made of $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

This is a useful shoe for carriage horses used on macadam roads, and for horses which slip with their hind-feet, and yet require a feather-edged shoe. It gives the horse better foothold and more confidence in going. The calkins should be rather low and strong. In the shoe illustrated they are $1\frac{1}{8}$ inches in height. The clips are placed on either side of the toe.

## FEATHER-EDGED STAMPED HIND SHOE (WITH TWO NAILS INSIDE TOE) (FIG. 287).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

This shoe is much used in London. It is 'knocked up' inside, has a calkin on the outside heel, and is slipped at the toe and outside quarter.

Although useful as a stock shoe for carriage horses, it has no special advantage, and the inside limb presenting so narrow a bearing surface for the foot, soon becomes imbedded in the horn.

* Great difficulty has been found in drawing a sharp line of demarcation between shoes which may properly be regarded as of every-day use and those which should be relegated to special sections, such as 'cutting and forging.' The arrangement adopted is far from perfect, but, in face of the great practical difficulties to be encountered, the reader's forbearance is relied on.

## PARTIALLY FEATHER-EDGED FULLERED HIND SHOE (Fig. 288).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

For harness or riding horses which have not much horn at the toe, or which cut towards the back of the inside heel of shoe and require to be clipped on either side of the toe, this shoe has been designed.

Two nail holes are placed in a short length of fullering close to the inside toe. The calkin on the outside heel gives a certain amount of hold on slippery ground. The foot surface of the inside limb is considerably greater than in the ordinary feather-edged shoe, and the shoe is therefore less likely to sink into the foot.

## PARTIALLY-FULLERED FEATHER-EDGED HIND SHOE (Fig. 289).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

This shoe is intended for harness or riding horses which cut badly at the inside toe. There are two clips, one at the outside toe and another at the inside heel. This disposition allows the inside toe to be fitted very fine. The inside clip is drawn on the *corner* of the anvil and from the inside of the shoe, so that no clip hole appears on the part of shoe opposite the injured limb; this part of the shoe, on the contrary, presenting a perfectly plane surface. The shoe is, in fact, not of sufficient substance at this point to allow of a clip being drawn in the ordinary way.

The above method of drawing a clip is worthy of special notice, as such inside clips are often very useful when the horse breaks the inside nail of his hind shoes or drives the shoe outwards.

Fig. 288.—Partially feather-edged fullered hind shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

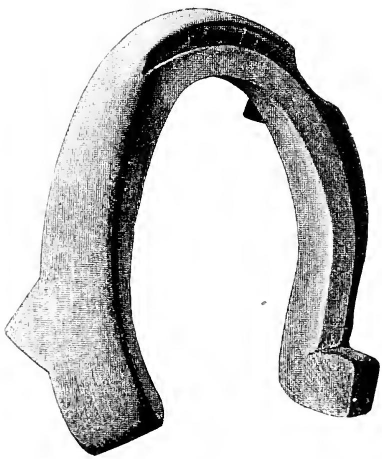


Fig. 289.—Partially-fullered feather-edged hind shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[To face p. 294.

FIG. 290.—Fullered hind shoe, 'set' inside. Made from ⅝ square iron.

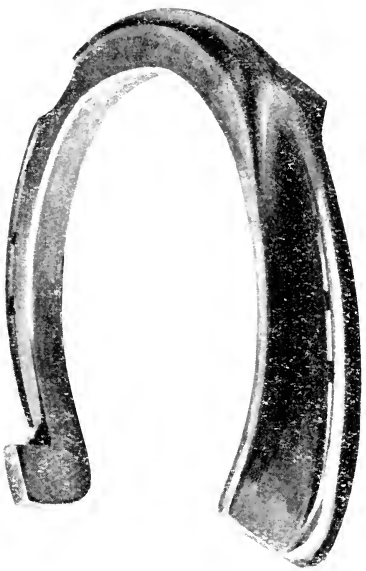


FIG. 291.—Side view of above special hind shoe for horse which cuts his fetlocks.

*To face p.* 295.]

## FULLERED HIND SHOE, 'SET' INSIDE (Figs. 290, 291).

*Made from $\frac{5}{8}$ square iron.*

This is really a feather-edged hind shoe which can be nailed inside. When a horse is deficient in horn at the toe, or the toe cannot be utilised and the horse cuts his fetlocks badly, this shoe is very useful. Though difficult to make and not commonly used, it has been subjected to a thorough practical test and found satisfactory.

The inside of the shoe is drawn very much like that of an ordinary feather-edged shoe; it is then turned on the beak iron of the anvil and the 'set' tool applied. When sufficient 'ledge' is obtained, the part is fullered and the nail holes stamped.

The shoe has a calkin outside of equal height with the inside feather-edge and is clipped at either side of the toe. It is suitable for hacks or for harness horses.

## FULLERED SEATED FEATHER-EDGED FORE SHOE. FOR HARNESS OR RIDING HORSE (FIG. 292).

*Made from* $\frac{7}{8} \times \frac{1}{2}$ *inch iron.*

Where a horse cuts close to the inside toe and has a tendency to cast his shoes, the use of this shoe is indicated. Two nails inside give greater security than one, and the clip provided at the outside quarter prevents the shoe being driven in, across the foot, as is apt to occur with horses which go much on the outside. The quarter clip also prevents the farrier placing the shoe 'across the foot' in nailing-on.

All shoes of this class should be lightly chamfered or bevelled along the outer, lower border of the inside limb.

It will be noted that the shoe has two clips, one at the toe and one at the outer quarter.

## FULLERED SEATED FEATHER-EDGED FORE SHOE (FIG. 293).

*Made from* $1\frac{1}{8} \times \frac{1}{2}$ *inch.*

On account of its being so frequently employed, it has been thought desirable to figure this shoe, but its use cannot be recommended. The inside quarter and heel are drawn down almost to vanishing point. The foot surface is narrow, and the shoe soon becomes embedded in the foot, bruising the sensitive structures and producing corns.

Fig. 292.—Fullered seated feather-edged fore shoe. For harness or riding. Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

Fig. 293.—Fullered seated feather-edged fore shoe. Made from $1\frac{1}{8} \times \frac{1}{2}$ inch iron.

[To face p. 296.

FIG. 294.—Fullered feather-edged concave fore shoe. Made from $\frac{5}{8} \times \frac{3}{8}$ inch iron.

FIG. 295.—Fullered hind shoe for hack. Made from $\frac{5}{8} \times \frac{1}{2}$ inch iron.

*To face p.* 297.]

## FULLERED FEATHER-EDGE CONCAVE FORE SHOE (FIG. 294).

*Made from $\frac{5}{8} \times \frac{3}{8}$ inch iron.*

This is a very light pattern shoe, suitable for a steeplechase horse that requires a feather-edged shoe, or for a hunter which wears little and has a fairly strong foot. The lightness of the shoe is, in itself, a powerful factor in lessening the chance of a horse cutting; and the toe-nail being placed well forward and close to the clip, the shoe can be fitted 'fine' at the inside toe.

If made of steel this shoe often cures cases where a horse both 'cuts' and 'forges.'

It may even be used for riding and harness horses with strong feet.

## FULLERED HIND SHOE FOR HACK (FIG. 295).

*Made from $\frac{5}{8} \times \frac{1}{2}$ inch iron.*

This shoe is for cases where it becomes necessary to nail the shoe back at the inside heel, as when the toe is defective from having been worn away by 'forging,' or when the horse cuts at the inside toe, so that nails either cannot be inserted at that point, or the fitting has to be so very 'fine' that some other device seems preferable. The outside calkin is perhaps not an advantage. Calkins seem to displace the centre of gravity of the body in a forward direction or, in simple language, throw the weight of the body further forward; hence the offending foot is able to reach further. Whether the reader accept this explanation or not, it is at least certain that some horses which forge when shod with calkins cease to do so when shod flat (behind). Of course flat shoes should not be used when the horse suffers from curb, etc.

Clips are placed at the outside toe and inside heel. The three inside nail-holes can, if preferred, be stamped without fullering.

## CONCAVE FEATHER-EDGED HIND SHOE PARTIALLY FULLERED (FIG. 296).

*Made in concave tool from old shoes or from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

This shoe has the inside edge chamfered down, is level on the ground surface, and has only one nail hole, stamped well forward close to the toe-clip. The clips are not shown in drawing, but are usually drawn at the toe and outside quarter, the shoe being intended for use when the horse cuts badly. In exceptional cases the shoe may be cut down to three quarters or even less inside.

Assuming that the horse cuts to this degree, only one nail can be placed inside, and even then special care is required to see that the nail is well hammered home, the elench well drawn, and the head of the nail rasped off flush with the inside of the shoe (*i.e.*, the surface opposed to the injured fetlock). The nail hole must not be back-pritchelled, or only very slightly so, as this is a frequent cause of clenches 'rising' when the shoes become worn.

As a very great strain falls on the single nail, it is often advisable to draw a clip at the inside heel, in addition to those at the toe and outside quarter. In this position the clip relieves the single nail of all lateral or 'shearing' stress, and is a natural advantage. The toe of the foot may be allowed to overhang that of the shoe.

It may not be out of place to repeat that the inside margin of shoe opposite the fetlock, which is struck, must be well chamfered down, as shown.

## CONCAVE PARTIALLY-FULLERED FEATHER-EDGED HIND SHOE (FIG. 297).

*Made in concave tool from old shoes, or from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

To ignore this shoe might be looked upon as an oversight, but although it is included its general use cannot be recommended. The shoe is clipped at either side of the toe; has a calkin on the outside, and an inside feather-edge of equal height with the calkin.

FIG. 296.—Concave feather-edged hind shoe, partially fullered. Made in concave tool, from old shoes or from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

FIG. 297.—Concave partially-fullered feather-edged hind shoe. Made in concave tool from old shoes or from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[*To face p.* 298.

FIG. 298.—Feather-edged fullered concave fore shoe. Made in concave tool from $\frac{1}{2} \times \frac{1}{4}$ inch iron or steel.

FIG. 299.—Concave three-quarter hind shoe. Made in concave tool from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

*To face p.* 299.]

The objections to it are, the narrowness of its inside foot surface, which becomes imbedded in the foot after two or three weeks' wear, and may loosen the wall at the inside quarter or heel, and the fact that, as the fullering extends round the toe, a sharp knife-like edge is produced capable of inflicting very severe injury on the heel of the fore-foot in case of the horse overreaching.

## FEATHER-EDGED FULLERED CONCAVE FORE SHOE (FIG. 298).

*Made in concave tool from $\frac{1}{2} \times \frac{1}{4}$ inch iron or steel.*

This shoe, being very light, is suitable for steeplechasers, or light-weight hunters, which are exercised on grass. The inside is hammered or chamfered down to a very narrow ground surface, although the foot surface of the inside of shoe is preserved of equal or, if anything, of greater width than that of the outside. The inside of shoe exhibits one nail hole only, and is fitted very fine. Sometimes it is possible to stamp a second nail hole, but the nail heads must then be rasped off flush after nailing on the shoe.

The above is a useful shoe for horses which forge badly and cut the opposite leg. If the horse is used on the road, the shoe must be of steel. The fullering is produced by a ridge in the groove of the concave tool.

## CONCAVE THREE-QUARTER HIND SHOE (FIG. 299).

*Made in concave tool from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

In some cases of cutting, as, for instance, when the cutting part is near the heel, this shoe is very effective. Having no nail holes at the toe, it can also be well 'set-back' at that point, in the event of the horse overreaching, and on account of the inside heel being cut off, it may be advantageously used for a horse with inside false quarter.

Being most frequently used for hunters which are always on soft ground, the calkin is a distinct advantage; but when animals thus shod are worked on hard roads, there is a tendency to strain the joints, as the bearing is uneven.

As shown by the illustration. the clips are on either side of the toe.

## THREE-QUARTER PARTIALLY FULLERED HIND SHOE (Fig. 300).

*Made from old shoes, steel, or $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

Many horses which otherwise cut badly can be kept at work by using this shoe.

As the fullering stops short of the outside toe nail-hole, both toe nail-holes can be stamped, and the inner one can be placed well forward, while a strong clip can also be drawn. The position of the clips is sufficiently indicated in the drawing. The inside limb of shoe is gradually thinned down to about a quarter of an inch. The inner margin of the shoe (opposite the part struck) is chamfered down and hot rasped, so as to present a rounded surface. The inside toe of the shoe must be fitted very fine.

In extreme cases of cutting, the shoe can be cut off close behind the inner nail hole. The disadvantages of this shoe are that, as the position of the inner nail hole cannot be changed, the nail holes come in precisely the same spot, time after time, when shoeing; if the feet are weak and brittle, this constitutes a grave drawback. It is perhaps scarcely needful to point out that to place the inner nail hole closer to the toe would interfere with drawing the clip, while to place it further back would probably result in the animal again cutting.

Fig. 300.—Three-quarter partially fullered hind shoe. Made from old shoes, steel, or $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[To face p. 300.

## CHAPTER IV.

### LEATHER AND RUBBER SOLES, ETC.

These soles are either nailed on, and, therefore, remain in position until the next shoeing, or are slipped in and out between the limbs of the shoe.

Until comparatively recently only leather soles were in use, the object being to protect weak soles or diminish the pressure of the shoe on the hoof, which had been either excessively worn away or thinned with the knife. Rubber pads are quite a modern production. Following rubber came a series of materials, such as cork, straw, tarred rope, felt, bast, hemp, wood fibre, etc. Whatever the nature of the material, the purpose is to diminish or remove the disadvantages resulting from shoeing, especially in horses used on hard pavements. As one such contrivance has little advantage over another, they may here be considered in general. All, to a greater or less extent, (1) prevent slipping and falling on smooth pavements, (2) check desiccation of the sole, (3) prevent balling of snow in the foot, (4) diminish concussion, (5) favour expansion of the foot, and (6) guard against picking up nails.

Leather pads transmit to the sole, frog, and bars some of the weight which would otherwise fall on the wall and increase the functional activity of these parts. In a degree, therefore, they restore the hoof to the normal unshod condition. Remembering that many diseased conditions, like contracted hoof, sand-crack of the wall or bars, corns, etc., are ameliorated, if not cured, by removing the shoes and turning the horse out, the improvement produced by artificial soles is more easily understood. When used with suitable shoes they provide a means not only of arresting the bad results of shoeing, but also of curing foot diseases while allowing the animal to work. Expansion of the hoof follows their use. Nevertheless, they have their disadvantages. Occasionally they cause thrush, bruising of the sole, and, in some instances, they tend to loosen the shoe. When the sole is permanently fixed in position, thrush is comparatively common and cannot always be prevented even by using antiseptics or tar dressings. Leather pads, therefore, should only be used when the horse works on hard pavements. The following *resumé* is far from exhaustive, but contains a description of the pads most frequently used.

## 1. Leather Soles

are formed of leather from $\frac{3}{16}$ to $\frac{5}{16}$ inch in thickness. The hoof surface of the shoe is laid on a square piece of this, the outer margin and the recess for the clip marked, and the sole cut out. As the sole raises the hoof and renders it somewhat wider, the shoe must be fashioned to correspond. The clips should be drawn rather longer than usual, the exact extra length being the thickness of the leather used. The leather of the sole is fastened to the heel of the shoe by means of a 'stub.' The leather sole itself is of comparatively little service, but becomes much more effective when the space between it and the horny sole is filled with tow or similar elastic material, which transmits to the sole a certain amount of the pressure produced during motion. The tow may be locally distributed, any portion of the hoof which is painful being left uncovered; other parts may be caused to take more pressure. Leather soles can be used both for ordinary and bar shoes, even when the frog is affected with thrush. In such case, all loose parts are removed from the diseased frog, which is dressed with carbolic solution, smeared with Stockholm (wood) tar or Venice turpentine, so as to protect the frog from the air and from septic matter, and the space completely filled with tampons of tow. It is only necessary to use sufficient tow to exercise moderate pressure on the sole. With the exception of cases of canker and exposure of the sensitive structures of the sole, the leather sole with stopping may be used with advantage in all hoof diseases.

*Disadvantages.*—The most frequent accident is the entrance of sand, etc., between the horn and leather, causing bruised sole. When the stopping is carefully inserted, however, this need not be feared. Drying of the leather sole can be prevented by dressing the upper surface with tar or grease. In treating narrow or contracted hoofs it is well every few days to immerse the entire hoof in a bucket of water so as to thoroughly moisten the horn. Afterwards the sole itself may be rubbed with some form of hoof dressing.

## 2. Rubber Pads on Leather.

The leather used is similar to the foregoing, but on it is sewn, or more frequently cemented, a mass of rubber of varying shape. In the case of fig. 301 the rubber is about $\frac{5}{8}$ inch and in fig. 302 about $\frac{3}{4}$ inch in thickness. In the sole shown in fig. 301 the rubber corresponds in size to the width of the posterior third of the hoof. The heels of the shoe are, of

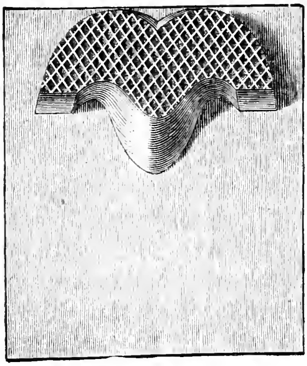


Fig. 301.—Rubber bar pad on leather.

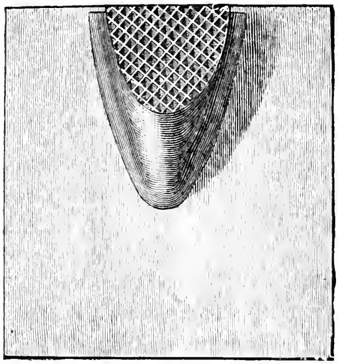


Fig. 302.—Rubber frog pad on leather.

course, shortened. The pad shown in fig. 302 is used with an ordinary flat shoe. As the rubber projects considerably the shoe should be made a little thicker than usual, though to act most effectually the rubber must project $\frac{1}{8}$ inch beneath the shoe. The pad shown in fig. 302 is much more easily and rapidly fixed than that shown in fig. 301. These pads are useful both for sound and for many diseased hoofs, in which they may advantageously be used where a leather sole would otherwise be applied, while at the same time they prevent slipping. They are only fully effectual when used in conjunction with a properly applied stopping of tow and tar.

### 3. Downie & Harris's Rubber Pad with Frog Cleft.

This is one of the oldest rubber pads. It is fixed to the shoe and forms a cushion, at the same time transmitting pressure to the sole and bars. Towards the frog cleft (*b*) it is depressed and becomes thinner (*a*). The margins of the frog cleft should lie in the lateral furrows of the frog. The pad prevents concussion, diminishes slipping, and obviates balling of snow. It can be worn continuously and improves many

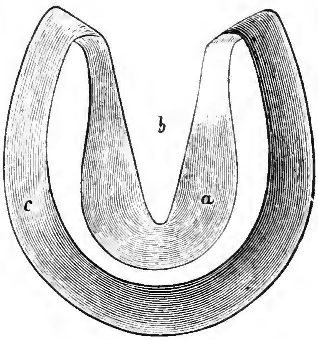



Fig. 302 a.—Downie's rubber pad. *a*, concave portion; *b*, incision for the reception of the frog; *c*, outer margin on which the wall rests.

(defective) feet. For convex soles, however, it is disadvantageous, and in very oblique hoofs there is difficulty in applying it.

In fitting it the lateral furrows of the frog should be moderately cut out, especially towards the heel, and to make it correspond to the sole the pad must sometimes be trimmed with the knife. The shoe should be moderately strong and not excessively seated out, the inner upper border being well rounded off. At the toe the pad should not project below the ground surface of the shoe, but at the heels it may extend $\frac{1}{8}$ inch lower. In driving the nails the cushion part should be pressed against the inner margin of the shoe by the thumb of the left hand, so as to ensure its lying correctly. The disadvantages of using this pad are the occasional loosening of the shoe and the entrance of sand, which leads to bruising of the sole.

### 4. Hartmann's Removable Rubber Pad.

This consists of an oval thick mass of rubber, corresponding in outline to the inner border of the shoe. The surface opposed to the hoof is rounded and exhibits at the back a depression for the reception of the frog; the under surface has two long shallow depressions. At the front and on either side a steel tongue projects, which slips into the space between the sole and seated portion of the shoe and holds the pad in position.

The shoe must be well seated, and the heels converge sufficiently to prevent the pad slipping out behind. Special tongs (fig. 302 B) are used for inserting and removing the pad, which

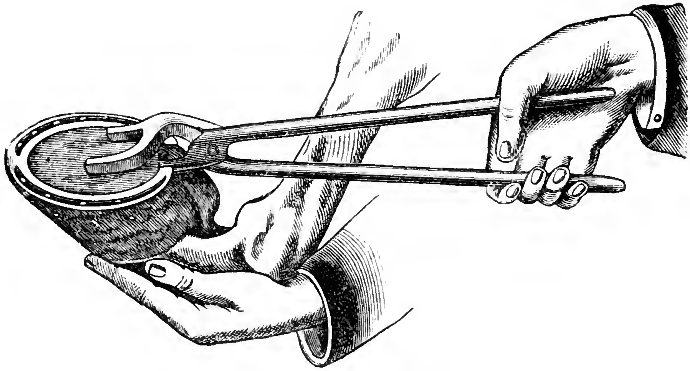


FIG. 302 B.—Showing method of inserting Hartmann's pad, and use of tongs.

is bent on itself, placed in position, and fastened by allowing the little steel projections to slip between the shoe and the hoof. The tongs are then relaxed and removed, the pad recovers its shape, thrusting the steel tongues well under the shoe.

This pad is useful in winter, when it prevents the balling of snow very effectually, and in summer for horses working at high speed on hard roads.

It can be used for all horses with concave soles, but when the sole is flat it is of little value, if not positively injurious, while it is difficult to fit to the foot, because the shoe must not only fit the margin of the hoof but that of the pad in addition, while the nail holes cannot, of course, be displaced.

The more irregular, therefore, the form of the hoof the more difficult does fitting become.

Whether the horse will go well or badly depends upon the fit of the pad. The sole will not bear strong and continued pressure, and, therefore, while the back of the pad may project slightly below the shoe, the toe should always be above its ground surface, and even then should yield a little under the pressure of the finger. To secure this, the pad when first applied must be fitted to the concavity of the sole by rasping

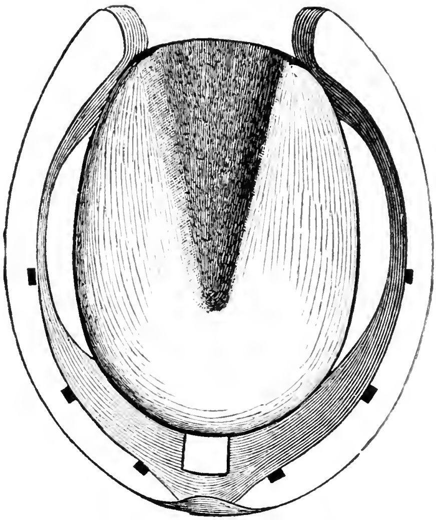


FIG. 303.—Hoof surface of shoe with Hartmann's pad inserted.

or paring. The hoof is prepared as usual, except that the point of the frog must not be left too high. After fastening the shoe with a couple of nails the pad is inserted, and if found to fit the nailing on is completed as usual.

Twenty different sizes are made, ten in rounded and ten in long forms. For hind-feet ten different sizes are also manufactured, so that there should seldom be much difficulty in fitting the foot. The pad should always be long enough to cover the limbs of the frog.

The time it will wear varies according to the horse's work. It may serve for as many as four shoeings. As soon as the horse is brought home the pads should be removed and washed.

If left on the feet they favour thrush, bruising of the sole, and other mischief.

These pads are contra-indicated when there is extensive disease in the white line. They should then be replaced by leather soles. They should never be used in the treatment of diseases of the hoof, except under the advice of a veterinary surgeon. Similar pads, provided on the ground surface with a number of depressions and on the hoof surface with a layer of spongy rubber, are made by Priest & Co., Oxford Street, W. They are termed anti-concussion pads.

### 5. Rope Pads (fixed)

consist of a leather sole covered on the hoof surface with thick felt and on the ground surface with a flat coil of rope arranged to form a pad resembling Hartmann's. They are inserted in the same way. On moist, greasy asphalt, wood, or stone pavements these are more effectual against slipping than Hartmann's, on account of their picking up sand and always presenting a rough surface. They are not removed in the stable.

### 6. Straw Pads

were invented by a German military veterinary surgeon, Reinicke. They consist of straw plaited into a flat mass, corre-

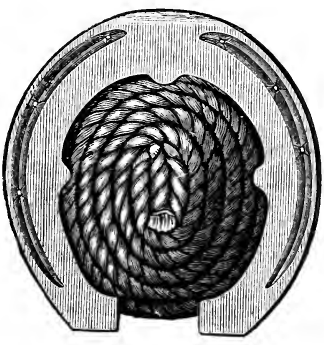


Fig. 304.—Special shoe for straw or fibre pad.

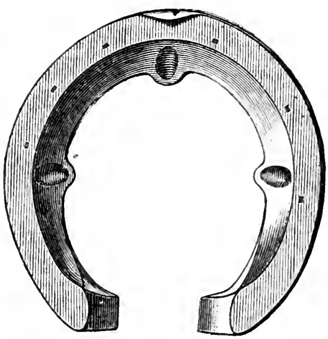


Fig. 305.—Upper surface of above shoe.

sponding in shape to the space enclosed by the shoe. The shoe used with them is well seated out, and provided with three projections on its inner margin, while the heels are turned inwards at the ends, like a broken or interrupted bar shoe. Before insertion, the straw is moistened, and the horny sole smeared with tar to prevent thrush. To ensure it remaining in position, the pad should be so large that its margin extends between the hoof and shoe. It has the same advantages as the rope pad, and is very cheap—in fact, it can be made by the groom. Its disadvantages are: the rapidity with which it wears out on rough hard ground, and the fact that in thrushy feet its use aggravates the disease, despite the previous use of tar or other disinfectant. Pads formed of wood fibre or hemp are somewhat more durable, but otherwise have no special advantages over straw pads.

### 7. Cork Pads

are made by cutting from a sheet of cork about $\frac{3}{4}$ inch thick a piece corresponding in size to the outline of the seated portion of the shoe. The piece is then pared so as to fit the surface of the sole, and the outer and under margin cut away, corresponding to the seating of the shoe. After being softened in hot water, the mass of cork is forced into position between the limbs of the shoe. It is not necessary for the heels to be so incurved as when using straw pads, nor for the cork to enter so far under the shoe. Being at first soft, it moulds itself to the inner margin of the shoe.

The cork pad is light, cheap, and durable; sometimes, however, it induces thrush.

### 8. Felt Pads.

Felt, which on account of its soft, elastic nature has been largely employed, as an upper layer, in various forms of pad for tender feet, and even as a material for the fabrication of entire pads, does not, in general, deserve the praise it has received. It is too yielding, and, therefore, does not always prevent pressure by the shoe. It rubs through at the heels, takes up too much water, and in oblique hoofs renders the sole soft. Further, its yielding soon causes the shoe to become loose. In all these respects it is much inferior to leather. If it is intended merely to prevent shock, felt should be employed in conjunction with leather.

### 9. Pads of Elastic Cement.

In this case the shoe is of the ordinary variety, the pad being inserted after shoeing is complete. The hoof is first cleansed and disinfected. The elastic cement is melted in a ladle over a slow fire, until it forms a thick fluid. It is then smeared over the entire surface of the sole with an iron spatula, and well pressed in between the seating of the shoe and the hoof. When sufficient has been inserted, the cement is cooled in water, or the hoof let down, though in such case the ground must be level and moist, so that the cement shall not stick to it. Instead of being melted in a ladle, the cement may be softened in water until ductile, in which condition it is pressed into the hoof.

Artificial soles of elastic cement appear to succeed very well, the upper surface necessarily corresponding exactly in shape to the sole, of which it is a plastic reproduction. The counter-pressure of the ground is, therefore, evenly transmitted to the entire sole.

The frog can be covered or left exposed. At the toe the ground surface of the shoe should be about $\frac{1}{8}$ inch deeper than the inserted cement, so that the latter does not touch the ground when the animal stands on a level surface.

## CHAPTER V.

### THE SHOEING OF MULES AND ASSES.

MULES and asses used on hard roads, either in draught or under the saddle, must necessarily be shod. In these animals the formation and functions of the hoof are precisely similar to those of the horse, the form alone differing somewhat. The mule's hoof is long and narrow, round at the toe, possesses somewhat upright quarters and a concave sole. In the ass the elongated form is still more pronounced. The horn of the wall is thick, the entire frog well developed, especially in its

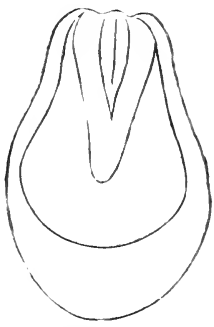


FIG. 306.—Hind-foot of ass, seen from below.

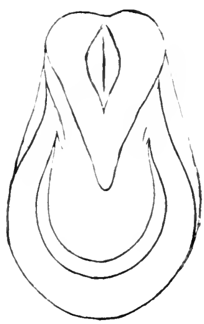


FIG. 307.—Fore-foot of ass, seen from below.

FIG. 308.—Fore-foot of mule, seen from below.

limbs, and, therefore, the posterior portion of the hoof is comparatively wide (see fig. 306). In both animals the horn is very tough. In proportion to the size of the hoof, and compared with small equine hoofs, the thickness of the wall in mules and asses is very marked. In mules the hoof at the toe is from $\frac{3}{8}$ inch to $\frac{1}{2}$ inch, at the quarters $\frac{1}{25}$ inch less, and at the heels about $\frac{1}{4}$ inch in thickness. In asses the thickness at the toe is $\frac{5}{16}$ inch to $\frac{1}{2}$ inch, at the quarters $\frac{3}{16}$ inch to $\frac{3}{8}$ inch, and at the heels $\frac{3}{16}$ inch to $\frac{1}{4}$ inch.

The shoes differ from those of the horse in respect of the number and disposition of the nail holes, and in being lighter and less thick. In the ass the nail holes need not exceed four, and in the mule five to six in number.

As the wall is very hard and tough, the nails employed are short, but fairly stout. Ordinary horse nails are rather weak in the shank, and, though often used, are liable to double up when being driven, if used for donkeys or mules.

# CHAPTER VI.

## CARE OF THE HOOF.

THE ideas entertained by many owners, and especially by farriers and coachmen, as to the proper treatment of the hoof, are usually so peculiar, and their practice is attended by such disastrous results, that a few remarks on the care of the hoof may not be superfluous. The primary objects should be to retain the natural form of the hoof, and to keep the horn sound and elastic.

### (*a*) TREATMENT OF UNSHOD HOOFS.

The treatment of the foal's hoof is of considerable importance. The most beneficial effects are obtained by free exercise on dry but not stony ground. The hoofs being thus worn down, it is only occasionally necessary to note whether wear is regular, and should it not be so, to remove irregularities with the rasp.

When foals are confined to the stable this regular wear ceases, the hoof becomes distorted, the wall growing too long, becoming bent, or at times even separated, from subjacent structures. Weak heels tend to bend inwards and to diminish in width. The toe becomes elongated, rendering the fetlock too sloping, the tread unsafe, and the gait stumbling. It should, therefore, be shortened from time to time. In-curved heels are to be lowered and the outer and lower margin of the wall rounded off with the rasp. Should the hoof begin to assume a flat appearance much may be done to remedy the defect by intelligent trimming of the hoof, always keeping in mind, however, the normal relations of the hoof and foot axes. Regular washing of the hoofs and the provision of plenty of clean bedding are of great importance.

The shoeing of colts is to be strongly deprecated. The development of the hoof is impeded by shoeing, and young horses when shod are often excessively worked and thus ruined before they attain maturity. Moderate work in the fields does not injure young stock, but for this purpose shoes are not required.

When full-grown unshod horses are not regularly exercised it is also necessary from time to time to lower the wall and to round off its outer edge with the rasp.

### (*b*) Care of the Shod Hoof.

The hoof when shod is more exposed to injury than when unshod, for shoeing, though absolutely necessary to permit of work on hard roads, prevents or diminishes the expansion and

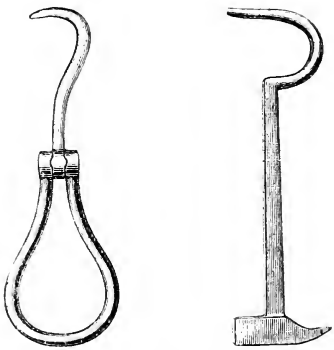


Fig. 309.—Instruments for cleaning out feet. Left, portable form; right, stable form with hammer.

contraction of the hoof, and thus interferes with local circulation and checks the growth of horn.

To this may be added the bad effects of standing in stables. The animal suffers from want of exercise, from the foulness of the surface on which it stands, and from drying of the hoof. Continued standing causes contraction of the hoof, a condition favoured by dryness. This is best seen in front hoofs. Badly laid or uneven floors cause fatigue of the limbs, favour the accumulation of urine, etc., and are thus indirectly responsible for attacks of thrush. To prevent such contingencies the hoof should be shortened every four to six weeks, and if necessary the horse should be re-shod. The stall should be kept clean and the foot itself moist. The straw should be dry and renewed daily, and the hoofs picked out and washed every morning. This will prevent thrush in the hind-feet. The front-feet gain sufficient moisture from the daily washing to preserve their elasticity, and thus permit of the horny capsule yielding when weight is thrown on the hoof. To prevent the hoofs becoming dry, the entire surface may afterwards be smeared with hoof ointment. This prevents loss of moisture, and, in cases where daily washing is impossible, some variety of hoof dressing is advisable. Only a small quantity of the ointment is necessary, but the entire hoof, especially the perioplic ring, frog, and horny sole, should be covered. Vaseline and lanoline are very good dressings, the latter being somewhat expensive. One of the chief means of securing a healthy hoof is plenty of exercise. This increases local circulation and growth of horn, for which reason horses in regular work usually have better hoofs than those much confined to the stable.

*Note.*—Zschokke, Smith, and Dominik have all made experiments on the action of hoof ointments. Zschokke considers they diminish absorption and evaporation, and are most effectual where these processes go on most actively, viz., in the frog and in the sole. They have little effect on the horn wall. Vaseline and lanoline produce the best results, glycerine tends to dry the hoof.

Apart from this indirect action no hoof ointment appears to have much effect in preserving the horn. Vaseline, applied to freshly trimmed soles and frogs, may prevent rapid drying of the exposed horn and exclude dirt or irritant fluids. Its action principally depends on its retarding the evaporation of water previously absorbed ; it has little effect on the wall, and its effects on the sole and frog are increased by previous cleansing. An ideal hoof dressing should not chemically alter the horn, should keep well, be impervious to moisture, exercise a disinfectant action, and be cheap. According to Veterinary-Major Fred. Smith (see "The Chemistry of the Hoof of the Horse," *Veterinary Journal*, 1887, page 373), the horn very readily loses water, fresh wall horn losing in twenty-four hours from 1·92 to 2·45 per cent., and in five days from 4·36 to

4·71 per cent. Smith gives the following figures as to the capacity for absorption of fresh wall horn. In from twenty-six to ninety-eight days the horn absorbed:—

| | |
|---|---|
| Water, . . . | 20·36 per cent. |
| Castor oil, . . | 0·234 per cent. (brittle, dry horn). |
| Olive oil, . . | 2·2 per cent. |
| Lanoline, . . | 8·5 per cent. |

The loss of such substances in a given time is more or less the same as the gain. Dominik has confirmed the experiments of Zschokke and added to them as follows:—

1. Horn loses moisture but slowly: evaporation is greatest from the periople, frog, sole, and portions of the wall which have been rasped or fissured.

2. Horn takes up water to a slight extent, absorption being freest in the frog and periople; less so in the freshly pared sole and in the rasped and fissured wall.

3. The frog and periople become completely softened and their length and thickness alter.

4. Hoof ointments diminish both evaporation and absorption of water, especially by the periople and frog.

5. Oil is a less valuable dressing than ointment. The dressing should be of moderately firm consistence and may contain wax, turpentine, and fat.

6. Tar penetrates and softens the superficial layers. It is, therefore, only suitable for the sole and frog, in which the superficial parts are naturally shed.

7. Ointments of wax, turpentine, and fat are most effectual on the periople, on the freshly trimmed frog and sole, and on the rasped or fissured wall. They preserve the elasticity of the horn chiefly by preventing evaporation. Poultices and foot-baths are only necessary where the feet become excessively dry from horses standing continuously in the stable.

As ointments have little power of softening horn, their use should always be preceded by that of water.

# SECTION III.

# THE SHOEING OF DISEASED FEET AND OF LAME HORSES.

ON account of the intimate connection and interaction between the hoof and the limb above it, changes in one part are usually associated with changes in the other, and it is not always possible to draw a sharp line between sound action and lameness. Disease of the limb may produce changes in the form and condition of the foot, while, *vice versa,* changes in the foot or faults in shoeing may be followed by disease in the limb. The diagnosis of disease of the hoof and limb is chiefly the function of the veterinary surgeon, but the instructed farrier should possess at least an elementary knowledge, because it is his duty, on the one hand, to avoid inducing disease, and, on the other, to prevent or minimise its evil effects.

## CHAPTER I.

### INFLAMMATION WITHIN THE HOOF.

LAMENESS is usually produced by a localised disease process, consisting of interference with nutrition and its resulting phenomena, which are recognised under the title of inflammation. The first stage of inflammation is indicated by the sudden determination of blood to the part. This is followed by congestion and even by complete stoppage of circulation in the injured area. Certain constituents of the blood may then pass through the vessel walls into neighbouring tissues, causing changes in form and relation and interfering with the function of the inflamed parts.

The *symptoms* of inflammation are five, viz., pain, increased warmth, local reddening, swelling, and impaired function. These symptoms are only to be observed in their entirety during inflammation of superficial portions of the body. Inflammation of internal organs, on the other hand, can only be conjectured from disturbed function and its consequences.

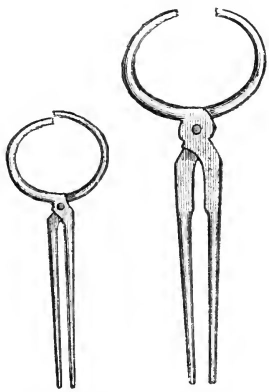
In inflammation within the hoof the five above named symptoms are all present though not all observable; thus swelling and redness can only be noted when the coronary band and the bulbs are inflamed, and even then redness is only to be seen in non-pigmented skin. In laminitis, however, another important symptom is usually present, viz., increased pulsation of the digital arteries. Pain, increased warmth, and lameness are, however, invariably present, and are, therefore, of the greatest diagnostic value. The seat of inflammation is usually the corium. When lameness is solely due to contraction, etc., of the hoof, symptoms of inflammation are wanting, though laminitis is probably more apt to occur in weak and fleshy than in sound, strong hoofs.

The inflammation in from about two to six days ends in resolution, or may be followed by so-called rheumatic or chronic laminitis, suppuration, which is indicated by continued pain, or even by necrosis and septic-inflammation, which are usually followed by loss of the hoof and death.

The *examination* should be commenced by walking the horse, when it will be seen whether the animal is lame at all, and if so, on which limb. The statements of the groom are not always to be relied on, nor (after exercise) is the lameness always so marked as to be seen at the first glance; sometimes it is only visible at a trot or on hard pavement. The horse when walked or trotted, especially on hard ground, will be seen to go short and timidly on the lame foot, the limb not being extended in the ordinary way, the diseased foot being lifted from the ground more rapidly than the sound one, and the weight of the body thrown more rapidly and with more force on the normal foot. The body, therefore, appears to sink towards the sound side. In short, the horse nods. Once the lame limb is discovered the foot may be examined.

The painful spot may be only of small size, and, therefore, the examination should be thorough. Specially formed tongs have been made for this purpose, the smaller of which (fig. 310) is for the examination of parts close to the circumference of the sole, the larger for parts further removed and for the examination of the joint and navicular bone. The farrier's ordinary pincers serve every purpose, however.

It requires considerable care to distinguish between the natural sensitiveness of the horse and the pain caused by disease. Rough, violent use of the pincers must always be



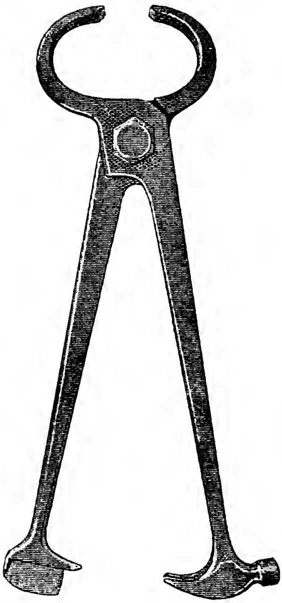
FIGS. 310, 311.—Special pincers for examining diseased feet.

avoided, for severe pressure will produce pain even in the soundest hoof. The same force must be applied at each spot, the hoof being tested at short intervals over its entire surface, as the diseased spot and corresponding area of tenderness are often very restricted.

The degree of pressure should be adapted to the condition of the sole. When the parts are thin and yielding, very little pressure produces pain, and the tender spot is quite sufficiently indicated by slight quivering of the muscles of the shoulder and upper limb.

Sometimes the pincers fail; the suspected spot may then be tested by light blows with the hammer. Increased local warmth sometimes gives information, which can be confirmed

## COMBINATION FARRIER'S TOOL.



The tool illustrated combines in itself pincers, hammer, and buffer. As it occupies no more space than an ordinary pair of pincers, it may be carried without inconvenience, and is useful for removing a shoe in an emergency. By removing the nut, the hammer and buffer can be used to cut the clenches, and by replacing it a pair of pincers for removing the shoe and 'trying round' the foot is obtained.

[*To face p.* 318.

by the use of the hammer. The condition of the lateral cartilages should be noted and the individual joints of the foot tested by passive movement and by manipulation to detect new growths or excessive sensitiveness. If, in spite of all this, no satisfactory indication of disease is forthcoming, the flexor tendons may be examined by running the thumb and forefinger along their course and noting any thickened or painful spot.

The *causes* are numerous and varied. They may be divided into (1) congenital, (2) mechanical, (3) thermal, (4) chemical, and (5) specific. The first three, however, are of chief importance. Congenital causes are to be found in faulty conformation of the limb and irregularities in the condition of the hoof causing unequal distribution of pressure. Mechanical causes are numerous; amongst them must be ranked, errors in trimming the foot, weakening the hoof, bad fitting (causing local pressure), dryness of the hoof, unskilful or excessive driving, as well as direct wounds and bruises of the sensitive structures of the hoof. Amongst thermal causes is burning of the toe during fitting. Chemical and specific causes are rarer. The fact that the corium lies between the hard horny box and the equally hard os pedis explains the frequency with which it is bruised and inflamed.

The front feet (especially in their inner half) are more often diseased than the hind. This results from the greater weight they carry and the drying influences to which they are exposed. In shoes with heels or heels and toes, one heel is apt to be higher than the other, and as the foot is then raised unnaturally high, any slight error in form or fitting is exaggerated, the joints are strained, and the hoof itself suffers.

*Treatment.*—The chief object is to remove the cause, permanently if possible.

The shoe is carefully taken off, and its form, position, and bearing surface examined. By replacing it for the moment we note whether it fits at all points or not. The hoof is then carefully examined in every part; the white line especially should receive attention. After removing a thin slice from the white line and neighbouring parts the form and direction of the nail holes can be seen. Any superfluous horn is then removed from the wall and sole. The frog is cautiously trimmed, partly to assist the action of poultices, should such be required, partly to make the horny capsule more yielding (and to discover injury caused by gathered nail, etc.). If the sole is coloured yellow, yellowish-green, yellowish-red, red, or pink, we know that blood has been extravasated and has penetrated the horn. The cutting out of the diseased hoof should follow the examination with pincers, and the amount removed should not be sufficient to alter the direction of the limb, nor the manner of tread.

To limit the local inflammation the hoof should be kept cool and soft. The difficulty is less to cool it than to soften the horn, and so, by relieving pressure on the inflamed spot, to favour free circulation of blood. Linseed-meal poultices, to which is added some antiseptic, act most effectually, especially when frequently moistened with water. A piece of sacking 20 to 30 inches square is taken, the poultice placed in the centre, the foot placed on the poultice, and the sides of the sacking drawn upwards and fastened around the coronet by a bandage or straw band, which impedes the flow of blood much less than cords or straps. The portions of sacking which project above the straw band are then turned downwards and fastened securely below the straw band by means of a tape. To thoroughly soften the hard, dry hoof it is necessary to leave the poultice forty-eight hours in position and to moisten it freely with water during that time. In fact it does no harm to leave the poultice in position until the pain has greatly diminished. *But this method must not be resorted to when pus formation has occurred*, as it favours discharge of pus at the coronet and the formation of 'quittor.' After removing the poultice the hoof is washed clean, the shoe replaced, if necessary, and the hoof rubbed with vaseline or fat. Instead of the poultice described, six or eight thicknesses of wet linen may be wound round the hoof and retained in position by a leather or felt boot.

The onset of suppuration is notified by severe, continued pain and marked pulsation of the digital arteries. To provide free drainage for the pus, the most painful spot has first to be discovered. The sole should then be thinned all round the painful spot until the sensitive structures are reached, the bearing surface of the wall being left intact. For this purpose a 'searcher,' *i.e.*, a special knife with a slender blade, or the instrument shown in fig. 312 may be used. The margins of the opening, so far as they are formed by the sole, should be thinned until they yield to the pressure of the finger. If pus be discovered the parts are next flooded with warm 5 per cent. carbolic, creosote, or creolin solution, and covered with carbolic, sublimate, iodoform, or salicylic wool. There is some advantage in afterwards painting the parts with a resinous tincture, like tincture of myrrh or the compound tincture of myrrh and aloes. The dressing is held in position by broad strips of gauze and a

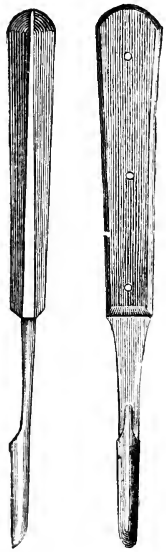


FIG. 312.—Special 'searcher' used in giving exit to pus.

shoe with leather sole applied. A better way to fix dressings in position is by thrusting two thin strips of wood or hoop iron cross-wise between the dressing and shoe.

If no pus be found, cold poultices or baths may be continued.

The colour of the pus is of importance. A grey fluid discharge is a result of superficial inflammation of the corium; a condition which readily yields to treatment. The production of yellowish thick pus, however, even in very small quantities, points to inflammation of the deeper lying layers of the corium and to a more obstinate condition. Under such circumstances the advice of a veterinary surgeon should be sought.

The shoe is made wider or longer in the diseased region than at the points opposite. If, for example, the inner heel is painful, the inner heel of the shoe should be a little longer and a little wider than its fellow, and *vice versa*. To prevent the shoe pressing on the painful spot, the wall is slightly rasped away around that point. But if an ordinary shoe is so fitted that one side of the hoof is free of pressure, it will be noted that during movement the hoof approaches, and actually comes in contact with, the shoe at that point, and with a rapidity in direct proportion to the flatness of the hoof. The hoof springs, in fact. Under such circumstances there must inevitably be pressure upon the diseased spot, and, therefore, in flat feet, ordinary shoes should never be used. In strong, upright feet, on the other hand, this 'springing' is much less, the heels descend comparatively little, because the posterior half of the hoof bears much less weight than in flat feet.

The bar shoe (fig. 313), so called because its heels are united by a transverse bar, is of the greatest service for injured or diseased feet. It enables the frog to assist in supporting the

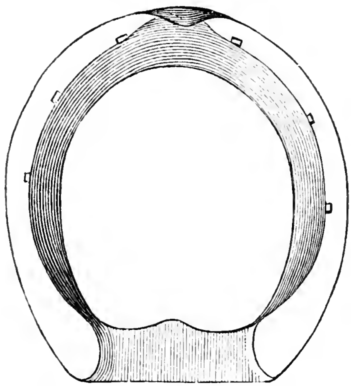


FIG. 313.—Bar shoe, seen from above.

body-weight, thus relieving the wall to a corresponding extent, and whilst with ordinary shoes the frog is almost always functionally passive, the bar shoe restores it more or less to its normal function. In heavy horses with weak feet this relief is of great importance.

A few practical examples will confirm this. We may take the action of the ordinary seated shoe, having a narrow bearing surface covering that of the wall but not extending to any portion whatever of the sole. In horses with narrow upright hoofs and in those working on soft ground this shoe is quite satisfactory, but is liable, under opposite conditions, to produce separation of the wall. By increasing the width of the surfaces of contact between shoe and hoof, or by applying a bar shoe, this is, however, entirely avoided.

In horses with weak heels the ordinary shoe is apt to cause the heel to turn inwards and its use to be followed by production of corns and contraction of the hoof. The cause is the shape of the shoe, which relieves the frog and sole of weight at the expense of the heels, which yield, bend inwards, and cause lameness. The lameness disappears, when, by the application of a bar shoe, the frog is forced to sustain a portion of the weight. In sandcrack and cracks of the bar, this form of shoe supports the posterior part of the foot, and by increasing its functional activity encourages growth and expansion. Where a hoof shows more than one crack the action of the bar shoe is assisted by applying a thick leather and padding the space between it and the sole of the foot with tow. A portion of the weight is then borne by the frog and by the sole itself. A bar shoe can always be applied, even when one quarter or quarter and heel are much broken, provided the frog be sound and fairly developed. Should the frog be healthy, but small, it may be built up by applying gutta-percha or the special cement later described.

In case of the frog being affected with thrush, the procedure is as follows:—After the shoe is fitted, all loose pieces of horn are removed by a searcher, the parts thoroughly washed with water, then with 5 per cent. solution of carbolic acid, creosote, or creolin, the entire ground surface of the hoof smeared with wood tar or Venice turpentine, a pad of tow applied, a leather sole fitted over all and the shoe nailed on. The bar shoe should *not* be employed in navicular disease, double side-bones, or in the case of picked-up nails (which almost always enter the frog).

The bar shoe permits any part of the bearing surface of the hoof to be left uncovered and to be relieved of pressure without stoppage of work. The entire frog is capable of bearing weight, but the posterior part is best suited for the purpose, and there the bar should take its bearing.

## CONCAVE BAR FORE SHOE (FIG. 314).

*Made in concave tool from $\frac{3}{8} \times \frac{5}{8}$ inch iron.*

This is a bar shoe for hunters suffering from sandcrack or any of the other conditions in which bar shoes seem indicated. Although it is often stated that bar shoes are inapplicable to hunters as they are sure to be torn off, the experience of the authors is to the contrary, and Mr Wheatley has on many occasions applied them with success.

Special precautions, however, are necessary. The shoe must be drawn from the centre of the quarter towards the bar until the extreme posterior part is only about $\frac{1}{8}$ inch in thickness, and the bar must not project even a fraction of an inch behind the heels.

To obtain the best results the heels must be fitted 'full' on either side, and the upper outer edge hot-rasped to the dimensions of the foot, so as to present an oblique bevelled margin about $\frac{1}{16}$ or $\frac{1}{8}$ inch wide. There is then no danger of the shoe being trodden off.

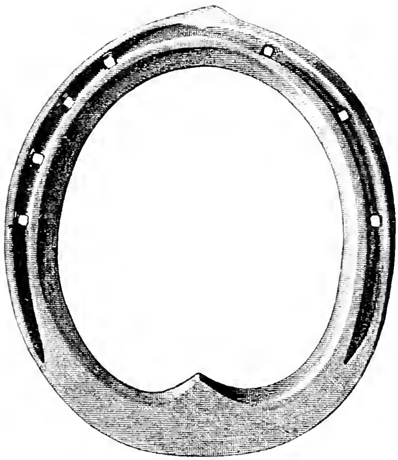


FIG. 314.—Concave bar fore shoe. Made in concave tool from $\frac{3}{8} \times \frac{5}{8}$ inch iron.

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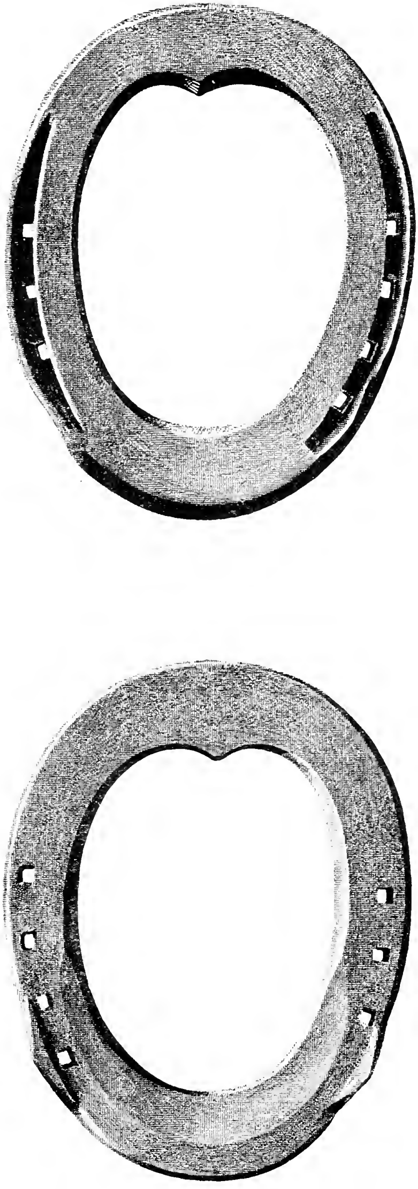

Figs. 315, 316.—Fullered bar hind shoe (seated around toe). Made from $\frac{3}{4} \times \frac{5}{8}$ inch iron.

*To face p.* 325.]

## FULLERED BAR HIND SHOE (SEATED AROUND TOE) (FIGS. 315, 316).

*Made from* $\frac{3}{4} \times \frac{5}{8}$ *iron.*

This is a special shoe for harness or riding horses with 'dropped sole' in a hind foot; it can also be used for the treatment of 'seedy-toe,' as the diseased parts can be dressed through the seating without the shoe being removed.

Clips are drawn on either side of the toe, because in many cases there is not sufficient horn at the toe to permit of their being placed there, and also because clips in this position allow the shoe to be placed further back if required.

The shoe is slightly cradled, *i.e.*, it is thinner at the toe and heel than at the quarter, a formation which enables the animal to place more weight on the back of the foot, thereby relieving the toe. In many cases this is a very important consideration.

The toe of the shoe is widened as well as seated-out, so as to give ample 'cover' to the injured or diseased parts.

## FULLERED SEATED BAR FORE SHOE (FIG. 317).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

This is the ordinary form of bar shoe for harness horses.

Among the conditions in which its use is indicated are :—

1. Corns. Here it relieves the heels of pressure by imposing a proportion of the weight on the frog. A bar shoe can also be fitted 'fuller' at the heels than an ordinary shoe, and hence is less likely to produce pressure on the seat of corn than a narrow heeled shoe.

2. Flat or dropped sole following laminitis. The heels of the shoe should be thinned, or the heels and toe also may be thinned, the quarters being left of full strength. This 'cradling' of the shoe much improves the gait of horses with dropped sole.

3. Flat feet with weak, low heels. By giving a broad bearing surface at the heels and by transferring weight to the frog, attrition between the heels of foot and of the shoe is lessened, and an opportunity is given for the parts to grow and become stronger.

4. Sandcrack and seedy toe. It is possible that in the case of sandcrack steady pressure on the posterior parts of the foot lessens the chance of the crack opening, and, by retaining the edges of the crack in apposition, favours the growth of a (new) sound wall.

Wherever there is any painful affection about the toe of the foot and the horse goes on his heels, bar shoes are useful. They should be fitted 'full' at the heels, and either 'boxed up' or 'hot-rasped' up to the heel of the foot. This is more important than fitting them so long at the heel, as is customary.

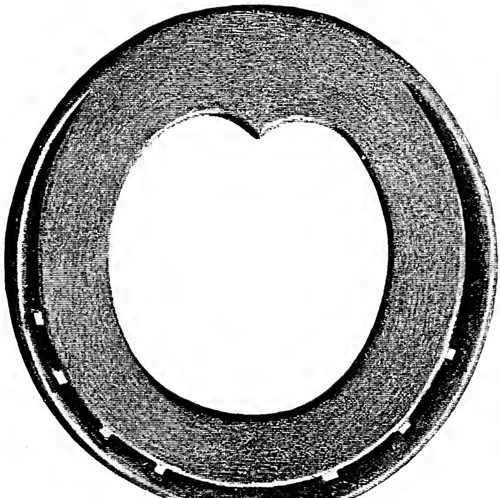

FIG. 317.—Fullered seated bar fore shoe. Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

[To face p. 326.

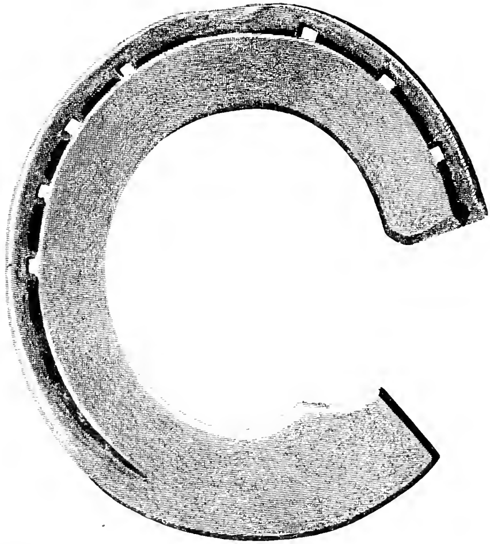

FIG. 318.—Fullered seated three-quarter bar fore shoe (for harness horse). Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

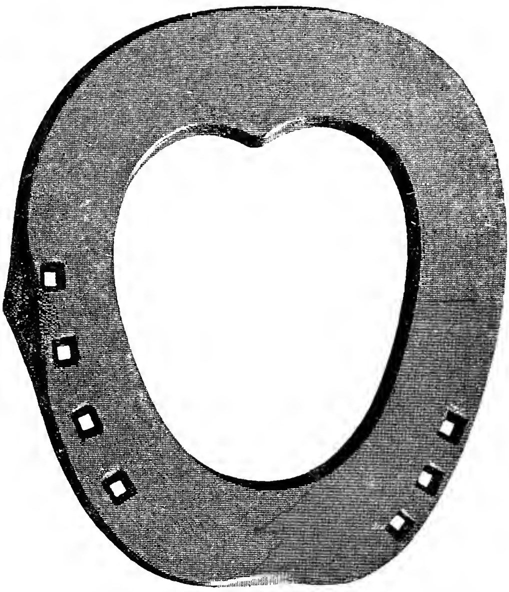

FIG. 319.—Stamped bar hind shoe (for cart horse). Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.

*To face p.* 327.]

## FULLERED SEATED THREE-QUARTER BAR FORE SHOE (FOR HARNESS HORSE) (FIG. 318).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

This shoe is intended for a fleshy, low-heeled, weak foot, or for a foot with dropped sole and with a corn in the inner heel. In cases of suppurating corn it allows of the parts being efficiently poulticed, and in sandcrack or false quarter involving the extreme back portion of the inside quarter is very useful.

The back part of the inside quarter of shoe must be fitted 'full,' otherwise it is liable to cause the hoof to split away at this point, especially as hoofs affected with sandcrack are usually very brittle.

The clip may be at the toe or outer quarter, or a clip may be placed at both points. The outer quarter is recommended, however, as the preferable spot.

## STAMPED BAR HIND SHOE (FOR CART HORSE) (FIG. 319).

*Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.*

This shoe is intended for cases where the hoof shows a 'false-quarter' inside, and where the horse has sustained an injury to the inner heel, which must be relieved of weight. The inside nail holes are therefore placed opposite the only sound part of the foot, viz., that close to the toe.

The clips are at the toe and outer quarter.

## Substitutes for Horn.

De Fay's hoof cement was the first material introduced for the treatment of cracks, etc., in the wall. It consists of purified gutta-percha and gum ammoniacum. The gutta-percha is softened in water, divided into pieces the size of a hazel nut, mixed with an equal proportion of gum ammoniacum and melted in a vessel of tinned iron over a slow fire. The mass is slowly stirred until thoroughly mixed, when it has the colour and appearance of chocolate. Lastly, it is formed into sticks. Thus prepared, it is hard at ordinary temperatures, and is, therefore, suited for use in summer; softer mixtures for winter use can be prepared by increasing the proportion of gutta-percha.

De Fay's artificial horn closely resembles natural horn in consistence and toughness. It can readily be softened and moulded, is insoluble in water, and adheres very firmly to the hoof. It may be employed to build up too low a wall or to replace lost portions; to close sandcracks and thus prevent entrance of dirt; in the various forms of dropped sole to raise the bearing surface of the wall in seedy toe, or, before applying a bar shoe, to build up the frog if atrophied and functionally inactive.

It should not, however, be resorted to in cases of loose wall, because, after hardening, it acts as a wedge and increases the separation. In use it is warmed till fluid, and applied with a spatula to the part to be filled up or raised. To smooth off the surface the spatula is moderately heated and once more passed over it.

Before applying the composition, the horn should be freed from grease, thoroughly dried and slightly roughened. To remove grease, the parts are rubbed over with a few drops of sulphuric ether or benzolin applied on a pledget of tow. As repeated heating injures the qualities of the mass, it is advisable to melt only the exact amount needed on each occasion.

Until recently this was the best known material for repairing and replacing horn, but of late another and better material has been produced. It is a German preparation, and is termed 'hufiederkitt.' As purchased, it resembles leather, is reddish-brown in colour, and appears to consist largely of gutta-percha with the addition of some india-rubber and inorganic materials. It is very elastic and tough, can be warmed either in water or over a fire, when it becomes plastic; on cooling, it again assumes its hard, leather-like condition, without losing the form given it. It may be used in any part of the hoof where additions are required. As compared with De Fay's artificial horn it possesses the following advantages:—1. After melting it solidifies more rapidly than De Fay's preparation. 2. In cooling it remains firmly fixed to the horn wall and does not shrink, whilst De Fay's mixture contracts, and is apt to lose its hold. 3. It can be melted as frequently as required without losing its qualities, whilst De Fay's cement rapidly deteriorates. 4. It requires no special preparation, like the removal of grease or the roughening and drying of the horn, though such precautions are perhaps still advisable.

In all cases where De Fay's artificial horn can be used with advantage this preparation may now be substituted for it. In Germany it is largely used instead of vulcanised rubber or rope in special grooved shoes designed to diminish slipping on smooth pavements. It has also been employed as a dressing for hoofs. In this case the under surface of the hoof is carefully cleaned and disinfected, and the melted 'huflederkitt' applied with a spatula. The frog may be covered or left exposed. If the space be filled up as far as the bearing surface of the shoe, the counter-pressure of the ground is transmitted very perfectly to all parts of the sole, etc., whilst at the same time slipping on asphalt or stone pavements is minimised.

## CHAPTER II.

### DEFORMITIES AND DISEASES OF THE HOOF.

#### 1. Flat Sole.

A flat sole is one which exhibits no arching towards the centre, but lies more or less evenly in the same plane as the wall, the latter being usually very oblique. The condition is commoner in front than in hind feet, and is frequently con-

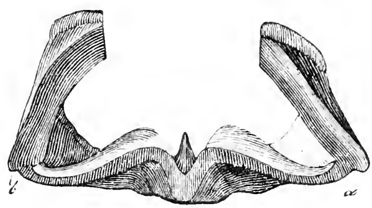


Fig. 320.—Section of flat hoof with weak sole. *a* shows weakened sole; *b*, weakening of the union between wall and sole.

genital, especially in horses reared on soft marshy ground. It may also be produced by paring away too much of the sole around its union with the wall (figs. 320 and 321), and keeping the hoof continually moist. Apart from congenital conditions

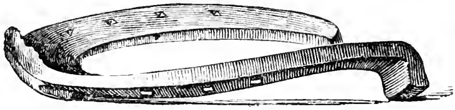

Fig. 321.—Special shoe for above foot.

the most frequent cause, however, is the use of shoes which raise the frog clear of the ground, and thus throw the entire weight on the wall. On account of its oblique course, the wall is then unable to sustain the load, and the os pedis, especially in its posterior parts, gradually descends; the descent being greater on the side which bears the greater weight. The union between the sensitive and horny structures is exposed to severe strain, the laminæ gradually enlarge and yield, and the os pedis presses on the sensitive and horny soles until it finally thrusts them downwards. This is followed by changes in the sole and atrophy of the os pedis, best marked at its wings and sharp plantar margin. The more developed the atrophy the more convex does the horny sole appear. Change in position of the os pedis, again, produces distortion of the coronary band and displacement of its papillæ. This gives rise to the formation of rings and splits in the wall, while, owing to its oblique position, the wall itself tends to bend outwards at the bearing surface. The more oblique the wall and the heavier the horse the more rapidly do such changes proceed. When the toe is much turned out they only affect the inner half of the foot, but then occur very rapidly. The flat-soled hoof grows chiefly forwards and outwards, and is hence very liable to suffer from separation of the wall. When the heels are weak and the sole flat the heels turn inwards; when the hoof is less spread the bars may grow over the posterior portions of the sole: in either case corns are common.

It is impossible to *cure* this flat condition of the sole. Possibility of improvement exists when the condition is not far advanced, when the horn fibres are fine and tough, and the animal is of light weight, but, as a rule, all the unfavourable factors are combined. The animal is then absolutely unsuitable for rapid work on hard roads, and can be employed only at a walk or in the fields.

Something may be done to improve matters and prevent the changes which have taken place becoming aggravated. The sole, being very thin, should be trimmed as little as possible. Loose fragments of horn may be removed, the bars, if overlapping the posterior portions of the sole, cut back, and the bearing margin of the wall levelled with the rasp. The outer edge of the wall, especially at the toe, should be well rounded off, and unduly convex portions as far as possible levelled. The frog and sole must be spared. Where the position of the limb is normal and the horn of good quality an ordinary flat, wide-webbed, well-seated shoe with a broad bearing surface, and made from thick iron, is suitable; the heels should be somewhat long. A leather sole is useful, and the frog should be allowed to come to the ground. In all other cases, as when the horn is of bad quality, or when corns, contraction, sand crack, separation of the wall, etc., are present, bar shoes are preferable. The bearing surface should be as large as possible, so that the weight may be distributed over the entire foot. The wall, white line, and outer margin of the sole should all assist. Where the wall projects below the sole, the bearing surface of the shoe may be given a slight cant inwards (fig. 322, *b*), but a horizontal bearing surface should be preferred when the wall has grown down again. The toe-clip can be

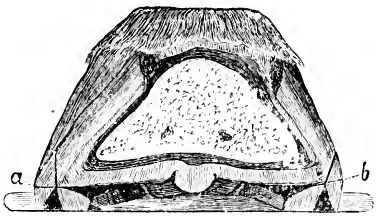


FIG. 322.—Transverse section through a flat-soled hoof with shoe. At *a* the wall is sufficiently high and the surface of the shoe is therefore flat. At *b* the wall is not high enough and the bearing surface of the shoe is therefore canted inwards.

let into the foot almost as far as the white line without injury —sometimes several clips are required; the direction of the nail holes must in all such hoofs be governed by the direction of the wall.

The space caused by separations in the wall may be filled with tar or Venice turpentine. De Fay's hoof cement mass should never be used, because as it hardens it acts like a wedge, and causes further separation. Two quarter-clips may be raised opposite the point of the frog, and will be found very useful in retaining the shoe in position. To protect the sole, it may be smeared with Venice turpentine, pitch, or soft resin. Where the wall and frog are defective, a leather sole can be applied. If, however, the frog is large, and projects below the heels, the cross piece of the bar shoe may be allowed to bear on it, or an ordinary flat shoe provided with low heels may be applied.

The condition just discussed may be still more aggravated. The sole is then distinctly 'dropped' or convex. This condition may involve either one or both sides of the hoof; in fig. 323 only one-half of the sole, the inner, is so deformed. The wall generally exhibits rings and furrows, and is more or less depressed at the centre, its outline being concave. In the unshod hoof the frog and horny sole then take the entire weight, hence animals with convex sole can neither go nor stand continuously without shoes.

The wavy appearance sometimes shown, which reaches from

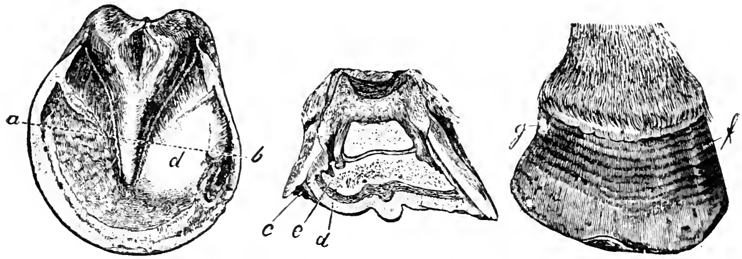


FIG. 323.—Left front foot with inside half of sole 'dropped' or convex, seen from below, in front and in section. *a–b*, direction of section; *c*, broken wall; *d*, 'dropped' portion of sole; *e*, os pedis atrophied by pressure; *f*, depression extending from coronet to ground; *g*, concave inner quarter.

the coronet to the bearing surface, and the form and condition of the hoof, point strongly to the displacement of the os pedis.

Dropped sole may result from a continuation of the process which produces flat sole, or from laminitis. In the former case one lateral half of the sole is usually deformed, and the white line is not increased in breadth; in the latter the convexity usually appears in front of the point of the frog, the white line is perceptibly broader, and the rings on the wall are close together at the toe, but diverge as they extend towards the heels.

In general, the same treatment is appropriate in convex as in flat sole. When the sole projects so far below the bearing surface of the wall that it would touch the ground even after the application of a thick bar shoe, it may be necessary to build up the wall with an artificial composition, and to secure the sole from contact with the ground by the use of toe-pieces and heels. Screws are then very useful in conjunction with bar shoes.

On account of the brittleness of the wall, as few nails as possible should be employed, and to secure the shoe it is often well to form a quarter-clip at either side. The position of the nails should be slightly changed at each shoeing. Horses with convex soles are, of course, quite useless for rapid work.

To prevent the sole being bruised the shoe must be well seated out, and, unless the case is very aggravated, a leather sole applied. To save the hoof being softened by long contact with moisture during wet weather, a hoof ointment should be used.

## STAMPED FORE SHOE (FOR CART HORSE). THE 'QUOIT' SHOE (FIG. 324).

*Made from* $1\frac{5}{8} \times \frac{5}{8}$ *inch iron.*

In making this shoe the outer margin of the web is thinned down to $\frac{1}{4}$ or $\frac{3}{8}$ inch, the inner margin being left of the full $\frac{5}{8}$ inch strength.

The shoe has been recommended for cases of laminitis where exudation is occurring and there is danger of the sole becoming convex, but where pain is slight. Some practitioners consider this condition is best treated by applying a 'quoit' shoe and steadily working the animal on soft ground.

## STAMPED FORE SHOE (FOR CART HORSE) 'SET' AROUND OUTER MARGIN (FIG. 325).

*Made from* $1\frac{1}{2} \times \frac{5}{8}$ *inch iron.*

This shoe is 'set' around the outer margin of the ground surface and is deeply seated-out on the foot surface, and has two calkins. The 'set' tool resembles a single-faced hammer. It is held and applied in the same way as a stamp or fuller; the result of 'setting' is well shown in the illustration.

This shoe is intended for a horse with very convex (dropped) soles and weak feet and large frogs.

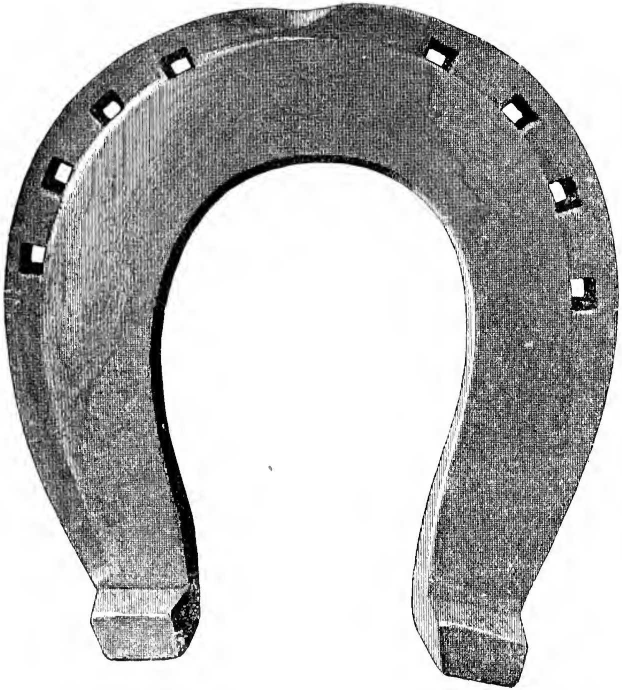

FIG. 325.—Stamped fore shoe (for cart horse), 'set' around outer margin. Made from $1\frac{1}{2} \times \frac{5}{8}$ inch iron.

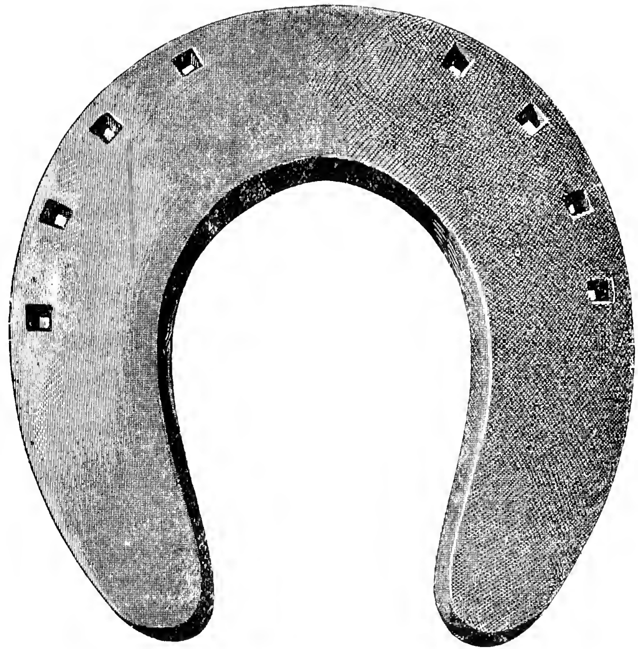

FIG. 324.—Stamped fore shoe (for cart horse). The 'quoit' shoe. Made from $1\frac{5}{8} \times \frac{5}{8}$ inch iron.

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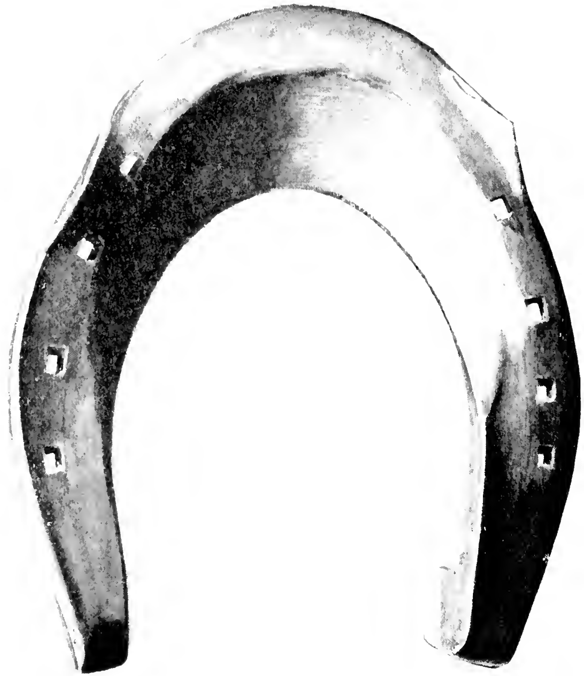

FIGS. 326, 327.—Stamped hind shoe (for cart horse). Made from $1\frac{1}{2} \times \frac{5}{8}$ inch iron.

## STAMPED HIND SHOE (FOR CART HORSE) (FIGS. 326, 327).

*Made from* $1\frac{1}{2} \times \frac{5}{8}$ *inch iron.*

Being intended for a foot with 'dropped sole' or 'seedy toe' (or both), this shoe is deeply seated out round the toe, at which point, in consequence, it has extra 'cover.' The shoe has a clip on either side of the toe, and the nail holes are stamped a little further back than usual, in order to obtain a firm hold of the foot even when the toe is 'seedy,' and to allow the shoe to be set further back on the foot and the toe to be shortened.

Calkins as shown are necessary to give working horses a good foothold, though it is open to question whether they could be pronounced advantageous were one considering the question of disease alone.

## 2. Upright Hoof.

The description 'upright' may be applied to any hoof, the toe of which, when viewed from the side, forms an angle of more than 60° with the ground, and the heels, compared with the toe, appear too high. The relative lengths of heel and toe vary. While in slight cases of upright hoof the length of the toe is scarcely double that of the heel, measured at the posterior border, in aggravated cases the height of the toe and heel may be equal. The toe is then at right angles to the earth, and the quarters nearly perpendicular. The sole is usually very concave, though the os pedis does not always correspond. In walking, the toe is most worn, and (except in the conformation shown by fig. 169) the entire weight of the body falls on the anterior half of the hoof.

Upright hoof is seen in all classes of horses, and affects both the fore and hind feet.

The condition is peculiar to the positions shown in figs. 151 and 169. It is due to hereditary tendency, or is produced by neglect of the feet in young animals, the toe being disproportionately shortened in comparison with the heels, and is apt to follow diseases of the limb, which, for lengthened periods, prevent extension of the fetlock joint. Among such are inflammation of the flexor tendons and of the posterior ligaments of the limb, spavin, and ring bone. Thrush is very apt to accompany this formation of hoof. According to Siedamgrotzky, it is always present in old standing cases of contracted tendon. In consequence of the gradual shortening of the flexor tendons, the os pedis undergoes a partial rotation on its transverse axis. The resulting pressure on the toe leads to the papillæ of the coronary band assuming a more upright position, and to the formation of an upright, thin, but firm toe wall. This is followed by a similar change in the heels, while, under continued pressure, the anterior portion of the sole becomes flattened and the white line increased in breadth.

The *prognosis* depends on whether the condition is congenital, *i.e.*, whether it results from the conformation of the limbs or whether it is acquired.

When due to faulty conformation the defect is incurable, but less grave than when acquired. The uncertain, stumbling, boring gait seen in horses with such hoofs is oftener a result of defects in the limbs than of the form of the hoof. The worst cases are those in which the heels do not touch the ground during movement, and the condition is not due to malformation of the limb. The tendons and ligaments are then continuously under great strain, and, in unshod animals, the sensitive structures of the toe are bruised in consequence of excessive wear. In congenital cases the heels bear an undue proportion of the weight. An approximately equal wear of the shoe and a level tread show that the faulty position of the limb has been compensated by change in form of the hoof. In fact, where the conformation of the limb is abnormal, uprightness of the hoof is, strictly speaking, neither pathological nor faulty.

The *method of shoeing* varies. The upright hoof, when compensatory to defective conformation, must be left alone. This is the case where the entire foot from the fetlock downwards is upright, or where the suffraginis bone is nearly horizontal. But if it result from increased wear of the toe in foals which have not been shod, and it seem impossible to restore the normal position by shortening the heels, a tip or plain shoe with thin heels may be applied. On the other hand, in heavy bodied horses doing hard work on streets the heels should be lowered and care taken that the tread is kept level, while the axis of the foot is rendered somewhat more oblique.

Uprightness consequent on excessive paring of the toe can be diminished by using shoes with thin heels and broad toes, sometimes by building up the toe with a horn substitute (*huflederkitt*), or by gradually lowering the heels.

If the cause be some diseased condition of the limb above the hoof, the object of the farrier should be to ensure a level tread, and it may be necessary to apply shoes with calkins or with thickened heels. In this case the production of upright hoof should be favoured, a course which at first sight may appear objectionable, but will be better understood by recalling the improvement which follows the application of a thick-heeled shoe in flat-footed horses with strain or contraction of the flexor tendons. The hoof is then too low at the heels to allow of regular distribution of weight and must be raised. In proportion as the disease of the limb, which causes uprightness, disappears, a better form can be given to the hoof by appropriate paring. To attempt to convert an upright into a normal hoof at one operation is only allowable in view of performing tenotomy.

In shoeing ordinary working horses with upright feet it is generally necessary to strengthen the toe. This is best effected by letting in a piece of steel at that point, by drawing up a strong toe-clip and by 'rolling' or rounding off the toe. The shoe must be broad in the web, and take a good hold of the toe of the hoof. The calkins should be so high as just to touch the ground when the horse is standing level on all four feet. In shoeing horses with spavin, ring bone, and shortened tendons a similar shoe, but with wedge heels instead of calkins, is useful.

## STAMPED CART HIND SHOE, WITH TOE-PIECE (Fig. 328).

*Made from $1\frac{1}{4} \times \frac{5}{8}$ inch iron.*

In cases of commencing contraction of the flexor tendons of the hind limb this shoe will often be found useful. The calkins give the animal an assured foothold, while the toe-piece prevents 'knuckling' at the fetlock, limits wear of the toe of shoe, and maintains a steady though limited pull on the contracted structures. At each shoeing the calkins may be slightly lowered, so as to keep pace with the improvement in position of the limb.

Many horses, which would otherwise rapidly become useless, can be rendered workable, if not actually cured, by the application of this shoe.

The toe-piece, which is about $1\frac{1}{2}$ inches long, is made independently of the shoe, and is 'shut' or welded on to the foot surface.

Fig. 328.—Stamped cart hind shoe, with toe-piece. Made from $1\frac{1}{4} \times \frac{5}{8}$ inch iron.

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## 3. Special Shoes for Horses Knuckled Over at the Coronet or Fetlock.

'Knuckling' at the coronet or fetlock is produced by shortening of the flexor tendons or by bony growths around the joints; the foot, from the fetlock downwards, takes a perpendicular or nearly perpendicular course, so that the animal treads on the toe alone. This condition can sometimes be modified, though never cured by shoeing. Sufficient may be done,

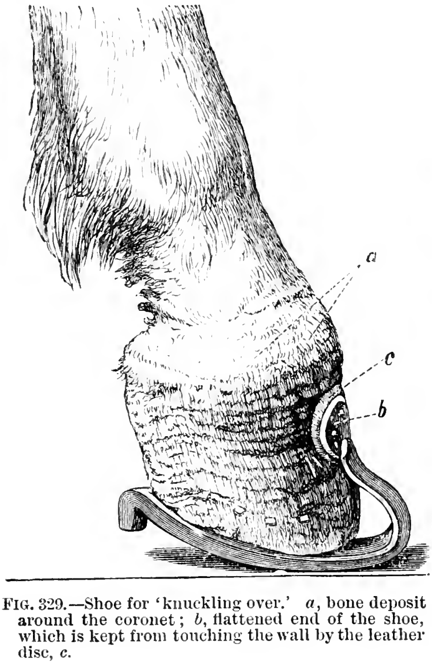



Fig. 329.—Shoe for 'knuckling over.' *a*, bone deposit around the coronet; *b*, flattened end of the shoe, which is kept from touching the wall by the leather disc, *c*.

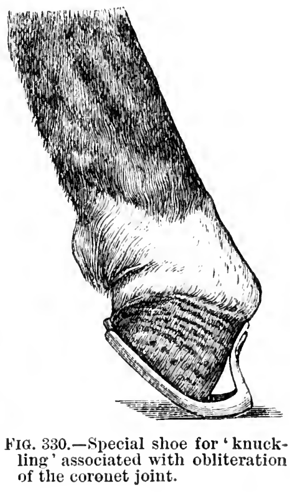


Fig. 330.—Special shoe for 'knuckling' associated with obliteration of the coronet joint.

however, to permit of the animal continuing for a long time at work. The shoes should be provided with heels which just touch the ground when the animal stands on all four feet, but in aggravated cases this is not sufficient, and to assist in movement it becomes necessary to lengthen the toe of the shoe. The exact extent and form of this prolongation cannot be given, as they must necessarily vary in each case.

Such shoes have the disadvantage of being torn off occasionally, the prolongation at the toe acting as a lever. To prevent this, Neuschield thins and flattens the extremity and bends it upwards and backwards so as to take a bearing on the wall of the toe, a stout piece of leather being interposed.

For the early forms of this condition in foals a special shoe has been used, provided with a kind of iron splint welded to the toe and extending upwards above the fetlock joint. It is made to fit the front of the large metacarpal bone, to which it is secured by a well-padded bandage. The steady opposition to the pull of the shortened tendons gradually causes elongation and reduction of the knuckling.

## 4. Contracted Foot.

(*A*). *Contraction of heels.*—In contracted foot the posterior half of the hoof becomes narrower and presses on the contained structures, such as the corium, lateral cartilages, etc. The condition frequently affects flat feet, and is commoner in front than behind. It may develop to a very varying extent, and its recognition demands a clear perception of the form of a normal hoof. This should have, firstly, a broad and well-developed frog. Both limbs of the frog should be of equal size, and between them should lie a moderately deep but broad groove.

In unshod horses neither the central nor lateral furrows are widely open, because the horny frog is pressed flat and thrust closely against the bar at either side.

In the contracted hoof the triangular space destined for the reception of the frog is diminished in size and the frog itself is smaller to a corresponding extent. The extremities of the wall, therefore, approach one another. When the condition is aggravated the lateral and central grooves of the frog are narrow, they exist as more or less deep fissures, and in fully developed cases the limbs of the frog almost disappear. The bars are sometimes even in contact or overlap one another, and the previously rounded prominent bulbs of the frog become thin and closely pressed together. Whilst in hoofs of good form the bars are straight, in this condition they describe a curve, directed towards the bearing surface of the wall, that is, they run backwards, outwards, and again inwards. In flat hoofs the frog sometimes becomes compressed by the bars (fig. 331); this is not infrequently the forerunner of contraction.

Just as the space occupied by the frog diminishes, the direc-

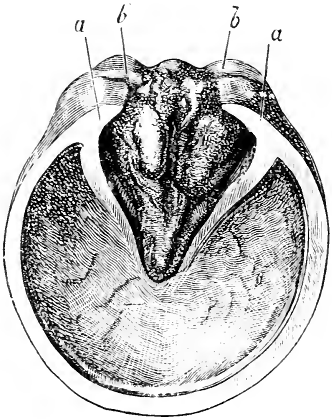



FIG. 331.—Strangulation of the frog by the bars.

tion of the walls at the heel alters. The heels gradually encroach on the frog, converging from the coronet towards the bearing surface; they draw together either in an equal degree

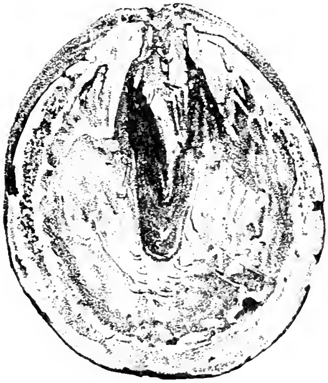


FIG. 332.—Excessive contraction of heels. The frog has almost disappeared.

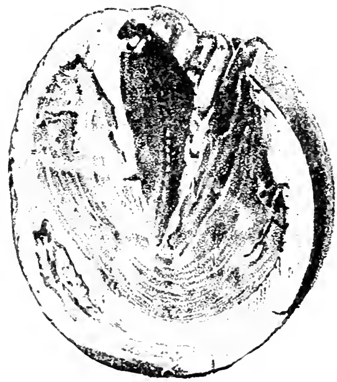


FIG. 333.—Unilateral contraction.

(fig. 332), or one to a greater extent than the other (fig. 333). It must not be supposed, however, that every hoof in which the walls at the heel converge is a contracted hoof, because, with the exception of pronounced upright hoofs, *all* show moderate convergence of the posterior parts of the heel walls.

Horses with contracted heels usually stand with the fetlock upright while the axis of the foot is not infrequently bent backwards (see fig. 201). The diseased foot is placed a little in advance and is also slightly flexed. When both feet are diseased the animal rests them alternately, and when the condition has existed for long there is bending at the knees. Both the last named symptoms result from tenderness of the sensitive structures.

The gait is low, 'shuffling,' and uncertain, especially for the first few steps. The foot strikes against obstacles and the animal stumbles, even on fairly level ground. This symptom, most marked when the horse is ridden, renders him both unpleasant and unsafe. At a trot he fails to extend the front limbs, and if only one hoof is affected may go quite lame. If the shoes impede expansion of the heels, the pain may even become acute enough to throw the horse off its feed, and cause it to lie continually. The pain forces the animal to go on the toe, and there is at first increased wear of that part of the shoe, though, when the process is complete, the shoe may again be worn level. Manual examination reveals slightly increased warmth at the heels, pulsation of the digital arteries, pain on pressing and on tapping the heels.

In consequence of the changes going on in the hoof it loses its normal form and becomes longer and narrower, the horny sole being usually more concave, and the horn of the heels weaker and less tough. The bulbs are atrophied so that the frog partly disappears. On dissection, there is often to be found in the posterior half of the foot atrophy of the coronary band, of the plantar cushion, and sometimes even of the os pedis. Atrophy of the pedal bone is best seen at the wings, but in severe cases may extend even to other parts.

As the hoof contracts at the heels the sensitive sole is subject to continued pressure in direct proportion to the degree to which the heels converge and to which they are thrust downwards. Both conditions are most marked in flat feet, and, as a consequence, flat feet with contracted heels almost always exhibit corns as a complication. The point which suffers most is perhaps where the coronary band is reflected forwards to become continuous with the corresponding part of the bars.

The strain on the coronary margin often causes sandcrack, and as the bars become distorted from the continued approach of the heels they may also exhibit fissures.

Contracted feet expand to a much less extent than do normal feet, and experiments on the living animal show that in well-marked cases this movement is diminished, sometimes even entirely absent or replaced at the most anterior portion of the bearing surface of the heel by contraction. The coronary margin of the heels, on the other hand, dilates, and whilst, in the healthy foot, contact of the frog with the ground produces dilatation both at the coronary and bearing margins, in contracted feet this is always diminished if not inhibited. The symptoms seem due to the position of the heels relatively to the ground, because the more the heels converge, from above downwards, the less does the bearing margin expand. Under the body-weight the portions comprised between the two heels, that is, the plantar cushion, lateral cartilages and sensitive wall, are strongly compressed by the inner surfaces of the heel walls, especially when the shoe is fitted 'too fine' at the heels. This pressure (caused by the body-weight) is rendered more injurious by the shoe preventing any yielding at the heel—a condition comparable to that produced in man by too narrow a boot.

This contraction at the heels leads to bruising of sensitive structures, rupture of small blood-vessels, and extravasation of blood, which stains the new horn red, while the increased strain at the coronary margin favours splitting and formation of sand-cracks.

Though usually easy to detect, the condition may be mistaken for shoulder lameness, chronic navicular disease, or strain of the pastern joint. The corns which occur as a sequel are sometimes regarded as the principal disease.

The causes are numerous, but may be divided into two groups, namely, predisposing and exciting.

(*a*) The predisposing causes include faulty conformation of the limb and defective shape of the hoof, but they seldom come into play before the hoof is shod. The greatest tendency to contraction is seen in weak feet, which naturally possess long toes and low heels, and in which the anterior and posterior margins, viewed from the sides, form an angle of less than 45° with the earth. The more oblique the hoof, the more rapidly does contraction proceed, whatever the previous condition of the heels. Despite every care in shoeing, contraction may still occur in consequence of the altered direction of the walls at the heel and of the greatly increased load they are called on to bear. It is the excessive pressure on oblique and inwardly-directed heels, in the absence of counter-pressure on the sole and frog, which so rapidly produces the change in form. At the same time, instead of the coronary and bearing margins of the heels being equally exposed to the expanding strain when weight is thrown on the foot, dilatation occurs only at the coronary margin, which is, therefore, continually in tension, while the bearing margin is fixed or even thrust from all sides towards the centre of the sole. A well-developed frog and strong bars, especially when exposed to the counter-pressure of the ground, prevent contraction. If, however, the parts are weak or diseased and the horny frog no longer bears weight there is nothing to oppose its progress. It has even been suggested that a small or diseased frog and weakened bars form the sole cause of contraction, a view in a measure supported by the following examples.

In severe thrush in flat feet the portion of the frog marked *b*, in fig. 35, may be lost. Under such circumstances the hoof contracts precisely to the extent left vacant by the portion lost. In upright hoofs, on the other hand, even when this part of the frog is lost, contraction does not occur. The cause of contraction is, therefore, not thrush, but the pressure of the body-weight, which forces the walls of the heel downwards, forwards, and inwards. On the same day two young carriage horses were shod for the first time. In one horse the front hoofs formed an angle of 40 and in the other of 55 with the ground. All four hoofs were sound. These animals were shod in precisely the same way for a year, but, despite similar treatment, the flat hoof was visibly contracted as compared with the other. In this case the greater weight thrown on the posterior half of the hoof was not the only cause.

A pair of trotting horses, of similar age, size, weight, and breed, had each weak fore-heels. In one case, however, the hoofs were flat, in the other upright. The horse with flat hoofs suffered from contraction, the other did not, the reason appearing to be simply that in upright hoofs the heels bear less weight than in flat hoofs.

As a rule, when the formation of the limb as viewed from in front appears normal, both heels contract equally, but when the toes are turned in or out contraction is unequal. With turned-out toes the inner, with turned-in toes the outer, heel appears to suffer most. Once the heel contracts sufficiently to run downwards and *inwards*, the body-weight aggravates the condition. The heel becomes more and more oblique and the affected half of the frog diminishes in size. The os pedis wing of the same side also suffers and may undergo atrophy. The change progresses with a rapidity proportioned to the extent to which the toes are turned out or in, and is sometimes very marked in flat feet. When contraction is limited to one side of the foot the bulbs of the heel may be displaced.

(*b*) *Exciting Causes.*—1. The first of these is defective shoeing, that is, not only the use of badly constructed shoes but faulty preparation of the feet.

Of the latter class of errors perhaps the most serious is weakening the bars and frog by excessive paring, and next, thinning the sole. It may be laid down as a principle that to remove more than loose horn is a fault. Fortunately, excessive use of the knife is much less common than formerly; at one time it was usual to pare the parts until the sole yielded to the pressure of the finger and spots of blood appeared on the frog. In-curved heels, which tend to compress the frog, should be carefully lowered without weakening the union between heel, frog, and bar (see fig. 331, *a*, *b*). When the heels are lowered overmuch the toe becomes disproportionately long and the axis of the foot distorted, so that worse effects are produced than by corresponding lowering of the toe. The direction of the foot axis must always be kept in view when paring the foot.

In flat hoofs contraction may also be favoured by insufficient paring or by allowing the shoes to remain on for too long a time.

Shoes with bearing surfaces inclined inwards at the heels and shoes fitted too wide, that is, in which the heels (of the shoe) do not cover those of the hoof, compress the latter.

The same effect is produced when the seating is continued right up to the heel of the shoe, especially if the bearing surface of the heel (of the hoof) rest in the seated out portion. Shoes with calkins favour contraction more than flat shoes. Finally, by shoeing young horses too early complete development of the hoof is checked and contraction favoured.

2. *Dryness.*—Dryness of the horn diminishes its elasticity and volume.

3. *Insufficient Exercise.*—If young horses, after being shod for the first time, are long confined to the stable, the posterior half of the hoof invariably contracts, while want of exercise causes the front hoofs to become hard and dry and the hind-feet to be attacked with thrush. Circulation and horn secretion are also less vigorous. In yearlings all these ill results are seen in an aggravated form.

*Prognosis.*—Attention should first be directed to the state of the lateral cartilage, because, when this is ossified, no improvement in form need be expected. Next, the conformation of the limbs demands consideration. When the axis of the foot and the form of the hoof seen from the side are upright or normal, the prognosis is favourable. If, on the other hand, the foot axis is oblique and the hoof flat, and if in addition the toes are turned out, the conditions all point to contraction, and in such cases the inner heel will be found wired in and the bulbs of the frog displaced. In old animals, which for years have suffered from contraction, the prognosis is unfavourable, because atrophy of the os pedis has often occurred, and complete recovery is impossible; but in young animals even well-marked contraction, if uncomplicated, can frequently be cured without much difficulty.

Preventive measures have occupied the attention of many investigators, but owing to the treatment of working horses and the various styles of shoeing, success has been distinctly limited. It is often useful, after correcting the form of the feet, to turn the horse out to grass without shoes, and later to apply a shoe which permits free movement of the posterior section of the foot and allows the frog to come to the ground. Treatment, therefore, comprises the application of a flat shoe, with a horizontal surface at the heels, non-interference with the frog, and abundant exercise on moist ground. The farm horse seldom shows contracted hoof, for he is almost always on soft ground, and his soles are, therefore, exposed to the counter-pressure of the earth. Horses working in towns require this moisture to be supplied artificially, and it is sometimes necessary to use flat shoes and to fill the space between the limbs of the shoe with felt pads or to give a foot-bath occasionally. In severe cases bar shoes promote the growth of the frog and hinder contraction.

The *treatment* aims at restoring the normal width of the hoof, and is best commenced by the use of poultices or warm baths which soften the horn. Thereafter several courses are open.

(A) Restoration of the counter-pressure of the ground. This may be regarded as the natural method of cure. Under it are comprised :—

(1) Turning horses out to grass without shoes.
(2) The use of tips.
(3) Of shoes with thin heels.
(4) Of heelless shoes with leather soles.
(5) Of bar shoes with or without leather soles.
(6) Of pads covering the entire sole.

(B) The use of mechanical devices, which thrust or draw apart the heel, such as :—

(7) De la Broue's slipper shoe.
(8) Shoes with bar clips.

(C) Operations on the hoof itself, either alone or in conjunction with one or another of the methods already named.

## A. Methods of Re-establishing the Counter-Pressure of the Ground or Compensating for its Absence.

1. Rest at grass, to be effectual, should be oontinued from four to six months, at any rate not less than three, and is not advisable for animals with very weak low heels. As a preparation, excess of horn should be removed, the wall rounded off, incurved heels, pressing on the ground, removed, and the point of the frog (to the commencement of the central groove) lowered to the same height as the bearing surface of the wall; the limbs, on the other hand, may be left somewhat higher. The horse can then be turned out to

grass or, if this be impracticable, regularly exercised in a large shed. Light saddle or draught work on soft ground is useful.

In horses with well-marked unilateral contraction, turning out to grass is inadvisable and it is better to trust to proper shoeing.

2. The use of tips produces a somewhat similar effect to turning out to grass, and can be recommended when the animal cannot be rested or when, on account of the condition of the ground, the hoof tends to contract in spite of light work. Two kinds of tips may be distinguished: the ordinary and the modified Charlier; both are well adapted for feet of the upright and ordinary shapes, but less for oblique feet.

The methods given under 1 and 2 have the advantage of producing a more rapid growth of horn because of the natural distribution of weight in all parts of the ground surface of the hoof, which favours the normal movement of the parts and the circulation of blood. The final result is to increase the width and strength of the hoof at its posterior half.

3. Shoes with thinned heels can be used both for upright feet and those of normal angle, but are less desirable in flat feet. They act by allowing the frog to come to the ground and bear a certain proportion of weight.

4. Heelless shoes with or without leather soles are sufficient in all cases of moderate contraction if the frog is strong enough to touch the ground, and their effect is more marked the more faulty the previous treatment and shoeing. Where the sole and bars have been weakened and the seating out of the shoe has been continued to the heels, it is sufficient to round the toe and to apply a shoe with a perfectly horizontal bearing surface at the heels to produce in two or three shoeings a marked improvement. The application of a leather sole will hasten recovery.

5. Bar shoes, with or without leather soles. Where the frog is healthy and the bar can take a bearing on it, a leather sole is scarcely required. Should the bearing surface of the hoof be defective or broken away, or should corns or sand-cracks co-exist with contraction, the ordinary, or the three-quarter bar shoe, is perhaps to be preferred. It is fitted close at the toe and quarter and slightly 'sprung' at the heels. Expansion of the hoof is greatly assisted by carefully filling

the lateral and central furrows of the frog with some plastic composition.

If, however, the frog is attacked with thrush, or if other diseases of the hoof accompany defects in the bearing surface of the wall, a simple leather sole and stopping are more useful.

The bar shoe with leather sole can also be used in unilateral contraction with displacement of the bulbs. As the chief object is to restore the bulbs of the frog to their normal position and to thrust outwards the contracted wall, it must be borne in mind that the upward displacement of the bulbs results from excessive and irregularly distributed weight. Various authors and practitioners recommend lowering the affected heel wall until there is a clear space between it and the shoe, thinking thus to allow the affected bulb to sink, but experience shows that this often fails in its object. Lowering the affected heel is not sufficient; it is of much greater importance to throw the weight of the body on the wall of the opposite quarter and heel. To effect this the hoof should be pared and shod so as to bring the higher side to the ground a little earlier than the other, though it is necessary to avoid distorting the axis of the foot, and to fit the shoe close to the outline of the sound heel, but somewhat broader and longer than that of the unhealthy one. If this style of tread cannot be produced by trimming the hoof alone, the branches of the shoe can be made of unequal thickness. A leather sole with plenty of stopping will greatly assist recovery.

6. Filling the hoof with cement is a slow method, and it is absolutely necessary that the cement should thoroughly cover the limbs of the frog. Straw or cork soles or Hartmann's rubber pads are to be preferred on account of their continued pressure, though precautions must be taken against thrush. The gutta-percha composition may advantageously be tried; being perfectly plastic it moulds itself to all the depressions of the ground surface of the hoof, and exercises an exceedingly even and, therefore, efficacious pressure. In the treatment of unilateral contraction the bar shoe and leather sole are to be preferred to all other measures. Plenty of tow must be used in the furrow of the frog on the diseased side, so as to maintain constant pressure.

## B. Mechanical Methods.

7. De la Broue's slipper shoe tends to expand the entire wall of the hoof. It is claimed that the bearing margin lying on an oblique surface spreads outwards under the pressure of the horse's body-weight, and that the shoe is useful in all cases of contraction where the coronary margin is wider than the bearing margin of the hoof. It exposes the white line, however, to excessive strain, and is, therefore, no longer used in this form, especially as there are other and less dangerous methods of expanding the hoof. By confining the outward slope of the bearing surface to the heel (or heels, when both sides of the foot are affected), it, however, renders good service. Nevertheless great care is needed in determining the exact amount of slope, and the distance to which it should extend, otherwise severe lameness results. It is usually sufficient if the outer margin of the hoof surface is $\frac{1}{12}$ to $\frac{1}{8}$ inch lower than the inner, and this oblique surface should only extend as far forwards as the wall of the heel forms with the ground an acute angle. The same principle may, of course, be applied to the heels of bar shoes.

8. *Shoes with bar-clips.*—(*a*) De Fay's is a flat shoe with a clip at the inner margin of either heel. The clips should lie in the lateral furrows of the frog, exactly at the points where the wall is reflected to form the bars. They should fit evenly on the bars, but should not extend to the bottom of the lateral furrow of the frog. The foot surface at the heel must be absolutely horizontal. The shoe should be cooled and nailed on, and the dilator (fig. 334) then adjusted with its cheeks between the heels, which are expanded by turning the screw *b*. This forcibly widens the hoof. The method requires the greatest care, and is certainly not often applicable. On the first occasion it is sufficient to dilate the parts $\frac{1}{12}$ to $\frac{1}{8}$ inch, and nothing further should be done until the space gained can be filled with horn, that is, in from ten to fourteen days.

(*b*) Hartmann's expanding shoe (fig. 335) is narrow, and possesses one or more saw-cuts on its inner border. When it is desired to dilate the hoof equally, these cuts are made at the centre opposite the toe-clip, but when contraction has taken place at the heel, the cuts are placed towards the side of the shoe at which contraction is visible.

(*c*) Einsiedel's automatic hoof-expanding shoe (fig. 336) is

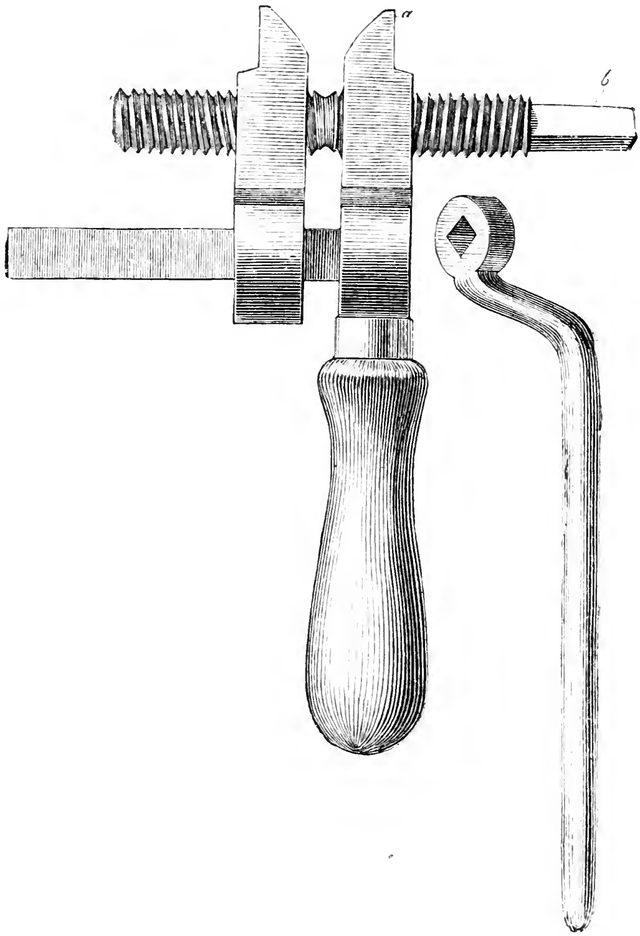



FIG. 334.—Instrument for expanding De Fay's shoe. *a*, the iron cheeks which fit between the heels of the shoe; *b*, square head on the right and left-handed screw, for taking the key.

an ordinary flat shoe with bar-clips, the bearing surfaces of which are moderately inclined outwards. After accurately fitting, but before nailing the shoe, it is advisable to dilate the heels about $\frac{1}{8}$ inch. The animal's own weight is the expanding power. It produces its effect slowly but surely. In uni-

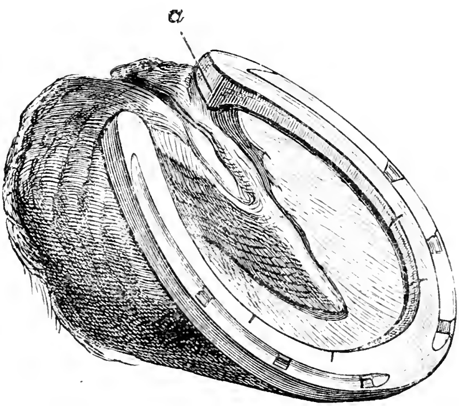



FIG. 335.—Shoe for expanding the hoof. *a* shows the point where the bar-clips should come.

lateral contraction the bearing surface of the clip only inclines outwards on the affected side. Shoes with bar-clips should

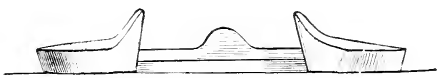


FIG. 336.—Einsiedel's shoe, seen from behind.

not be used when the heels are very low and when the lateral clefts of the frog are correspondingly shallow.

Other special shoes for promoting expansion of the foot are described in the next two pages.

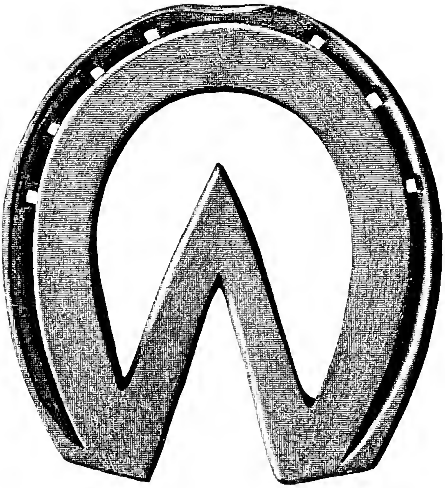


Fig. 337.—Fullered fore shoe (for harness horse), with frog plate. Made from 1 × ½ inch iron.

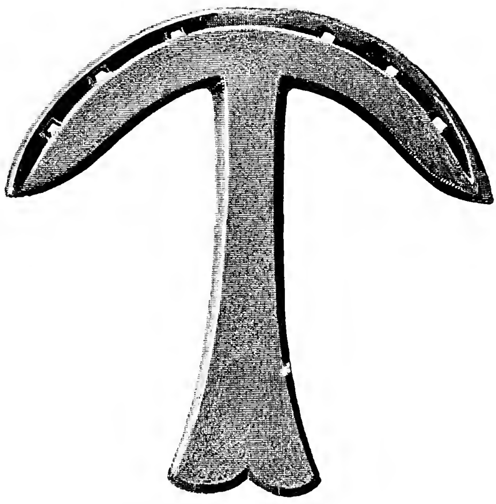


Fig. 338.—Tip for producing frog pressure. Made from ¾ × ½ inch iron.

*To face p.* 353.]

## FULLERED FORE SHOE (FOR HARNESS HORSE) WITH FROG PLATE (FIG. 337).

*Made from 1 × $\frac{1}{2}$ inch iron.*

To obtain frog pressure without interfering with the animal's paces, and to widen the foot and to promote the growth of a strong healthy frog, are the objects of this shoe.

Care must be taken, when fitting the shoe, that the frog plate has a good bearing on the frog itself, otherwise it will prove ineffective. To ensure a bearing, it is sometimes necessary to rivet pieces of leather on the frog plate, so as to raise it to the needful height.

## TIP FOR PRODUCING FROG PRESSURE (FIG. 338).

*Made from $\frac{3}{4}$ × $\frac{1}{2}$ inch iron.*

The tip is made in the same manner as the ordinary pattern, the frog plate being made, and welded on afterwards. The clip is then drawn, and the tip is ready to fit to the foot.

The plate must take a good bearing on the frog; sometimes it is necessary to rivet on pieces of leather in order to secure frog pressure.

The above tip is very useful for horses having one foot smaller than the other. Its application will often expand the contracted foot to a marked degree, but it requires care in fitting. The quarters must be fitted full, to prevent the tip sinking into foot at this point, and splitting away the wall. The frog plate should be a trifle shorter than the animal's frog, otherwise the toe of the hind-foot is liable to catch it, and tear off the tip.

## PROFESSOR F. SMITH'S FORE SHOE FOR EXPANDING CONTRACTED FEET

(FIG. 339).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

The diagram sufficiently explains the construction of the shoe.

By means of the screw, steady, but slight, pressure is exercised on the bars. Neither Mr Dollar nor Mr Wheatley has used this shoe, but it has been highly recommended by Professor Smith, who kindly lent the shoe from which the illustration was made.

It will be seen to closely resemble Fourre's shoe for the same purpose.

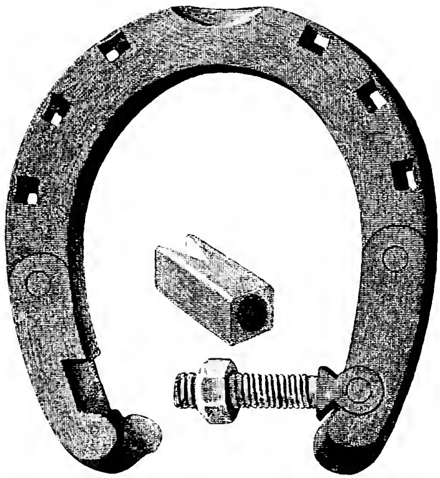


FIG. 339.—Professor F. Smith's fore shoe for expanding contracted feet. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[*To face p.* 354.

## C. Operative Interference in Contraction.

(*a*) Thinning the wall of the toe was recommended by Dominik, but is of little real value, the improvement noted probably resulting from the animal's being turned out to grass without shoes.

(*b*) Collin's method consists in making a groove about $\frac{3}{8}$ inch broad and as deep as the sensitive wall, beginning $\frac{5}{8}$ inch from the skin of the coronet and running parallel with it. From this he carries two wider grooves as far as the lower margin of the hoof, the posterior groove being about $\frac{3}{4}$ inch from the heels, the anterior running obliquely backwards; its highest point being about $1\frac{1}{2}$ inches, its lowest about $\frac{3}{4}$ inch from the posterior furrow. The wall of the quarter behind the anterior furrow is lowered with the rasp until it no longer touches the shoe. Where both quarters are diseased, the same procedure is adopted on either side. A bar shoe is then applied. When the frog is insufficiently developed to afford the shoe proper support, a leather, gutta-percha, or vulcanised pad is applied, and the grooves are filled with ointment, with which the entire hoof is dressed. If movement is painful, the feet can be placed in a foot-bath, and poultices applied, after which lameness soon disappears. Collin's method undoubtedly produces good results when the animal can be rested for several months; otherwise, the next in order should be tried.

(*c*) *Thinning the Wall of the Contracted Heel.*—A portion of the coronary margin, about $\frac{3}{4}$ inch in breadth, should be left intact. A bar shoe is then applied, which should not touch the heels by about $\frac{1}{8}$ inch. The limbs of the frog should, however, take a good bearing on the bar of the shoe. If necessary, the frog may be filled up with artificial horn composition or a leather sole, and plenty of stopping applied. To prevent drying and hardening, the exposed parts should be dressed with a tampon of tow or wood wool saturated with tar, and lightly bandaged. The results are good; the horn of the heels grows in a better direction, and lameness soon disappears.

(*d*) *Simple Incision below the Coronet.*—Three-quarters of an inch below the meeting of hair and hoof, parallel with it and to an extent corresponding to the contracted wall, an incision is made with a searcher, saw, or an instrument resembling a drawing chisel, the horn being removed as deep as the laminal sheath. The groove is filled with wax. The further treatment may comprise any of the methods given under A. A bar shoe taking a good bearing on the frog succeeds best if the horse cannot be completely rested.

The effect is shown by the upper margin of the incision overlapping the lower in consequence of expansion at the coronet. Cure results from the portion of the wall above the incision growing down in the normal direction.

Many other methods have been suggested, such as those of Bracy Clark, Coleman, Fulch, Barbier, Beaufils, etc., but cannot be recommended.

(*B*) *Weak heels* (figs. 340 and 341) are sometimes developed to an extraordinary degree. Being too weak to carry the body-

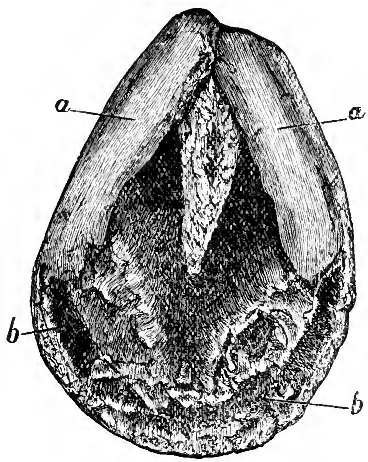



FIG. 340.—Contracted hoof from unshod horse. This growth resulted from want of movement and neglect of the feet. *a*, excessively long heels; *b*, clefts in the region of the white line.

weight when the horse is shod, they grow inward over the posterior parts of the horny sole and bars; indeed in some cases over the limbs of the frog, and cause bruising, which we recognise as corns. The hoof becomes narrower, and falls within the definition of 'contracted hoof.'

Weak heels are only too common in thin, shelly feet, and when occurring in flat hoofs render the animal useless for rapid work on stone-paved streets.

The best application is a bar shoe and leather sole, the frog resting on the bar, but the heels being kept clear of the shoe. The nail holes should be confined to the anterior two-thirds of the shoe. Pads, etc., are of little service.

(*C*) *Local Contraction, or Contraction at the Coronary Margin.*—Instead of the wall of the heel running in a straight line from the coronet to the bearing margin, it pursues a curved course (fig. 342, *a*). This contraction affects either one

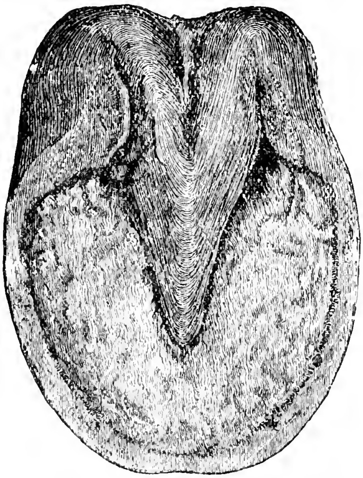


FIG. 341.—Left fore-foot with weak heels. The dotted lines indicate the portion to be removed.

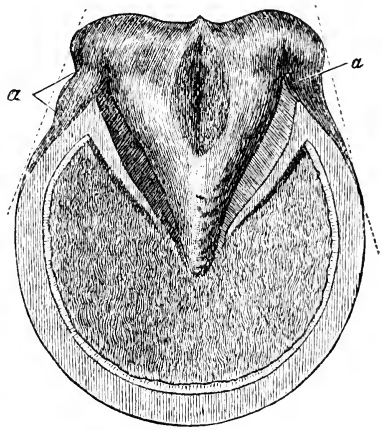



FIG. 342.—Foot with local contraction. *a*, the contracted spot.

or both heels; the hoof appears as if drawn in by the application of a cord, and its outline has been compared to an hour-glass. Occasionally, instead of this wide curve, it presents local deformities, but the latter are most common in flat hoofs.

The horse goes in a shuffling style, or is positively lame, especially at a trot. Pressing on the hoof with pincers produces pain, as do light blows over the contracted portion of the wall.

Broad, flat feet are especially disposed to this form of contraction, though it is also found in hoofs of normal character and in those with turned-out or turned-in toes. In upright hoofs, however, it never appears to such an extent as to produce lameness, though even hoofs with very strong walls do not always escape it.

The comparative frequence after the first shoeing of this form of contraction in horses which work on hard dry ground leaves little doubt that desiccation of the hoof and want of counter-pressure are its principal causes, though these again depend upon the artificial conditions set up by shoeing. All who have carefully studied the question agree that the change in the normal direction of the heel wall is produced by interference with the expansion of the hoof. Dominik, who first described the condition, refers it to interference with expansion at the coronet. The tendency to contraction is, therefore, greatest at the coronary margin. Fambach regards it as due partly to excessive obliquity of the heel wall, and to removal of support from the frog. In this connection it may be pointed out that almost all hoofs that show local contraction of the heel wall are otherwise sound. The contraction at the coronary margin probably results as follows:—By lifting the frog clear of the ground, the shoe more or less prevents expansion of the bearing margin of the heel. The coronary margin, being the most yielding part, spreads outwards under the continuous strain of the body-weight. The direction of the coronary papillæ is changed, the horn they secrete takes a more perpendicular course, and the wall, previously quite straight, shows, after eight to ten days, an apparent slight contraction opposite the lower third of the coronary groove. By growth from the coronet the contracted part is thrust downwards; finally it reaches the centre of the heel wall, where it produces an appearance resembling an hour-glass. Arrived at the bearing margin it gradually disappears just as it had appeared above. The effects, however, continue, for on close observation it will be seen that the entire portion of wall involved has become more upright, so that instead of pointing outwards and backwards it now points forwards and inwards. In other words, the heel walls previously diverged; now they converge. The hoof has become narrower at the bearing margin of the heels. When the weight is greater on one side and the hoof very flat, well-marked furrows may appear on one or other heel wall, as can be proved by comparative measurements of the hoof immediately before the first shoeing and a few weeks or months later. Rest in the stable will produce similar results. The causes are shoeing, deficient frog support, desiccation, and insufficient exercise.

The *prognosis* is favourable and lameness disappears when the contraction has grown down as far as the lower third of the wall. When it affects only the posterior part of the heel it can be removed in two or three shoeings, but if the feet are flat and the contraction extends further forward it may persist for a much longer time. Treatment consists in paring the hoof, so as to produce a level tread and straight foot axis; the use of shoes of a thickness proportioned to the animal's size and work, and such as will allow the frog to bear weight. The bearing surface of the shoe should be horizontal at the heels: the other portions may be horizontal or inclined slightly inwards, depending on whether the sole is concave, flat, or convex. If the frog is well developed and projects below the wall an ordinary thin-heeled shoe is most suitable, as it allows the frog to touch the ground. If, however, the frog is low or badly developed, a bar shoe is preferable. With this the necessary frog pressure can generally be produced, even when the frog is affected with thrush. In such case the frog is cleansed and disinfected, well smeared with tar or Venice turpentine, and the bar shoe, provided with a leather sole and plenty of stopping, nailed on. Needless to say any, portions of the wall which appear painful must be eased, that is, where it is impracticable to sufficiently seat out the shoe, a slight amount must be removed from the bearing surface directly below, before affixing the shoe.

In cases of even well-marked lameness thinning of the heel wall and four to eight days continued poulticing is often sufficient. The hoof should be kept moist and the animal exercised at a walk.

This treatment is not directed towards preventing contraction at the bearing surface, but only aims at restoring the natural counter-pressure of the ground and thus promoting expansion of the hoof. Other means of relieving the heels and forcing the frog to bear a certain amount of weight, like the use of tips, filling the hoof with elastic cement, etc., are sometimes found advantageous. So far as its occurrence, position, and treatment are concerned, contraction of the coronary margin may be regarded as a modification of ordinary contraction, for the main differences between them are—the former affects flat, spreading feet and only the extreme posterior part of the heel region, whilst ordinary contraction is commonest in upright feet and affects both quarters and heels. Many other sub-divisions of contracted hoof are described by German writers but have little interest for English readers, the practical advantages of such classification being almost nil.

### 5. The Laterally Distorted Hoof

is produced by one quarter and heel being upright, while the other takes a slanting direction. Such a hoof, therefore, when cut through its longer diameter consists of two unequal portions. It has previously been remarked that oblique limbs usually have oblique hoofs, which may, therefore, be termed normal oblique hoofs and which should not be regarded as pathological. In determining whether a hoof of this description really is pathological, attention should be paid to the direction of the walls when viewed from behind and the width of the back of the hoof. When one-half of the wall runs from above downwards and inwards, *i.e.*, towards the middle line of the hoof, and the corresponding half of the frog is smaller than its fellow, the hoof is abnormal. The condition, in fact, may be regarded as unilateral contraction. Similar distortion is produced by faulty paring of the hoof.

*Causes.*—Whilst in normal oblique hoofs the primary cause is almost always bad conformation of the limb, and consequent unequal distribution of weight, in pathological oblique hoofs the same unequal distribution of weight is aided by excessive paring or wear of the upright half of the wall. All faults in shoeing which favour contraction promote this condition, especially when they affect the upright wall. One of the most fertile causes is neglect of the hoof during the first years of life.

The degree to which this malformation may be developed varies immensely. In some, the upright wall is drawn inwards, and the corresponding limb of the frog almost entirely atrophied; in others, the (previously) normal wall may be affected as well, being bent outwards and exhibiting a convex surface.

*Prognosis.*—When the distortion of the hoof is a result of the deformation of the limb, and the old shoe shows comparatively level wear, the condition is not serious. If, however, the hoof is much deformed, the horn of the wall weak, the wall itself curved inwards, and if, in addition, other disease exists, improvement is difficult and affected animals are of little use for work on hard roads, least of all at a rapid pace.

Hoofs so deformed show a great tendency to disease, the upright wall always suffering first; corns and sandcracks are of frequent occurrence.

The style of *shoeing* depends on the degree of disease and on the conformation of the limb, the two chief objects being to remove or minimise existing defects and to promote the return of the foot to its normal shape.

The hoof must be trimmed so as to make the tread level, the bars and sole of the upright side being left stronger than those of the opposite, for a strong sole and well developed bar

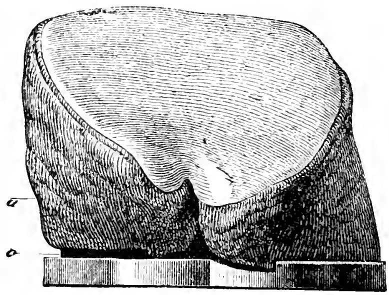



FIG. 343.—Bar shoe for laterally distorted hoof. *a*, the upright (contracted) wall; *b*, the spot over which the hoof is 'sprung.'

prevent contraction of the wall better than any special shoe. Flat shoes (*i.e.*, without heels) are most suitable, because they favour a level tread and equalise wear.

Too much weight may be thrown on the upright wall, as happens when, during the extension of the fetlock joint, the fetlock, instead of remaining behind the middle line of the hoof, tends to assume a position above the contracted coronary margin of the heel. In such case an attempt should be made to relieve the contracted wall of weight. The hoof is, therefore, trimmed so that the upright wall comes in contact with the ground before its fellow when the animal is walked. Unless striking is to be feared the limb of the shoe covering the upright wall should be fitted as full as possible, the extreme edge being perpendicularly beneath the coronary margin of the contracted wall, whilst that on the sound side should exactly fit the wall.

A bar shoe is even more useful, especially when the bulbs of the frog are displaced; the shoe, however, should be fitted as described and the bar should take a bearing on the outer limb of the frog (fig. 343).

Pathologically oblique hoofs may also be treated with De Fay's dilating shoe (see 'De Fay's shoe'), the notches on the inner margin of the shoe being made at the same side as the deformed wall, so that the effects may be confined to that side. If the hoof has been pared unevenly and the disproportion in the height of the two walls cannot be removed by trimming the horn, the parts may be built up by using some gutta-percha composition.

Once improvement occurs and the upright wall assumes the

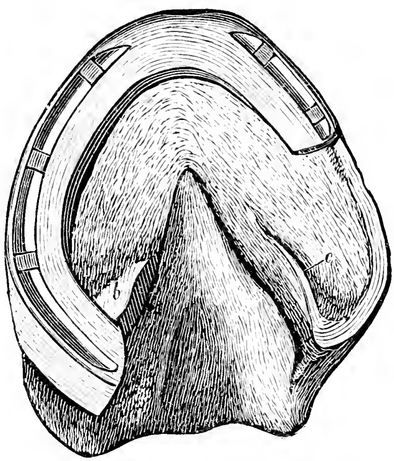



FIG. 344.—Right hind-foot of foal with three-quarter shoe of unequal thickness. The foot is thus tipped inwards. *b*, untouched bar; *c*, bar cut back.

same direction as the limb, while the posterior portions of the hoof are of nearly normal width, treatment should cease, as its continuance may produce other evils.

The distortion of the hoof sometimes seen in unshod young horses cannot always be cured by paring and rasping the hoof, and a special shoe becomes necessary. The heel is thick on the same side as the contracted wall, and the shoe gradually becomes thinner from this point to its termination (fig. 344). In severe cases the shoe need only extend as far as the centre of the quarter (three-quarter shoe).

## 6. The Curved Hoof.

The form of this hoof is well seen in fig. 345. One side is bent outwards, the other inwards, so that when viewed from in front they respectively appear convex and concave. Exaggerated cases of this distortion are uncommon.

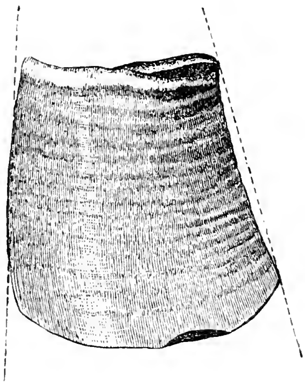


Fig. 345.—Right fore-foot showing lateral curvature.

The causes are unequal distribution of weight and unequal wear; in unshod horses and foals neglect of the hoof is a fertile cause. The curvature is often accompanied by contraction. In older (shod) horses the same condition may be produced by injudicious trimming of the hoof and by shoes badly made or fitted. If, for instance, one or other quarter is left too high for several shoeings, the corresponding side of the wall (fig. 346, *a*) becomes convex, whilst its fellow tends to become concave (*b*). Such distortion is favoured, for instance, by the outer half of the shoe being fitted too narrow in comparison with the circumference of the hoof and the opposite portion too wide. The bowing of the hoof always sets in from above.

*Prognosis.*—As a rule in curved hoofs the column formed by the pastern, coronet, and pedal bones is twisted to one side, *i.e.*, there is lateral distortion of the foot axis, the greater angle being directed towards the convex side of the hoof. In consequence the weight of the body is unequally distributed over the articular surfaces of the coronet and pedal joints, there is a tendency to bruising of the bones, while the lateral ligaments of these joints are exposed to strain.

The chief indication in *treatment* is to restore the normal position of the hoof. The convex half of the wall (fig. 346, *a*) is usually too high and too narrow, the opposite half (*b*) too low and too wide. The indications for fitting are, therefore, plain. The bearing surface of the shoe corresponding to the high and narrow side should be as wide as possible. A straight-edge

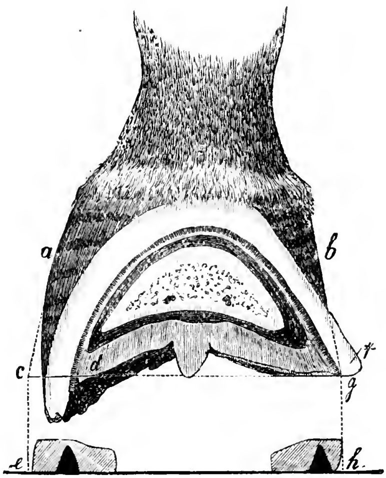



FIG. 346.—Cross section of a right fore-foot, showing lateral curvature. The horse turns his toes outwards. *a*, convex outer wall; *b*, concave inner wall. The line *c-d* shows how much too high is the outer wall. The lines *c-e* and *g-h* show the points to which the outer and inner limbs of the shoe must respectively be produced; *f* indicates the amount of horn to be removed.

laid on the convex half of the wall only touches it in the centre, and the point at which it meets the (imaginary) prolongation of the bearing surface shows how far the bearing surface of the shoe should extend outwards. The opposite half of the wall exhibits a concavity at the centre. With the straight-edge it is easy to determine how much of the lower margin must be removed before fitting the shoe.

The cure of this deformity requires considerable time.

# CHAPTER III.

## SOLUTIONS OF CONTINUITY IN THE HORN.

### 1. Sandcracks.

A sandcrack is a fissure in the wall running parallel with the direction of the horn fibres. Its position, length, and depth

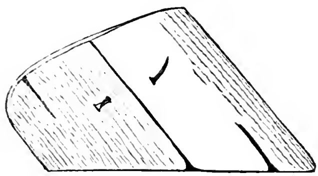


Fig. 347.—Hoof showing sandcracks at coronary and at bearing margin, and a sandcrack extending throughout the wall. The latter exhibits a nail inserted for the purpose of 'riveting' the crack (semi-diagrammatic).

are all of importance in determining its probable results and the proper treatment to adopt.

According to position we distinguish sandcracks of the toe, quarter, heel, and bar. Some affect the coronary margin, some the bearing margin, while some extend from one margin to the other of the wall; some are superficial, others penetrate the thickness of the horn wall. There is little difficulty in recognising sandcrack, except when a slight fissure has just commenced at the coronet and the hoof has been dressed with an ointment or when the crack has been filled up. To avoid overlooking such cases the hoof should be thoroughly cleansed before examination. Deep cracks which extend from top to bottom of the wall are easily seen, because bleeding often occurs when the animal is worked, and lameness is a frequent though not a constant feature. When of old standing, and involving the entire thickness of the wall, sandcracks show prominent edges, which sometimes overlap and which are very noticeable.

The depth of the crack may be measured with a nail beaten flat at the point. Some sandcracks are 'open,' others are 'closed' or only slightly open.

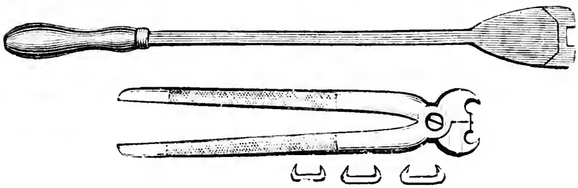
The *causes* comprise: injuries destroying a portion of the coronary band and thus leading to changes in the character of the wall; excessive tension at the coronary margin in upright feet (producing sandcrack of the toe) and in flat and contracted hoofs (sandcrack of the quarter). Fissuring is favoured by weakness of the wall, drying of the horn, bad fitting of the shoe, 'springing' the heels when shoeing with ordinary shoes, in the case of carriage horses by trotting work on hard, rough, or frozen streets, and in riding horses by trotting, galloping, or jumping with a heavy rider. Sandcracks sometimes start from the bearing margin, as when horses are turned out without shoes and without the hoofs having been rounded off; when the bearing surface of the shoe is uneven, and when the counter-sinks allow the nails to penetrate too far or when the nails themselves are too large.

*Prognosis.*—Sandcracks vary in gravity according to their cause and position. The most troublesome, perhaps, are those resulting from excessive strain on the coronary margin produced by unequal distribution of weight, because recovery then depends upon the downward growth of an unbroken mass of horn from the coronary band, and this again depends upon the length of the crack. The animal may be useless for months, for a time, in fact, sufficient for the hoof to be entirely renewed. During this period fresh cracks may develop if attempts are made to use the horse for trotting, galloping, or jumping, and again postpone recovery or seriously imperil it. Cracks resulting from wounds of the coronary band are also grave, especially when a portion of the horn-secreting structure is destroyed. On the other hand, those due to drying of the horn or to bad shoeing are unimportant, provided the hoofs are well-shaped and sound. The same is true of cracks at the bearing surface.

*Treatment.*—Recovery is assisted by fixing the opposing margins of the crack firmly in position, thus preventing the new horn from being torn through. Immobilisation of the edges is not, however, the principal point, and it is much more important to attend to the distribution of weight in the hoof and to improvement of its form.

The margins of the crack may be fixed together by one of the following methods:—

1. By means of clips, which may be either bought ready made or fashioned out of thin rod iron by the farrier himself. A depression to receive the clip is made in the horn by applying a specially shaped red-hot iron. The clip is then placed in position and the ends pressed inwards by means of special pincers. The operation should be performed while the animal stands on the foot, and the clip, which should be sunk almost flush with the wall, applied immediately after removing the iron, because then the horn is soft and allows the points to



FIGS. 348, 349.

penetrate, while it ensures the clip holding firmly. According to the length of the crack one to three clips may be applied. This method is only applicable to sandcracks around the toe and in strong hoofs.

2. By metal plates (fig. 351), fastened with small wood screws corresponding in length to the thickness of the outer sheath of the wall. For quarter and heel cracks shorter but broader plates are used, in which the screws are applied one below the other. The plate is slightly countersunk before being screwed on, by heating to a dull red and pressing it on the proper spot. Plates can be used for any kind of crack, except those at the extreme ends of the heel. They appear to have given satisfaction.

3. By rivets. One or two specially prepared horse nails are driven through the borders of the crack and afterwards clenched in the usual way. The operation is rendered easier by boring or burning the holes for the rivets beforehand. This is the oldest process and if carefully performed is very successful, but can be employed only at the toe and quarters.

4. By means of the special teethed sandcrack band invented by Köster. The hoof is cleansed, the edges of the crack, if necessary, smoothed, and grooves for inserting the jaws of the

band burnt with a special iron. The band is then inserted from above in the grooves and driven downwards to close the crack. This band holds exceedingly well, and in consequence of the toothed edge it never slips back; nevertheless, it sometimes has a tendency to produce fresh splits in the horn at the spot where the grooves have been burnt.

5. By means of sandcrack straps (fig. 350). These are intended to hold the edges of the crack firmly together. The broad, enlarged, and concave portion of the strap lies around the coronet. A mass of tow moistened with some fatty material is placed below it and the whole drawn together. The strap is removed every three or four days, the crack

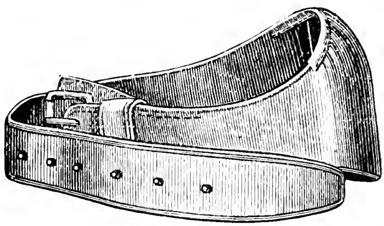


FIG. 350.—Sandcrack strap.

cleansed and a fresh tampon of tow applied. The advantages stated by Schleg are: (1) it allows of permanent application of fatty materials, which render the horn more elastic, and assist the normal growth from the coronet, while it prevents the separation of the edges; (2) it can be used along with any other method of fixation; and (3) it can be used as a preventive on brittle hoofs. It is, however, difficult to draw it sufficiently tight.

6. By means of broad linen tape. After applying a mass of tow moistened with tar, fat, or oil to the coronet, the tape is moistened and wound firmly round the upper part of the hoof. The ends are tied or sewn together, and the whole is then smeared with tar. This dressing, which acts somewhat like the strap, remains in position until the next shoeing.

7. To check the continued opening and closing of the crack, a shoe with 'bar-clips,' fitted closely to the bar of the foot on either side, has been successfully employed. By diminishing expansion at the heels, this shoe lessens movement in all other parts and prevents the sensitive tissues being nipped between the margins of the crack.

The methods 1 to 4 are applicable where the crack follows the direction of the horny fibres, but are of no value where the margins are irregular, zigzag, wavy, or overlapping. In the latter case the parts should be thoroughly thinned with a rasp or fine searcher, but bleeding should be avoided. The animal is then shod and the strap (5) or linen tape applied. All these methods act by bringing the edges of the crack together, and minimising movement at the coronet.

Grosswendt in 1888 suggested another method for use in special cases. As the crack was open and filled with granulations from the sensitive parts, riveting would have been useless (or worse). Grosswendt, therefore, applied a wooden wedge, thrust between the edges of the crack, thus holding it open. With suitable local treatment he effected a cure.

(a) *Sandcrack originating at the Coronary Margin*

is the form most commonly seen. In seeking the best method of shoeing it should be borne in mind that everything which renders the hoof broad and strong, improves its form, and relieves the diseased portion of the wall of pressure, favours recovery. Accordingly, tips, dilating shoes, bar shoes, and stoppings which cause counter-pressure on the sole assist recovery.

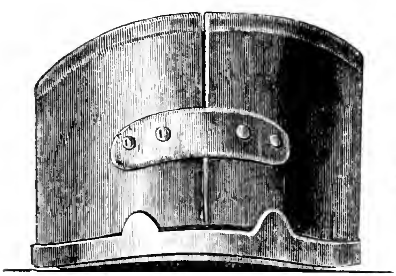


FIG. 351.—Hoof shod for sandcrack of the toe.

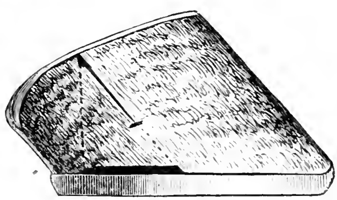


FIG. 352.—Hoof shod with bar shoe for quarter crack. The part of the wall which has been 'eased' is shown by dotted lines.

1. Toe sandcrack is best treated by trimming the hoof so as to give a level tread and by applying a shoe with two toe-clips. The nail holes should be punched somewhat further back than usual. The edges of the crack may be fixed together by metal plates (fig. 351) or by the insertion of a few rivets or

special clips. The choice of these must be determined by the position and character of the crack. Bar shoes are only resorted to when the bearing surface of the wall is defective.

2. Quarter and heel cracks are best treated by the use of bar shoes. Before nailing on, the portion of the wall below and behind the crack should be lowered so as to relieve it of weight. The exact area from which to remove horn can be judged as follows. The crack is prolonged in imagination in the same direction as the horn fibres until it reaches the bearing surface. From the upper end of the crack an imaginary vertical line is dropped to the bearing surface of the hoof. The portion comprised between these two lines is then lowered sufficiently to prevent any pressure on that part until the next time of shoeing (fig. 352). Another, and perhaps preferable, method is to seat out the shoe at the points indicated, leaving the wall untouched.

The same rule applies to cracks at the heel, even when the imaginary vertical line falls behind the bearing surface. Stoppings are of value because they convey a portion of the body-weight to the sole and frog, lead to expansion of the hoof, and diminish concussion during movement, all of which tend to prevent the new horn from cracking.

When the crack is widely open and the frog small, or when the hoof is contracted, a shoe with bar-clips may be employed.

If the edges of the crack are irregular or overlapping, all projecting parts should be removed. To assist the growth of sound wall and diminish the tendency to fresh fissures, the upper portions of the wall near the crack should be thinned, the hoof kept moist, and a sandcrack boot or tape applied. French clips are not advisable in cracks of the quarter, and are distinctly injurious in cracks of the heel. To prevent the fissure extending further, a furrow may be burnt or cut at its extreme end, and at right angles to its general direction. The furrow is made at the lower end of cracks starting from the coronet, and at the upper end of those starting from the bearing margin of the wall.

Blisters of cantharides or biniodide of mercury are sometimes applied to the coronet to stimulate the growth of horn. The wall secreted is found to be thicker than before. Animals suffering from sandcrack often recover without treatment if turned out barefooted, though an exception must be made as regards those with sandcrack starting from the bearing surface.

If during the first few days there is inflammation and lameness cold poultices may be applied. When lameness is absent horses may be used for slow work. Carriage and riding horses should not be used at a fast pace until at least half an inch of sound horn has grown.

(b) *Sandcrack of the Bars*

nearly always results from deformity of the heels, produced by contraction or by allowing the heels to become too high. It almost invariably affects fore-feet and is generally accompanied by corns. When it exposes the sensitive structures, superficial inflammation and lameness supervene. The limb is knuckled over at the fetlock during rest, and unless treatment is at once commenced, the inflammation extends to deeper-seated structures as far even as the plantar cushion, the bulb of the heel on the affected side shows tumefaction and severe lameness results, which demands the attention of the veterinary surgeon.

The bars form part of the most yielding portion of the hoof. The crack alternately opens and shuts during movement and tends to increase in length, while the sensitive parts become irritated and inflamed. By paring the parts after removal of the shoe, the split is seen as a black line, which exudes a little of the grey horn pus, or, in severe cases, even blood. Treatment should be directed towards producing a fresh growth of sound horn. The borders of the crack are to be entirely removed, the surrounding horn thoroughly thinned, and the affected heel wall relieved of all shoe pressure. The heel wall is lowered and a bar shoe with léather sole and stopping applied. Removal of the margins of the crack may leave a deep groove, especially in upright hoofs. If the bottom of this groove appears moist, a little tampon of tow moistened with tincture of myrrh or aloes is inserted, and the space filled with wax. The crack gradually closes, if due precautions be taken.

### (c) *Cracks at the Bearing Margin of the Wall*

are commonest in unshod horses, and result from excessive outward strain on this part. They can generally be prevented by rounding off the lower edge of the wall with a rasp before turning the horse out. In shoeing, such cracks may result from the use of large nails, especially when the nail holes are punched too near the outer edge of the shoe.

Every crack at the coronet may in time extend to the bearing surface. To prevent such cracks in unshod horses it is usually sufficient to shoe them, but in horses already shod attention must be given to the position of the nail holes and the use of thinner nails. The bearing surface in the neighbourhood of the crack should be lowered in the way afterwards described. To prevent the crack extending, a deep transverse furrow is cut or burnt at its upper end.

## 2. Transverse Cracks of the Wall

may occur at any point; they are generally seen at the inner quarter and toe, as a result of treads from sharp or faulty calkins. Pus from suppurating corns, etc., may break through at the coronet, and produce the same result by interrupting, for a time, the connection between the horn and coronary band. Such cracks are occasionally seen at the heel, the horn fibres having broken across, owing to dryness and contraction of the horn. They are not of much importance, and need only attract attention when they come within the region embraced by the nails.

In order to avoid disfiguring the hoof, the horn below the cleft should be preserved as long as possible, the wall at this point being lowered and kept clear of the shoe. If, however, the piece becomes loose, it is better to remove it and fill up the resulting cavity with gutta-percha or some composition.

## 3. Loose Wall, Seedy Toe, etc.

(*a*) When at any point in the white line the connection between the wall and sole is destroyed, the resulting condition is described as ‘loose wall.’

It is commoner in fore than in hind feet, and at the inner than at the outer side. Taken as a whole it is not of infrequent occurrence, though it only attracts notice when it extends to the soft parts and makes the horse lame. On account of this fact an artificial division between superficial and deep-seated loose wall has been made. The latter causes lameness by reason of the separation extending towards the lower margin of the sensitive wall and there producing superficial inflammation or even pus formation.

Loose wall can only be detected with certainty by removing the shoe and searching the foot, although its presence may sometimes be guessed by the bulging of the lower margin of the wall (fig. 353, *a*).

The prognosis depends on whether the separation is superficial or deep, and whether it involves a large portion of the wall. Separations occasioning lameness are, like sandcracks, apt to be very troublesome.

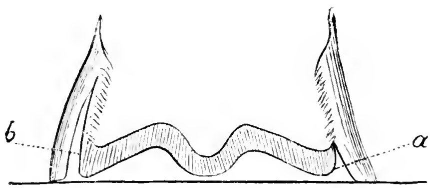



FIG. 353.—Vertical section of a hoof (semi-diagrammatic). *a*, loose wall; *b*, seedy wall (the process has extended further).

The *causes* of loose wall are various. When the wall forms an oblique angle with the ground, it is more liable to separate than when upright. Wide, flat hoofs, therefore, are its commonest seat, but laterally distorted and contracted hoofs also exhibit the condition. The soft horn composing the white line is doubtless largely responsible for the occurrence of separations, offering, as it does, little resistance to the ammoniacal fluids, etc., to which it is so often exposed, and suffering more severely than contiguous parts from the heat of the shoe when applied for fitting. Contact with manure alters its nature, the heat of the shoe dries it, and causes cracks and irregular strains in different portions, while the downward progress of the wall, which rather favours tension and cracking of the sole even when sound, contributes to the production of loose wall. Front feet suffer more frequently, because they are kept drier and carry greater weight. Rapid work on hard ground and faulty fitting of the shoe are also frequent causes. Narrowness of the bearing surfaces and an inclination outwards at the heels particularly favour separation.

Loose wall can only be cured by the downward growth of healthy horn. In this case the old advice to remove the cause is especially applicable. Careful preparation of the hoof is of great importance. The connection between the wall and sole should never be weakened, though all 'seedy' and broken-down horn must be removed, and the bearing surfaces should be made as broad as possible by allowing the shoe to slightly overlap the margin of the sole. This relieves the loose part of the wall of weight without doing any harm. Convex walls should be judiciously rasped so as to bring them towards their normal direction. If the hoof is weak, the bearing surface of the shoe may be very slightly inclined inwards. If, however, in addition to loose wall other disease of the hoof exists, a bar shoe with leather sole should be applied; sometimes quarter-clips are useful.

When lameness is present, the separated section of the wall should be relieved of weight, but this is not always possible when the separation is of large extent.

To prevent drying and the entrance of dirt the space may be filled with tar, or, better still, with Venice turpentine and tow, failing which, wax can be used. Horn substitutes like gutta-percha become hard, and are apt to act as a wedge, increasing the size of the space; they should, therefore, be avoided.

If pain is excessive and suppuration feared, the suspected area can be opened at its lowest point with a small centre-bit, and any blood-stained or purulent fluid removed, when the pain will diminish. After-treatment is similar to that given on page 320.

In unshod horses loose wall is treated by removing all the separated horn and, if necessary, by applying a shoe.

(*b*) *Seedy toe* is a condition in which the laminal and tubular sheaths of the horn wall are divided in the direction of their respective surfaces. Compared with that previously described, this condition is rare.

The presence of seedy toe may be suspected when a portion of the wall appears either prominent or hollow, and gives forth a hollow sound on being struck. To confirm the diagnosis the shoe must be removed. The white line is then seen to be replaced by a narrow slit, which, however, in no way indicates the extent of the disease. The division between the two portions of the wall extends further upwards than in loose wall, in many cases as far as the coronet. The space is usually filled with degenerated horn. The width of the diseased part may at times be very considerable. Möller states that it varies from $\frac{1}{4}$ inch to 4 inches.

Seedy toe is generally painless, but lameness is caused when weight is thrown on the diseased portion of wall and when the animal is worked at a fast pace.

The *cause* is stated by Möller to be an interruption in the formation of horn. In fact, there is considerable diversity of opinion on this point, but tentatively seedy toe may be considered as possibly due to the action of some fungus-like organism which obtains entrance to the inner sheath of the wall and induces change in the horn. A cure requires considerable time.

In *shoeing*, the diseased portion of wall should always be relieved of weight. The cavity should be cleared out and, after dressing with pure carbolic acid, filled with tow and tar, turpentine, or wax. When the disease is more extensive a bar shoe should be applied and the nails omitted at the diseased spot.

The radical method of dealing with seedy toe is to remove all separated and disintegrated horn, thoroughly disinfect the parts with pure carbolic acid, apply a bar shoe and blister the coronet. This, of course, necessitates a long rest.

### 4. Thrush

is characterised by the presence in the cleft of the frog of an ill-smelling, blackish fluid, and by the frog itself being ragged or atrophied. The disease usually begins in the central furrow of the frog and extends thence to the other portions, which it destroys partly or even entirely. The products of decomposition irritate the sensitive parts and cause tenderness if not actual lameness. The central portion of the frog first disappears: and as a result of the unopposed pressure of the wall the limbs next approach and fill up the previously existing cleft, a condition which renders it difficult to keep the space clean. At the same time, the discharge gradually attacks the horny bulbs and may lead to a similar process in the periople. This is followed by the formation of rings in the superficial horny sheath of the wall. The rings can be distinguished from those of the deeper sheath both by their appearance and course. They usually consist of slight elevations, which approach in front and towards the upper part of the foot, where they may end or again may take an irregular course backwards, extending as far as the opposite half of the wall. They always cross the rings of the deeper sheath; indeed, when thrush has existed for a long time, they sometimes cross one another. This peculiar ring formation, which is almost pathognomonic of thrush, shows that the disease has existed for at least several months.

Thrush results chiefly from want of cleanliness, insufficient exercise, and faulty shoeing. If for a long time the frog is prevented touching the ground by excessive trimming, or by the use of unsuitable shoes, it either atrophies or thrush develops. Prolonged rest, however, without any fault in shoeing, may produce the disease. It has been suggested that thrush is due to inflammation of the sudoriparous glands of the frog.

*Prognosis.*—The views held as to the significance of thrush are unusually varied. Some regard it as a very trifling disease, which may continue for years without any particular ill consequence, or even as a benign condition not to be interfered with.

If thrush in itself is not of much importance, it often leads, however, to much more serious conditions. It weakens the framework of the hoof, and in flat feet favours the advent of contraction. It may interfere with the animal's use, and even when not actually producing lameness, it causes the stride to be shortened and diminishes freedom of movement. When affecting one side of the frog, it is apt to lead to unilateral contraction and obliquity of the hoof. In addition, it has been held responsible for the production of corns, sandcracks, and even canker.

The *treatment* of thrush is neither complicated nor difficult, provided neglect has not resulted in serious changes in the hoof. When the attack is recent and there is no marked change in form, cure will be obtained by allowing the diseased frog to come in contact with the ground and exercising the animal freely. In more serious cases removal of all loose fragments of horn, thorough washing of the diseased frog several times daily, and the application of some antiseptic or mild astringent, such as raw pyroligneous acid or a 5 per cent. solution of sulphate of copper, will usually prove sufficient.

To prevent irritation by manure, etc., the frog should be cleansed and smeared with Venice turpentine, after which a moderately warm iron may be slowly passed over the parts without actually burning them; if, however, the disease is of old standing, the frog almost denuded of horn, and the hoof so contracted that the walls of the heel press on the plantar cushion and frog, De Fay's shoe (page 350) may be employed with great advantage. Contraction at the heels favours the disease, and conversely its removal assists recovery. As soon as possible the frog should be allowed to come in contact with the ground. Needless to say, the dilating shoe is useless except when the hoof is contracted. By using the knife in conjunction with astringent powders, thrush can be cured, *i.e.*, the offensive discharge can be stopped; but, as compared with the sound, well-developed organ which results from proper shoeing, the small, dry, shrivelled frog thus produced is most unsatisfactory. Thrush can only be regarded as cured when the discharge has ceased and the frog is once more dry and well developed. This is not to be obtained by the application of chemicals; regular exercise and the intermittent pressure it causes can alone produce sound horn. Canker can only be efficiently treated by the veterinary surgeon, and the work of the farrier in such cases is confined to fashioning the necessary shoe.

# CHAPTER IV.

## INFLAMMATION OF THE STRUCTURES ENCLOSED BY THE HOOF.

### 1. Pricks in Shoeing

RESULT from misdirection of the nail in driving, in consequence either of the driver's carelessness, or (and much more frequently) of badly-punched nail-holes. They may be divided into two kinds, direct and indirect.

The effects of the first are immediately perceptible, those of the second may be delayed.

In cases of direct injury the nail penetrates the sensitive sole or wall, and the lesion may vary from simple perforation to fracture of the edge of the os pedis. There is always bleeding, though the blood may not be seen.

In the second case the nail does not penetrate vascular tissues, but passes close to them, thrusting the soft horn inwards, pressing on sensitive structures, and in the course of a few days producing inflammation and lameness. There is no bleeding. This condition is often termed 'binding.'

*Symptoms.*—The first symptom of direct injury is pain, shown by the limb being pulled away, and intimating to the farrier that the nail has taken a wrong course. When removed, more or less blood follows the nail or discolours its point, but bleeding may occur inwardly without being visible. It is otherwise when the foot at some part is bound or indirectly injured. Pain is not then immediately evinced, or at least not until the animal places weight on the foot. If attempts are made to raise the opposite foot the horse leans in that direction and appears uneasy. The effects of indirect pricks usually become apparent in from two to three days, but may be postponed for eight to fourteen days, when inflammation and lameness draw attention to the foot. The hoof is then hot, painful to percussion and to pressure with the pincers; there is slight swelling, increased pulsation of the digital arteries, and partial or complete inability to bear weight on the foot.

Pricks in shoeing may be suspected when the animal is tender on the foot, when it has been newly shod, when the hoof appears too small for the size of the body, when the wall is excessively rasped or portions are broken away, and when the nails are very high or very unequally placed.

Premising that even with every precaution pricks in shoeing are sometimes unavoidable, the more common causes may be arranged as follows:—(1) badly placed or misdirected nail holes; (2) excessive paring and lowering of the hoof: (3) thinning the wall by rasping the outside; (4) faults in fitting the shoe; using very narrow shoes; sinking the toe-clip too far into the hoof (the nail holes, instead of corresponding with the white line, then fall within the region of the sole); (5) faulty driving; the use of badly pointed or excessively large nails; (6) placing the nail too deep, or reversal of its point. As accidental causes may be mentioned, (7) old stubs left in the hoofs; (8) very thin or broken walls; (9) abnormal softness of the horn, which renders it difficult to ascertain the course of the nail by the resistance and sound; (10) restlessness of the animal while the nails are being driven; and (11) (nowadays a very uncommon event) splitting of the nail in the hoof.

To detect pain in the foot the pincers are applied with moderate and regular pressure all round the sole and the clenches, and the lower part of the wall is gently tapped with the hammer. If the horse flinches at a certain spot, the shoe must be removed, each nail being drawn separately. Note should be taken of the direction and thickness of the nails and of any adherent blood, blood-serum, or pus. The point where each nail enters the hoof should be examined. If, instead of passing through the white line, one of the nail holes appears within it, *i.e.*, nearer the centre of the foot, it is in the highest degree probable that that particular nail hole is at fault. Each hole is then examined by passing a clean nail into it and pressing the point towards the soft tissues at different depths. Under such conditions symptoms of pain are a sure indication of the animal having been pricked. It need scarcely be said that the position and direction of the nail holes in the shoe must be carefully examined.

*Treatment.*—If the horse flinch while a particular nail is being driven, the nail should at once be removed, the hole disinfected with a few drops of carbolic oil (5 per cent.) and closed with wax. There is seldom any bad result. But when bleeding follows, the shoe should once more be carefully tried, and only affixed when it is seen to fit perfectly and the nail holes to exactly correspond with the white line; the nails should be left out in the neighbourhood of the injury and the latter disinfected and closed with wax or tar. After severe stabs or pricks a more or less well-marked inflammation of the corium is to be expected, though it may be prevented by cutting out and disinfecting the injured part, resting the animal, and using cold poultices. When, however, the wound is clean and fresh no good object is served by cutting it out.

'Binding' (or nail pressure) often remains undetected until pain becomes severe. In such cases the offending nail when withdrawn is usually covered with, or followed by, pus, or a dark coloured, sometimes stinking fluid. To allow the freest possible exit for this discharge it is advisable to remove all horn which has become 'underrun,' *i.e.*, which is separated from the sensitive tissues. The particular nail hole may be cut out sufficiently to accommodate the little finger, the surrounding parts of the sole well thinned, and discharge assisted by warm baths or poultices. Excessive paring is to be avoided. If pain continues after removing the nail and allowing the pus to escape, warm baths of 3 to 5 per cent. carbolic solution are very useful. The moisture and warmth soften the horn and diminish pain.

If after two or three warm baths the pain is diminished or not very severe, a few drops of carbolic oil or tincture of myrrh may be applied to the injured part and the opening closed with a little carbolic jute or wood wool. In most cases complete recovery will soon occur. If shod so as to prevent pressure on the injured spot, horses which have been pricked can often be returned to work in a few days. The shoe must take its bearing only on the wall, and pressure on the white line and margin of the sole must be avoided. No nails should be driven in the neighbourhood of the injury. Although, when early detected and appropriately treated, pricks in shoeing are not dangerous, yet in some cases they lead to extensive suppuration and loss of the hoof, or become infected, determine the onset of tetanus, and thus prove often fatal.

## 2. Picked-up Nails.

It not infrequently happens that nails and sharp bodies accidentally penetrate the hoof, either through the horny sole or frog, and, driven onwards by the weight of the animal's body,

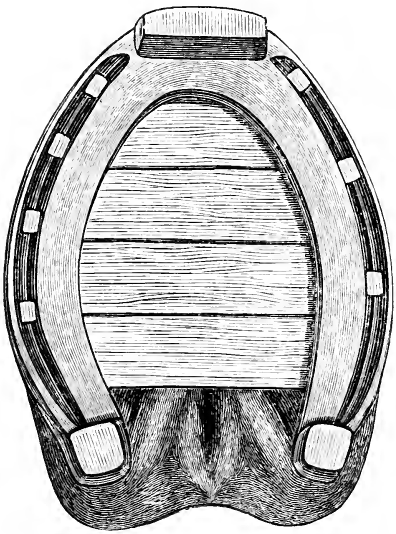


Fig. 354.—Hind-foot shod with surgical shoe for retaining dressings.

reach the sensitive sole, sensitive frog, plantar cushion, perforans tendon, navicular sheath, pedal bone or even the coffin joint.

The hind feet are perhaps more frequently affected than the fore. The commonest points of perforation are the lateral furrows of the frog, and, when weakened by excessive trimming, the sole and frog.

The *symptoms* are usually sudden pain and lameness. The shoe should be removed and a thin slice taken off the sole and frog when the point of entrance of the foreign body (or the body itself), whether a nail, piece of glass, or other pointed object, will be discovered, and should be cautiously removed, particular care being taken not to leave any fragment behind. As the prognosis largely depends on how deep the foreign body has penetrated, the latter should be preserved, so that the veterinary surgeon may examine it.

In slight injuries of the sensitive sole or frog, where pain is only moderate, the wound should not be enlarged, and it is only necessary to carefully thin the adjacent horny parts. In deeper penetrating injuries and when pain is severe, a veterinary surgeon should be called in.

Poultices or dressings are then necessary, and the special shoe (fig. 354) may be found useful. The shoe is well seated

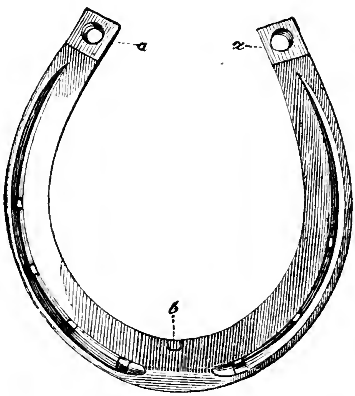


FIG. 355.—Shoe for surgical dressing of the foot. *a*, screw holes; and *b*, depression on upper surface for fastening the cover shown in next fig.

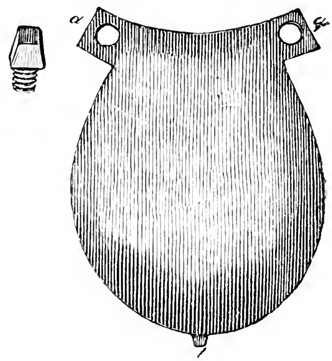


FIG. 356. — Cover for shoe shown in previous fig. The letters indicate similar points.

out and the dressing itself held in position by flexible pieces of wood thrust between the shoe and the horny sole. By using two crossed ‘splints’ of thin wood or hoop iron, a dressing may be retained in an ordinary shoe, the special form then being unnecessary.

In very special cases, when it is desired to exercise pressure on the injured spot and when the entire ground surface of the hoof must be protected, the shoes shown in figs. 355 to 362 may be used; the sole is protected by an iron plate affixed by means of a point at the toe and a screw at either heel.

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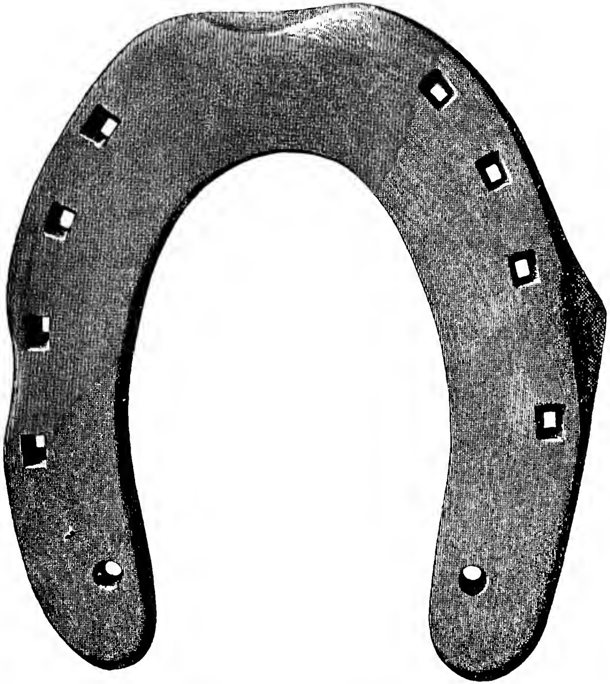

FIG. 358.—Stamped cart hind shoe (surgical), with arrangement for dressing foot. Made from $1\frac{1}{2} \times \frac{1}{2}$ inch iron.

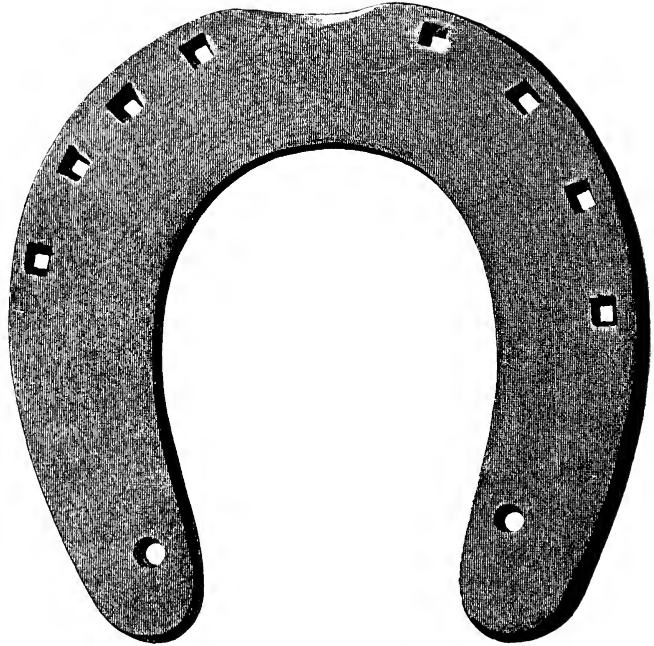

FIG. 357.—Stamped cart fore shoe (surgical), with arrangement for dressing foot. Made from $1\frac{1}{2} \times \frac{1}{2}$ inch iron.

## STAMPED CART FORE SHOE (SURGICAL), WITH ARRANGEMENT FOR DRESSING FOOT (FIG. 357).

*Made from* $1\frac{1}{2} \times \frac{1}{2}$ *inch iron.*

This shoe, specially made for treating cases of canker, etc., is seated out to the heels to allow of an iron plate (*see* following figures) being inserted between it and the foot. The *modus operandi* is to dress the foot, insert a proper stopping of tow, wood-wool, etc., and insert the plate, which serves the double purpose of retaining the dressing and excluding moisture.

As it is usually needful to dress the foot daily, this shoe obviates the necessity for removal and is of important service.

## STAMPED CART HIND SHOE (SURGICAL), WITH ARRANGEMENT FOR DRESSING FOOT (FIG. 358).

*Made from* $1\frac{1}{2} \times \frac{1}{2}$ *inch iron.*

This shoe corresponds in purpose with the preceding. It must be well seated out to the extreme limits of heels to allow the plate to be introduced. In most cases it is advantageous to have, as here depicted, a toe and two quarter clips. They give greater support to the shoe and prevent it shifting.

## PLATES FOR SURGICAL SHOES (FIG. 359).

*Made from 16 gauge sheet iron.*

This plate closes the under surface of the foot, retaining the dressing, preventing the entrance of moisture or dirt, and protecting the parts from injury. The sheet iron used must be fairly stout, otherwise the plate bends and rapidly wears out.

Before the shoe is nailed on the foot it is used as a guide for marking out the plate, which is made to slip in and out with a certain amount of friction. When the shoe is nailed on, the plate is inserted and the length of heel marked. Lastly, the heel portion is turned over in the vice and the holes for straps are punched.

## STAMPED CART HIND SHOE (SURGICAL), WITH ARRANGEMENT FOR DRESSING FOOT (FIG. 360).

*Made from* $1\frac{1}{4} \times \frac{1}{2}$ *inch iron.*

This shoe is used for a similar purpose to those preceding. The plate is attached by three screws, one at the toe and one at each heel.

Being more complicated, the shoe is, in general, less useful than that with sliding plate.

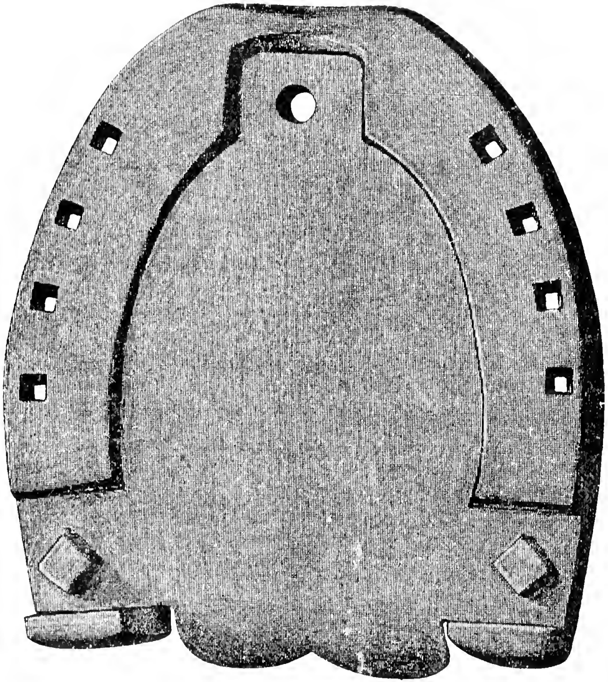

FIG. 360.—Stamped cart hind shoe (surgical), with arrangement for dressing foot. Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.

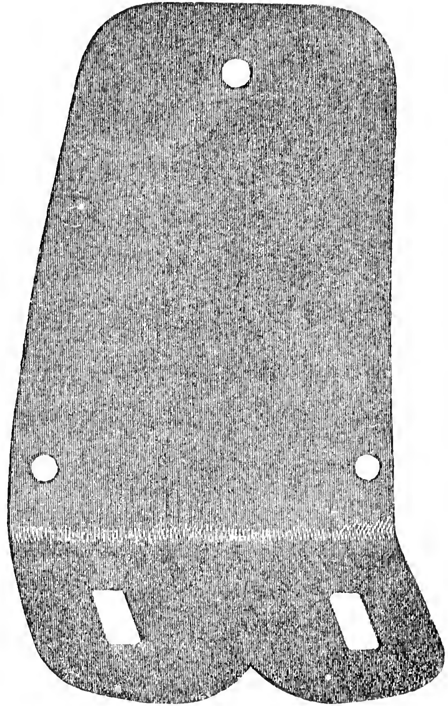

FIG. 359.—Plates for surgical shoes. Made from 16 gauge sheet iron.

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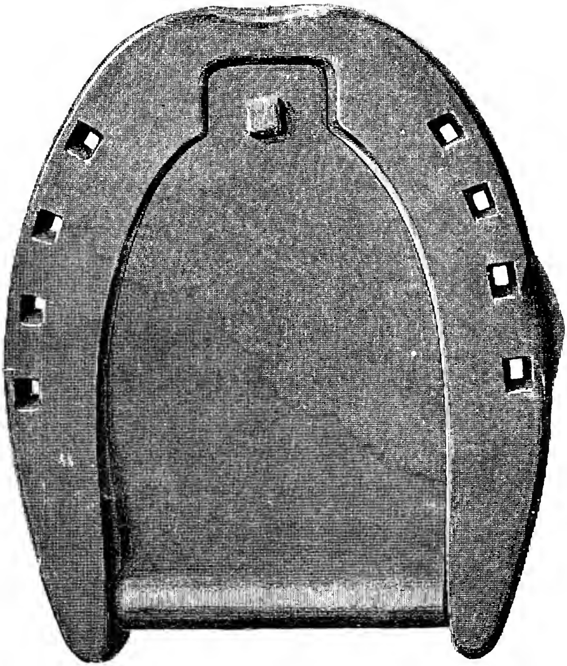

FIG. 361.—Stamped cart hind shoe (surgical), with arrangement for dressing foot. Made from $1\frac{1}{4} \times \frac{1}{2}$ inch iron.

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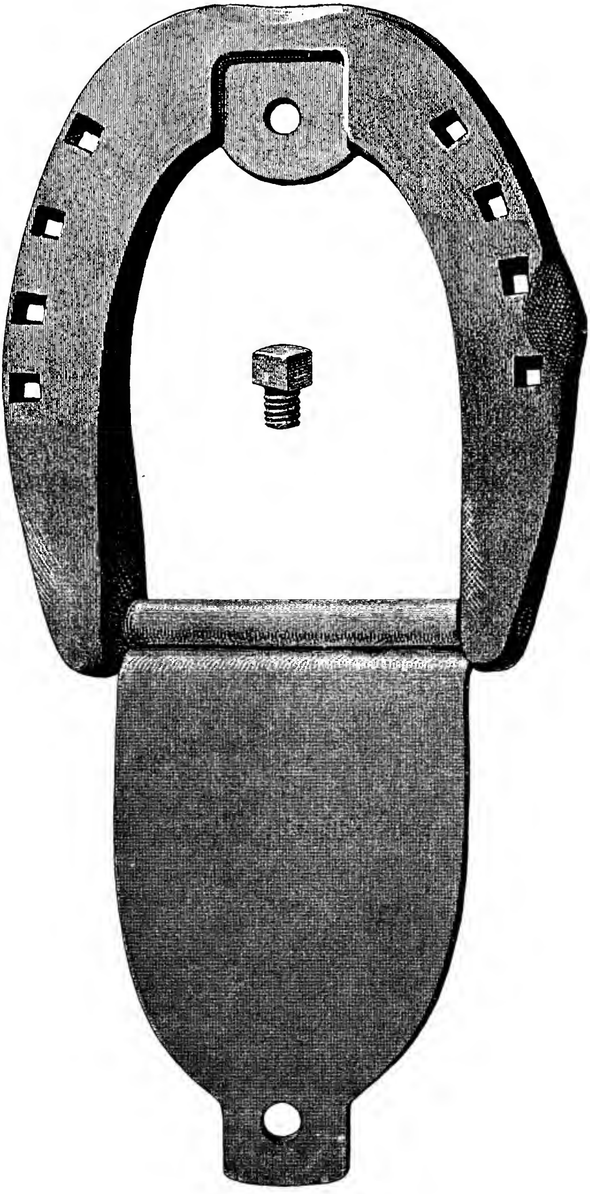

FIG. 362.

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## STAMPED CART HIND SHOE (SURGICAL), WITH ARRANGEMENT FOR DRESSING FOOT (FIGS. 361, 362).

*Made from* $1\frac{1}{4} \times \frac{1}{2}$ *inch iron.*

This shoe has a plate attached at the heels by a hinge, and at the toe by a screw. As shown in the following illustration the plate folds back, giving free access to the sole for the purpose of inserting dressings. The shoe is complicated and can only be made by a good workman, but in cases where a great deal of pressure on the sole is required it is of real value. Otherwise it can advantageously be replaced by the shoe with sliding plate.

### 3. Treads on the Coronet

are often produced, in horses with itchy legs, by the animal rubbing the coronet with the heel of the opposite shoe. At intervals the horse stamps violently, and it is then that the injury is done. The front and inner side of the coronet of hind-feet are most frequently injured. A 'tread' is a bruise or contused wound, associated with inflammation of the coronary band, which often results in destruction of a portion of the horn-secreting structures and permanent injury to the hoof. Such accidents are commonest in winter when animals are shod with sharp heels.

The inflammation results either in resolution or in necrosis with suppuration. The periople when separated does not again become adherent, and in consequence of this and of the interrupted formation of horn a cavity results in the horn wall (see page 372). When lameness follows treads, the portion of the wall below the injury must be relieved of weight. In fresh cases the injured parts should be carefully cleansed with warm water, all dirt, hairs, and loose portions of tissue removed, and some antiseptic (5 per cent. carbolic lotion) or mild astringent, like 5 per cent. alum or acetate of lead solution, applied. Severe treads always require the attention of a veterinary surgeon.

### 4. Inflammation of the Perioplic Ring.

The perioplic ring becomes inflamed comparatively seldom. The inflammation may affect the entire ring or, as when it results from dirt and irritants, only the portions above the toe wall.

The *symptoms* are increased warmth, swelling, tenderness on pressure, in white feet well-marked redness of the skin, and (later) a change in the condition of the perioplic ring and superficial sheath of the hoof. This superficial sheath exhibits elevations and depressions, running parallel with the coronet, and thus forming more or less complete rings, or the perioplic ring becomes irregularly thickened. The perioplic horn afterwards cracks longitudinally and transversely, giving the affected part of the hoof an appearance resembling the bark of an elm tree (fig. 363). Above the perioplic ring the epidermis usually shows an abundant growth of bran-like scales and crusts (as in dry eczema). In many cases the perioplic ring appears denuded of horn and so swollen as to project considerably above the upper margin of the wall. The disease takes a chronic course.

The *causes* are only partially understood. The perioplic ring, especially in pigmented hoofs, appears covered with dry, rough, brittle scales. Where fragments have broken away the

FIG. 363.—Showing appearance of hoof after long-continued inflammation of the perioplic ring.

reddened and inflamed perioplic ring becomes visible. Treads on the coronet or the use of irritants (frequent poulticing, grease, etc., etc.) may give rise to this condition. Gutenäcker describes cases caused by the use of unrefined vaseline.

*Treatment* consists principally in removing the cause. The parts are thoroughly cleansed with water and (carbolic) soap and any proliferations or thickenings removed. Gentle infriction with boric acid ointment or 3 per cent. carbolic ointment has been followed by good results. Some recommend sulphur ointment, consisting of sulphur 2 parts, lard or lanoline 5 parts, or a lotion of 2 parts tartaric acid in 100 parts glycerine, with the addition of 3 to 5 parts creolin. When deep cracks form and discharge, a pressure bandage combined with astringents is often useful.

## 5. CORNS.

In the widest acceptance of the word a corn may be defined as a bruise sustained by the keratogenous membrane. Corns are recognised by the yellowish-red or purple colour of the horn of the white line and sole. Their commonest seat is between wall and bar.

A light bruise causes exudation at the surface of the corium, forming the sensitive laminæ and papillæ. After more severe bruises blood-vessels are ruptured, blood poured out between the corium and growing horn, is absorbed by the latter and gives rise to the above described discoloration. The coloured portions are carried downward by the continued growth of horn, until finally they reach the ground surface. It is, therefore, clear that a corn is never visible at the time of its pro-

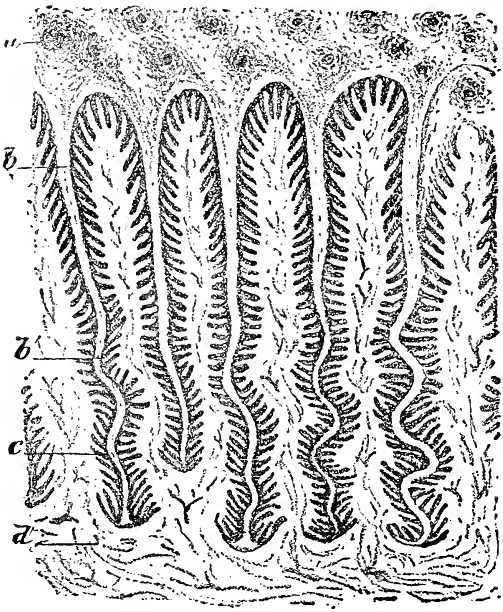



Fig. 364.—Cross section of the horny and sensitive walls from a case of contracted heel. Magnified 26 diameters. *a*, horny wall; *b*, horny laminæ; *b'*, their foldings; *c*, showing change in direction of secondary laminæ; *d*, sensitive wall.

duction, and cannot be detected until the hoof has been 'cut out.' Corns may be situate in the sensitive wall of the heel, the sensitive sole covering the corner of the heel and the sensitive bar, for which reason, wall, sole, and bar corns have been differentiated. They are rare in unshod horses. The front feet, and especially the inner heels, are their commonest seats. According to their severity and sequelæ corns may be divided into several varieties.

(1) Slight bruises lead to distortion of the horny laminæ and secondary laminæ (fig. 364, *b'* and *c*) and to superficial inflammation of the corium with exudation of sero-sanguineous fluid, which causes a yellowish, waxy or yellowish-red coloration. Extravasation of blood produces a red or bluish-red colour. The fluid exuded is again absorbed, leaving the spot dry, hence the name 'dry corn.' Lameness is seldom associated with this form.

(2) Severe bruising and the entrance of pyogenic organisms, lead to inflammation and suppuration, the condition termed 'suppurating corn.' Failing artificial paths of escape through the horn, the abscess enlarges in the direction of least resistance, *i.e.*, upward between the sensitive and horny laminæ


FIG. 365.—Transverse section of horny and sensitive wall from case of corn of the wall. × 24. *a*, horn wall; *b*, horny laminæ; *c* and *d*, degenerated horn; *e*, sensitive wall; *f*, space produced by formation of pus; *g*, shrivelled sensitive laminæ; *h*, distorted horny laminæ.

(fig. 365, *f*), and finally breaks through at the coronet. In corns of the sole the sensitive and horny soles are separated to a greater or less extent, and in corns of the bar suppuration may even extend to the plantar cushion. Suppurating corns often produce great pain and lameness.

(3) When mechanical irritation is continually renewed, the corn becomes permanent. Organic changes occur in the corium and hoof and sometimes in the pedal bone itself. The

horn is greatly discoloured, permeated with cracks, blood-stained, and of soft consistence.

Long continued irritation of the sensitive wall produces change in the horn of the quarters and heels. The sensitive wall often loses its laminated character at the centre of suppuration and exhibits a deep groove devoid of laminæ, though without sacrificing its power of producing horn. Though no horny laminæ are produced, the space becomes

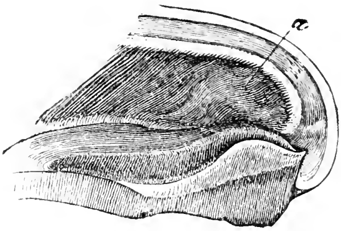



Fig. 366.—Portion of the inner surface of the wall showing changes after old standing corn. *a*, horn tumour.

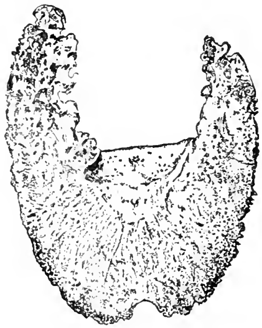


Fig. 367.—Ground surface of pedal bone showing bony enlargements on the wings (retrossal processes) in consequence of old standing corn.

filled with horn, which forms firm masses or tumours of varying size (fig. 365, *c*, and 366, *a*). The wings of the os pedis become enlarged, in consequence of chronic inflammation, ostitis or periostitis (fig. 367), as sometimes discovered after death.

The *symptoms* of corn are those of inflammation of the corium. In horses visibly lame there is always pain and increased warmth. The reddened spot in the heel is found on cutting out the foot. Corns may be due to very varied causes, and are by no means consequent on bad shoeing alone. Such causes are often to be found in the formation of the hoof itself or even in the conformation of the limb. Hence certain animals suffer more frequently than others, in spite of the best attention in shoeing, while, in consequence of the greater load thrown on them, the fore are much more liable to corns than the hind feet.

Unequal distribution of weight in feet which are turned in or out largely influences the position of the corn, which is most frequently found in the inner heel when the toe is turned outwards and *vice versa*. Weak, low, badly formed or contracted heels are all potent causes. Corns are also very common as a disease secondary to side bone. 'Dropped' soles often exhibit corns, the heels of the shoe being liable to press on, or even become embedded in, the sole at the point of the heel.

The *external causes* are many. First come faulty preparation of the hoof, bad shoeing, and reckless paring of broad flat hoofs; then follow weakening of the heels, sole, bars, and frog in all other forms of hoof, at the same time that the toe is left too long; unequal paring of one side of the hoof destroying the level character of the tread; excessive trimming of the sole and bars in order to give the appearance of a strong hoof, and cutting away the bars. Amongst faulty shoes may be mentioned those which are either too short, too far set under the hoof or nailed on across it, and shoes which incompletely cover the bearing surface or in which the bearing surface itself inclines inwards at the heels. These confine the expansion of the hoof. In flat and dropped soles insufficient seating out of the shoe is also a cause. Irregular and insecure fitting and shifting of the shoe from carelessness in nailing on may also cause strain of laminæ in the heel. Bad shoeing usually produces corns of the sole. In certain circumstances stones, becoming fixed between the frog and the heel of the shoe, bruise the sole.

Inasmuch as dryness is injurious to the hoof it may also produce corns. It renders the horny box hard and unyielding and produces a 'shuffling' gait at the commencement of work. After long continuance of wet weather the sole may become softened and so rather more liable to bruising, yet this is only of importance when other causes are also acting.

The very real character of the complaints as to hard roads, fast pace, etc., causing corns is shown by the fact that, in spite of good shoeing, horses which work in towns suffer much more frequently than even badly shod farm horses.

As shoes cause the entire body-weight to rest on the lower surface of the wall while the sole and frog are more or less suspended (especially when calkins are used), it is not difficult to believe that in the *suspending* parts, *i.e.*, the sensitive laminæ, strain is common. In this respect, as in many others, shoeing is a necessary evil.

The *prognosis* is influenced by the conformation of the limbs and condition of the lateral cartilages, etc. Turning out or in of the toe, weakness of the quarters, and (especially) ossification of the lateral cartilage are all unfavourable factors.

The *general treatment* of corns, from whatever cause arising, is tolerably constant, save when side bones are present, in which case bar shoes are objected to by some. The consequences depend not on the colour of the horn, etc., but on the position of the injury, on the degree of pain associated with it, and on the cause. As in other diseased conditions, removal of the cause plays an important part in treatment. Trifling bruises producing little pain and accompanied by slight extravasation of blood soon become converted into dry corns. Overgrown toes should be shortened, excessively high heels lowered, and a shoe applied which interferes as little as possible with the function of any part of the hoof. Before nailing on the shoe the posterior part of the bearing surface of the heel is often lowered $\frac{1}{8}$ inch, so as to prevent pressure and pain, but the use of a shoe 'set' at the heel is preferable.

When pain is so marked as to indicate extensive injury and severe extravasation of blood, the shoe should be removed, the horn thinned, the foot placed in warm boracic acid or permanganate of potash lotion for an hour or two, and poultices then applied, to diminish the inflammation, and, if possible, prevent suppuration. If, in spite of this, pain increases, suppuration has generally set in.

By careful examination the pus is found, and should be allowed free exit. The most direct way is the best, provided it necessitates no injury of healthy soft tissues or the removal of excessive quantities of horn. The first object must, however, be to provide free drainage; even when pus has reached the coronet, an opening should be provided below.

A warm foot-bath often facilitates the discharge, especially when the pus is thick or inspissated. Once pain is removed, the horse can be shod. The shoe must protect the diseased parts from external bruises and internal strain; a well-constructed bar shoe is usually best. This transfers, without damage, the weight of the body from the diseased to the sound parts. The depression in the horn is closed with a pledget of tow saturated with carbolic oil or tincture of myrrh, and retained in position, if necessary, by a leather sole.

In old corns it is not sufficient to temporarily protect the diseased spot, but the same precautions must be observed continually or for a long time. A three-quarter bar shoe is very useful, a portion being cut out at the diseased spot, so that it experiences no pressure whatever. The illustration (fig. 368)

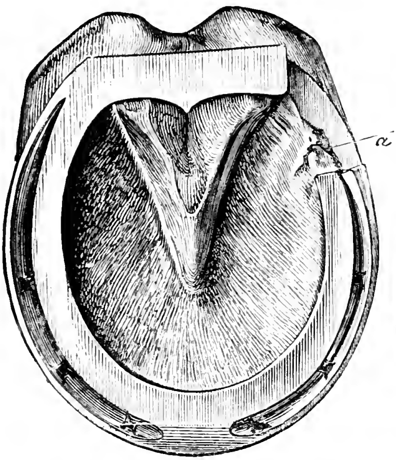



FIG. 368.—Three-quarter bar shoe. *a*, seat of the corn.

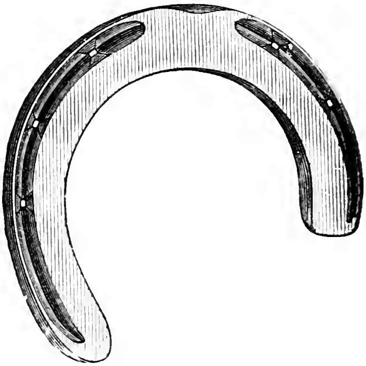


FIG. 369.—Ordinary three-quarter shoe.

sufficiently shows the construction of this shoe. In light horses with good frogs the ordinary three-quarter shoe, that is, a flat shoe minus the inner quarter, suits very well (fig. 369).

In corns associated with side bone, flat shoes with a thick leather sole are applied, and the hoof is kept moist.

If, in cases of old-standing corn, one or other of the bulbs becomes backwardly displaced, it is probable that the os pedis is diseased, as shown in fig. 368. The shoe, whether a bar or ordinary shoe, should then be provided with longer heels in order to remove weight from the diseased side (compare page 322).

Other complications, like sinus, etc., consequent on the further development or neglect of corns, require the attention of a veterinary surgeon.

Before affixing a shoe to a hoof showing corns, especially when the horse is 'going tender,' the reddened portion of the sole should be thinned. The surrounding parts should then be moderately thinned, so that they may exercise no pressure on the diseased area. The sensitive parts must not, of course, be exposed.

Reddish spots caused by bruising sometimes appear at other parts of the sole (bruised sole). The cause is either pressure on the sensitive parts by the horny sole, which has become too thick and hard, or, as is usual, bruising by loose stones. Such bruises may also end in suppuration. The treatment is similar to that of corns.

The shoes illustrated and described on next page will be found exceedingly useful in many cases of corn.

FIG. 370.—Three-quarter fullered seated fore shoe. Made from $1 \times \frac{1}{2}$ inch iron.

FIG. 371.—Fullered fore shoe ('set' on ground surface of inside heel). Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

*To face p.* 395.]

## THREE-QUARTER FULLERED SEATED FORE SHOE (FIG. 370).

*Made from* $1 \times \frac{1}{2}$ *inch iron.*

This shoe is useful in cases of corn in the inside heel, wiry inside heel, or weak and low heel. In the latter case very great benefit is often derived, and the heel speedily becomes stronger. Cases of 'capped elbow' may also be shod with this shoe.

A leather sole or frog pad may be used in conjunction. The inside heel is either cut off square, as shown, or round.

The inside quarter of shoe must be fitted fairly full, otherwise the corresponding part of foot is liable to split off, especially if the wall be thin.

## FULLERED FORE SHOE 'SET' ON GROUND SURFACE OF INSIDE HEEL (FIG. 371).

*Made from* $\frac{7}{8} \times \frac{1}{2}$ *inch iron.*

The method of 'setting' the inside heel of shoe in cases of corn is infinitely preferable to that of so-called 'easing' the heel by cutting away the wall. It gives protection to the injured parts without exposing them to the risk of pressure. Sometimes the 'set' is placed on the foot surface, but this is less advantageous that the system illustrated. It is produced by a few blows of the turning or boss hammer, the shoe being held on the edge of the anvil.

The 'set' part should be fitted long and full. It is essential that it be reduced to half the thickness of the shoe, otherwise as the shoe wears level with the 'set' portion pressure will again be produced on the tender spot. If the horse wears hard on the inside heel, it may be needful to reduce the thickness still more.

## 6. Shoeing after Laminitis.

Laminitis is a peculiar inflammation of the horn-secreting structures, usually seen to follow chill, digestive disorder, or overwork when the animal is in unfit condition. It suddenly affects horses and frequently leads to changes in the form of the hoof, as shown in figs. 372 to 374. Certain facts seem to encourage the view that it results from specific infection.

The disease is always accompanied with pain. The front feet are the most common seat, though occasionally all four feet or only one foot may be affected. In the first case the two front-feet are placed in advance of the body and the hind-feet thrust far under it. When all four feet are inflamed, the animal can scarcely walk. The disease often attacks very suddenly, and is then usually accompanied by well-marked fever.

The sensitive laminæ of the toe show the most marked

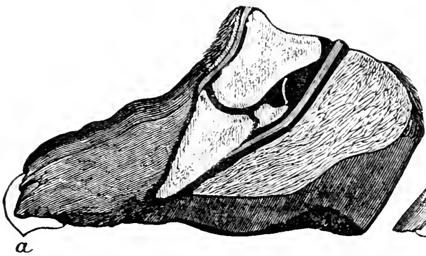



Fig. 372.—Longitudinal section of hoof one year after severe attack of laminitis.

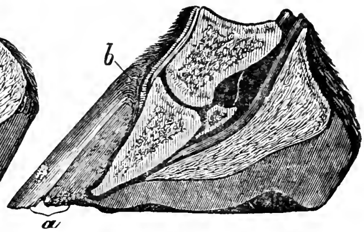



Fig. 373.—Longitudinal section of hoof three months after attack. *a*, pathologically modified horn of the white line; *b*, distortion of the horn tubules in consequence of sinking of the os pedis.

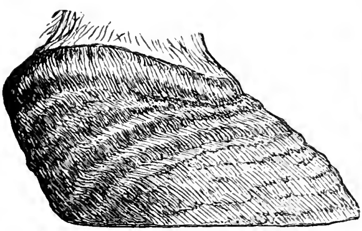


Fig. 374.—Hoof after laminitis.

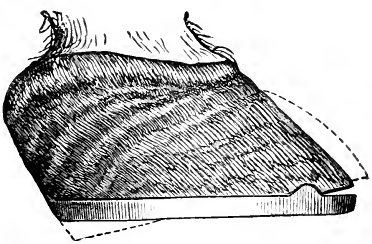


Fig. 375.—The same shod. The dotted lines indicate the previous form.

changes, those of the quarters and heels being less affected. Varying with the degree of disease the connection between the sensitive and horny laminæ is more or less obliterated, the os pedis sinks, and at the same time a depression occurs round the coronet (figs. 372 to 375).

The form of the hoof, therefore, alters and the heels appear higher. Rings form on the wall, the course of which is quite characteristic. At the toe they lie close together, gradually diverging from this point towards the heels (fig. 374). Below the coronet the toe wall generally sinks in, while its under parts appear thrust outwards. The white line is abnormally broad, its horn is 'cheesy,' loose, and easily broken down; as a consequence, the relations between the horny wall and horny sole are altered and there is a tendency to the formation of hollow wall. If no relapse occurs, recovery sometimes results, the new horn

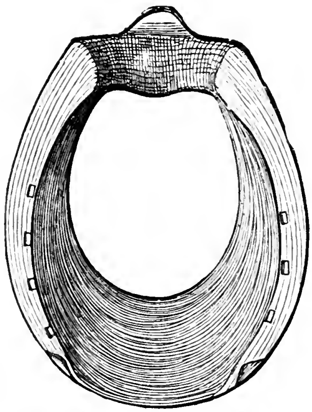


FIG. 376.—Special broad shoe for laminitis, with two toe-clips and a frog-clip.

growing down in the normal direction from the coronet, though as a rule the horn of the white line appears altered in character. If, however, the first attack be severe or repeated, the horny sole becomes flattened or even convex around the toe in consequence of descent of the os pedis. In aggravated cases the toe of the os pedis may penetrate the horny sole in front of the frog. The wall of the toe, previously little changed, is then completely distorted and bulged outwards.

Early *treatment* by a veterinary surgeon may cut short the attack and entirely prevent the changes in form and condition of the hoof, but when this is neglected the disease is apt to become chronic, and pathological changes in the hoof can never be completely prevented.

The animal may certainly recover sufficiently to be used, but its gait is always characteristic. The feet are not lifted fairly from the ground, but thrust forward and set down heel first. The heels of the shoe, therefore, wear most.

In preparing such hoofs for shoeing, a large amount of the prominent, bulging toe may be removed without injury. The sole should be spared and the heels lowered only slightly.

The choice of a shoe depends principally on the condition of the sole. When this still remains somewhat concave an ordinary shoe can be used, but if it is flattened or absolutely convex a broad shoe, preferably a bar shoe (fig. 376), should be chosen, especially if the bearing margin of the wall be broken.

As long as the toe continues sensitive toe-clips should be avoided and a pair of side-clips substituted, the portion of the wall lying between the clips being lowered $\frac{1}{8}$ inch to prevent pressure on the diseased toe (see fig. 375).

In horses which have suffered from laminitis the shoe is sometimes displaced forwards on account of the animal's unequal tread. This may be avoided by providing each heel or the heel prolongation with a clip (fig. 376).

## 7. Keratomata, or Horn Tumours,

consist in thickening of the inner surface of the horn wall (fig. 377). They are not common. Their most frequent seat is the toe, rarely the wall of the quarter. Gutenäcker regards them as due to chronic inflammation of the sensitive wall with suppuration between the sensitive and horny laminæ. The pus is retained, causes partial degeneration of the sensitive laminæ and separation of the sensitive from the horny laminæ. After the pus has escaped through a passage established by pressure or through an artificial opening, the space left is only partially filled up, and, in consequence of the inflammation, small prominences form on the free margins of the sensitive laminæ, which are the chief agents in the production of keratomata. As the free margins of the sensitive laminæ increase in thickness the track of horn they secrete becomes wider. The keratoma thus produced gradually occupies the formerly empty space, and in its turn may lead to partial atrophy (pressure atrophy) of the os pedis.

Keratomata may be caused by chronic inflammation unaccompanied by suppuration. The cavity in the os pedis corresponds in form and extent with the keratoma.

*Symptoms.*—Horn tumours do not invariably produce lameness, but, when lameness is present, pain, increased warmth and pulsation of the digital arteries may usually be detected. The growth can only be removed after it reaches the bearing surface. The white line is then distorted at some part of its

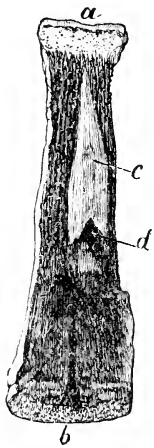



FIG. 377.—A piece of the toe wall removed, together with keratoma. *a*, coronary margin; *b*, plantar margin; *c*, keratoma; *d*, depression containing pus.

course, describing a semicircle around the horn tumour, which appears at the ground surface as a waxy-looking body. The new growth occasionally undergoes degeneration, producing a depression of varying depth, with dark coloured walls, from which a greyish-black pus is sometimes discharged.

*Causes.*—Chronic inflammation of the sensitive wall consequent on bruises, pricks in shoeing, clefts in the horn, corns, or treads.

The prognosis is unfavourable whether lameness exists or not. Under any circumstances lameness is probable and liable to recur even after removal of the growth.

*Treatment.*—When suppuration has seriously affected the sensitive wall, or when severe pain has existed uninterruptedly for a long time, operation is advisable and can only be successfully attempted by a veterinary surgeon. If, however, suppuration is only slight, and pain insignificant, the best treatment is to thin the neighbouring parts, expose the suppurating spot, and then to dress and plug the cavity with a 20 per cent. solution of iodoform in ether. This treatment should be repeated at every shoeing until improvement occurs. The latter, however, depends principally on thorough cutting out and cleansing of the suppurating spot.

*Shoeing.*—When the wall is good an ordinary shoe is sufficient, but if broken away or diseased a bar shoe, well seated out at the affected part, is preferable. The spot itself should be relieved of all pressure.

### 8. Canker of the Frog or Sole

is a peculiar intractable disease of the corium, which always tends to become aggravated, and which is attended with proliferation of the sensitive papillæ or laminæ, disturbance in the ordinary formation of horn, and the secretion of a thick, offensively smelling fluid. It usually begins unnoticed in one of the lateral furrows of the frog, less frequently in the sole, and is only detected after having made considerable progress. A moist discharging spot, from which the horn has been shed, is then noticed. Its base is pale red, swollen, and spongy, and not infrequently the sensitive frog, sole or wall exhibits warty, cauliflower-like or brushy growths. There is seldom lameness at this stage. The disease makes steady but slow progress, and a long period may elapse before it extends from the frog to the wall. At a later period the hoof, if not already very oblique, increases in width towards the heels.

The *causes* are not yet sufficiently known. Slight inflammation due to bruising, especially when the corium is exposed, is said to be sufficient to cause an attack. Although canker is quite distinct from thrush, the latter disease seems to favour the production of canker.

The *prognosis* is unfavourable and should always be guarded. The principal indications are afforded by the condition of the parts, the extent of the disease, the length of time it has existed, the rapidity of its return after treatment, and the number of feet affected.

*Treatment* comprises the removal of all loose horn, and the careful paring away and exposure of the diseased spot. For this purpose a searcher, scalpel, and forceps are required. The parts should be spared as much as possible and care taken that the surface in which the sound and diseased parts meet exhibits

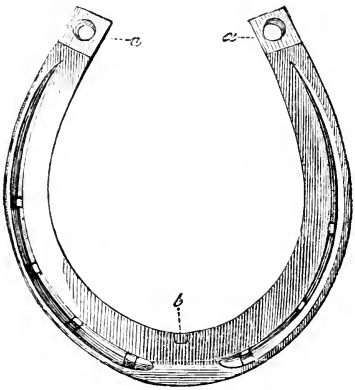



FIG. 378.—Shoe prepared for canker dressing. *a*, heels tapped and screwed; *b*, depression for taking the tongue of the cover shown in next fig.

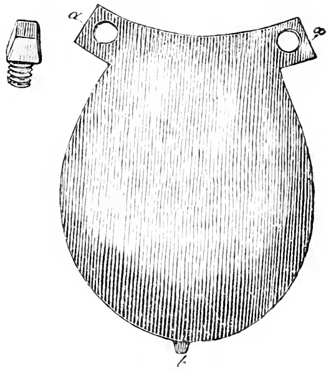



FIG. 379.—Cover for above shoe.

no hard margins. Bleeding should, if possible, be avoided. The paring, therefore, requires some skill. The parts are next thoroughly cleansed with clean lint or tow, without using water, and the dressing applied. All kinds of drugs have been tried, some with good, some with bad results. Distinct granulations should be removed by the use of mild caustics and the real curative material (generally an astringent and disinfectant) thereafter applied. Schleg recommends a mixture of sulphate of copper, sulphate of iron, and pulverised tormentilla root in the proportions of 1 : 2 : 3, or equal parts of salicylic acid and pulverised tormentilla root. Professor Putz suggests nitrate of lead. When the materials are used in the form of powder they must be rubbed in. Finally all parts denuded of horn should be subjected to moderate regular pressure by a surgical dressing, or less preferably by means of a special shoe and cover (see fig. 380). Wood wool or jute tampons are applied to the spot, the sheet of iron slipped into position and fastened. When the diseased parts appear very dirty it is useful after cleansing to saturate the new growth with tincture of iodine. The dressing is repeated daily, all loose fragments of horn being carefully removed. At a later stage the dressing need only be applied every two or three days. The special shoe presents nothing peculiar in regard to form, surface, nail holes, etc.; but

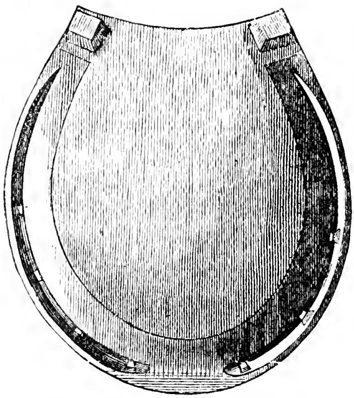


FIG. 380.—Special shoe for canker, with cover applied.

is made specially light and narrow, and presents at the centre of the toe a depression to receive the point on the front of the sheet-iron cover. The outer margin of the cover is rounded off and rests for a distance of about $\frac{1}{8}$ inch on the inner and upper margin of the shoe, which is seated for this purpose. The cover should not touch the ground. This prevents the front of the cover being pressed inwards. According to the condition and position of the diseased spots the shoe may be varied.

## 9. Ossification of the Lateral Cartilages. Side Bones.

Lungwitz states that, in 1251 horses examined, side bones occurred as shown in annexed table:—

| Description. | No. of Horses Examined. | No. affected with Side Bone. | Percentage. | Remarks. |
|---|---|---|---|---|
| Belgian cart horse, | 98 | 68 | 69·5 | Working only on hard pavements. |
| Danish carriage horse, | 120 | 25 | 21 | Do. |
| Heavy riding horse, | 388 | 36 | 9 | Working in heavy ground and partly on hard pavements. |
| Do., | 132 | ... | ... | Working on light sandy soil. |
| Light riding horse, | 133 | 8 | 6 | Working on light ground. |
| Riding horses (various weights), | 140 | 3 | 2 | Do. |
| Military horses, | 200 | 1 | 0·5 | Working on medium heavy ground. |
| Officers' horses (heavy), | 40 | 3 | 7·5 | Working on varied surfaces. |
| | 1251 | 144 | 14·4 | |

1. Ossification of the lateral cartilage occurs principally in heavy, coarse-bred horses. 2. The fore feet suffer more

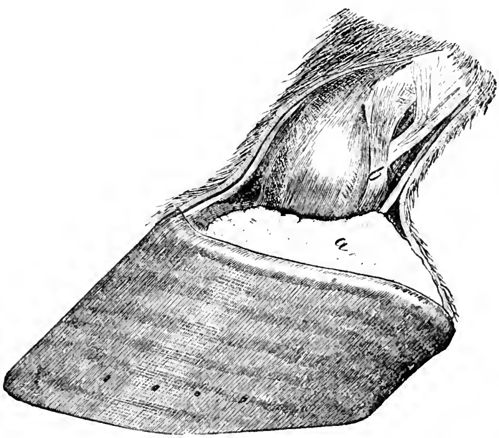



FIG. 381.—Left fore-foot, seen from the outer side. The skin has been partially removed to show that portion (*a*) of the lateral cartilage which projects above the hoof; *b*, ligament running from lateral cartilage to fetlock, one-third natural size.

frequently than the hind; 3, the cartilage of the left hoof suffers more frequently than that of the right; and 4, the outer cartilage suffers more frequently than the inner. 5. Ossification sometimes occurs at an early age, usually when the

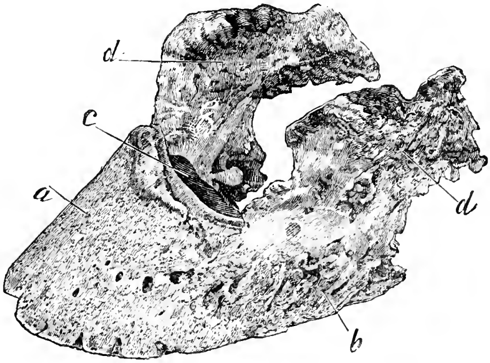



FIG. 382.—Pedal bone, with almost complete ossification of the lateral cartilages. *a*, pedal bone; *b*, wing of pedal bone, from which point, as a rule, ossification commences; *c*, articular surface; *d*, rough, uneven surfaces.

animal is first put to work. 6. Well-bred animals suffer less frequently than others. 7. The use of animals, of heavy build, on hard roads favours the occurrence of side bone.

The *symptoms* vary according to whether one or both cartilages are affected, and whether ossification is partial or complete. Expansion of the hoof is always diminished, and may be entirely suspended.

The *diagnosis* of side bone is easy as soon as the upper margin of the cartilage has become ossified; it then feels hard. On the other hand, when ossification has only attacked the lower portion of the cartilage lying within the hoof, it is either very difficult or absolutely impossible to detect the change, though the form of the hoof sometimes gives valuable indications.

Side bones produce a clumsy constrained action and at times marked lameness. The symptoms are aggravated by rapid work on hard roads, by allowing the hoofs to become dry, and by using high calkins. When, however, the hoof is kept moist, animals may work for a long time without inconvenience.

The *causes* are (1) congenital predisposition, in heavy, coarse-bred horses, and (2) excessive concussion produced by work on hard roads, for which reason the disease is frequent in large towns. The fact that the outer half of the foot suffers the greater shock during movement, explains why the outer cartilage more frequently becomes ossified than the inner.

The *prognosis* depends on the horse's work, weight, and breed, on the form of the hoof, and on the extent of ossification. Heavy horses with completely ossified lateral cartilages are of little use for rapid work on paved streets. When only one cartilage is affected, or when the animal is worked on soft ground, side bones are comparatively unimportant. While

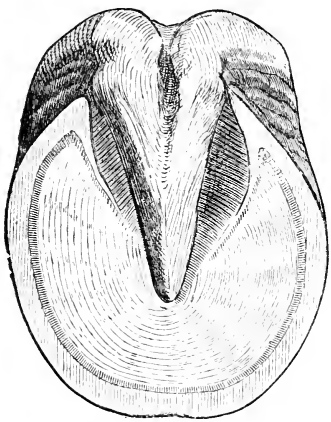


FIG. 383.—Right fore-foot altered in form in consequence of side bone.

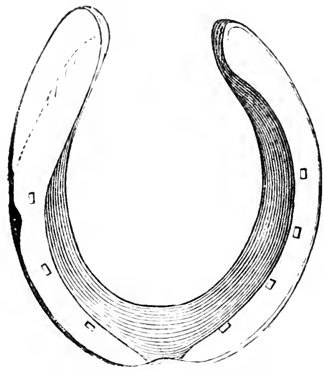


FIG. 384.—Shoe for above foot, with broad outer limb.

ossification is in active progress the animal goes tender, if not actually lame, but as soon as it becomes complete the lameness tends to disappear, though it readily returns in consequence of bruising or strain if the tread is not level. Lameness is usually temporary, but the diseased cartilage can never be restored to its primitive condition.

After ossification is complete, lameness may be produced by bruising of the plantar cushion and of the sensitive wall, which are then enclosed between two hard, unyielding structures; the plantar cushion, being confined by the ossified cartilages, can expand neither towards the right nor left at the moment at which weight is placed on the foot and the sensitive wall being similarly placed between the horny wall and ossified cartilage. A partial improvement may occur when the plantar cushion diminishes in volume. If, in addition, the wall is contracted at the heels, the condition is even more serious.

In *shoeing* animals with side bone it is important to know whether the condition is uni- or bi-lateral. In side bone of the outer heel the wall of that side is comparatively immobile, and the corresponding quarter and heel of the shoe is excessively worn. On removing the shoe the outer wall is found much higher than the inner. The external heel of the shoe is thin, the internal comparatively little worn. The hoof is either unchanged in form or the wall of the outer heel is contracted, and sometimes covered with rings (fig. 383). The outer portion of the coronet is more prominent, and the outer limb of the frog smaller than the inner. Bruises or strains in the wall not infrequently exist.

The shoe should be flat, the outer limb broader than usual, the seating out should terminate behind the last nail hole, so that the entire breadth of the heel surface may form a horizontal plane (fig. 384). The outer wall should be lowered more than the inner, and the shoe so formed that its inner limb fits as close as possible, the outer being left sufficiently wide to meet a perpendicular line dropped from the coronet. The supporting surface is thus widened towards the outside, and, in consequence of the level tread, more even wearing of the shoe produced.

When both lateral cartilages are ossified, a thick leather sole materially assists in diminishing shock. Special deeply-fullered shoes with rope inlay are also of value, but pads and bar shoes seem (in theory at least) contra-indicated, and, at first, cause pain by pressing on the frog and so tending to thrust asunder parts that are now unyielding.

Side bones are often accompanied by corns, which are usually extremely persistent. As, however, these are not primary but secondary conditions, they deserve less attention when choosing and fitting the shoe than the ossification. Under these circumstances 'springing' the heels, which is frequently practised in order to relieve corns, produces local strain and pain, and should be avoided.

Treatment consists in applications which soften and cool the hoof. In work, the hoof should be moistened daily, and afterwards smeared with some fat or ointment so as to preserve the elasticity of the horn.

## 10. Navicular Disease

is a chronic inflammation of the lower surface of the navicular bone and the portion of flexor perforans tendon passing below it.

The disease consists essentially in change in the gliding surface of the navicular bone and of the cartilage covering it. The previously smooth surface of the bone becomes roughened, the tendon abraded, inflammation then increases, the portions

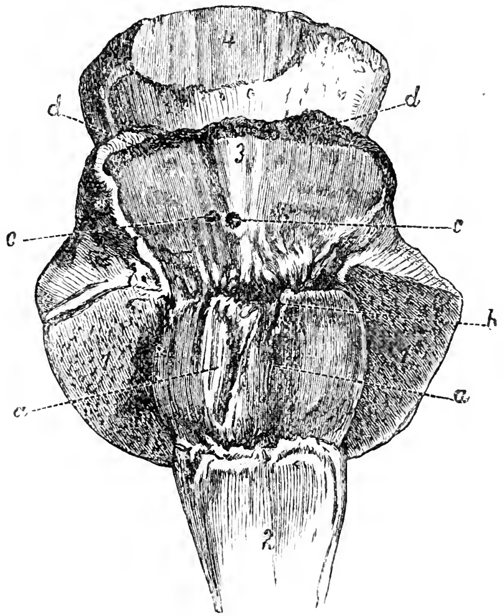



Fig. 385.—Preparation illustrating navicular disease. 1, os pedis; 2, flexor pedis perforans tendon drawn downwards; 3, lower (gliding) surface of the navicular bone; 4, coronet bone; *a* and *b*, roughened, abraded spots on the flexor perforans tendon; *c*, eroded spots on the navicular bone; *d*, proliferations from periosteum on the upper margin of the os pedis.

of the tendon involved may, in extreme cases, become necrotic, and still further aggravate the existing mischief; finally, periostitis and rarefying ostitis set in, and deposits form around the margins of the bone.

*Occurrence.*—The lameness usually affects one or both of the fore-feet. Horses with very concave soles appear more subject to it than those with flat hoofs. Compared with other forms of lameness it may be said to be rare.

*Symptoms.*—The first symptoms are slight tenderness on starting; the animal goes rather short or stumbles, but this soon wears off. Next, the foot or feet are 'rested' after any considerable exertion, but in many cases it is only after months that the symptoms become distinct. The foot is then extended and directed slightly towards the side, the fetlock is more upright in order to minimise tension on the flexor pedis perforans tendon, the gait becomes clumsy and difficult, especially at the beginning of movement and on hard, uneven ground. When only one hoof suffers, there is distinct lameness, but when both are affected, the gait is short and cramped, and the animal seems to suffer most at the moment when weight falls on the limb. Where the disease is well developed, the fore-limb is advanced with the toe first, and the pace comes to resemble a run. Attention to the feet and rest diminish the symptoms. The lameness is most marked on leaving the stable, but diminishes as the animal moves; after some considerable time, however, especially if the pace be rapid, lameness returns.

In old standing cases the hoof is contracted. On compressing the heels or the body of the frog pain is evinced. Increased pulsation of the digital arteries and increased warmth of the hoof are seldom present, but pain and thickening of the flexor tendons in the depression of the heel can sometimes be noted. When the foot is oblique contraction soon sets in. Slight rings sometimes form on the horny wall. Any considerable weight thrown on the diseased hoof causes pain, especially when the horse has prominent frogs and is unshod. Sometimes there is atrophy of the muscles of the shoulder and fore-arm.

The causes are severe strains, due to severe rapid work on hard, rough, or frozen streets. The lameness is most frequent in riding horses.

The *prognosis* is unfavourable, for even when the diseased process can be checked the freedom of movement never completely returns, because the destructive changes which have taken place are permanent. The animal's worth is thus greatly diminished.

*Treatment,* strictly speaking, is only palliative. Attempts should be made to diminish the pressure between the navicular bone and flexor pedis perforans tendon, and, in the early stages, to diminish inflammation. First of all the hoof must be softened and permitted to dilate. The shoe should be removed and the entire hoof immersed for twenty-four to forty-eight hours in a poultice, frequently moistened with lukewarm water. The hoof is then trimmed and shod. The points to

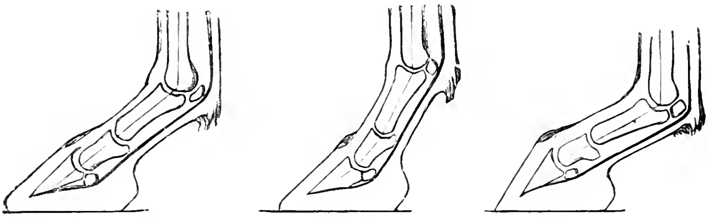


FIG. 386. FIG. 387. FIG. 388.

FIG. 386.—Showing normal relations of the bones of the foot and of the flexor perforans tendon.

FIG. 387.—Formation causing increased strain on navicular bone and perforans tendon.

FIG. 388.—Showing the manner of trimming the hoof so as to diminish, as far as possible, the effects of navicular disease. (The above illustrations are diagrammatic.)

remember are (1) that the hoof should be somewhat more upright than the fetlock, and (2) that it should be dilated. The toe is, therefore, lowered freely, but the heels spared. The frog is cut down to the height of the bearing margins of the heels and a flat shoe, with thin heels and bar-clips, applied and dilated to the extent of about $\frac{1}{8}$ inch. The toe should be 'rolled.'

For the next four to six weeks the feet should be kept well moistened. At night the animal should be bedded down with good straw. The hoof, if its form allow, should, during this time, be once or twice redilated. In any case, however, precautions should be taken by using fat or ointment to prevent the horn becoming dry. If a long rest cannot be given the coronets may be repeatedly blistered with a 1 to 8 ointment of biniodide of mercury. As neither shoeing, nor the use of the firing iron, nor of blisters completely restores the action, neurectomy has, for many years, been resorted to as a remedy. It certainly removes sensation from the foot and once more renders the animal useful, but the foot is then no longer spared, and when the animal, especially if a hunter, is used on hard ground, the pedal or navicular bone may be fractured. Not infrequently the flexor tendons undergo a kind of colloid degeneration and become ruptured.

So far as shoeing is concerned, the before-mentioned principles apply. Bar shoes are contra-indicated and horses usually go best in ordinary shoes, especially those which raise the back of the hoof, that is, shoes with thick heels or with calkins. Attempts may with advantage be made to dilate the hoof and to diminish concussion. The action of a shoe which raises the back of the hoof will immediately be seen from the diagrammatic figs. 386, 387, and 388.

The improvement produced by high heels depends on the concussion being conveyed in greater degree to the pedal bone, while pressure on the perforans tendon is diminished.

### 11. Curb, Strain of Flexor Tendons, and Capped Elbow.

Special shoes have been devised for the treatment of each of these conditions. A few notes on some of those more commonly employed are given below.

## STAMPED WEDGE-HEELED HIND SHOE (Figs. 389, 390).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

The above shoe is intended to give relief in cases of curb, spavin, or injury to ligaments and tendons, by raising the heels of the hind-foot. Should the horse not be lame or be adjudged by the veterinary surgeon to be capable of light work, he may be worked in this shoe.

The height of the wedges is $1\frac{3}{4}$ inches.

FIG. 389.—Stamped wedge-heeled hind shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

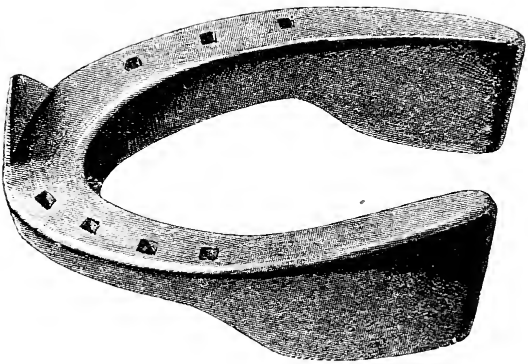


FIG. 390.

[*To face p.* 410.

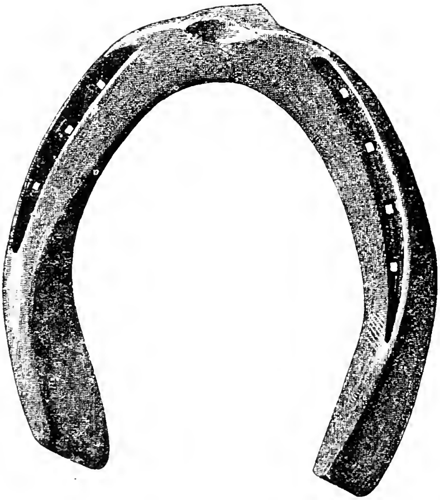


FIG. 391.—Fullered wedge-heeled hind shoe (for harness horse). Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

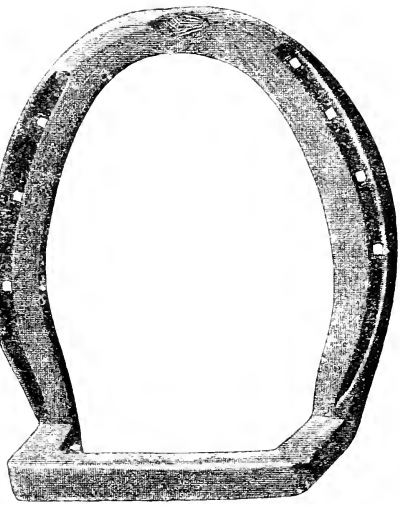


FIG. 392.—Fullered patten hind shoe. Made from $\frac{3}{4} \times \frac{3}{8}$ inch iron.

*To face p.* 411.]

## FULLERED WEDGE-HEELED HIND SHOE FOR HARNESS HORSE (Fig. 391).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

Many horses suffering from diseased hocks and tendons can be worked in this shoe, the purpose of which is similar to that of the shoe preceding, save that it is for a lighter class of horse.

The height of the wedges is $1\frac{1}{4}$ inches.

## FULLERED PATTEN HIND SHOE (Fig. 392).

*Made from $\frac{3}{4} \times \frac{3}{8}$ inch iron.*

Patten shoes are intended for horses suffering from injuries to tendons and ligaments, but which must necessarily be rested. That shown is suitable for a thoroughbred.

The patten (sometimes termed 'staple') is only $1\frac{7}{8}$ inches in height and is set on obliquely, so that the cross bar rests flat on the ground.

It is made separately from the shoe, and after the usual fitting is complete is 'shut-on' to the shoe.

A defect in the shoe illustrated is that the nail holes extend rather too far back.

## STAMPED PATTEN (OR 'STAPLE') FORE SHOE (FIG. 393).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

The shoe illustrated is for a recent and severe case of 'break-down' or cut tendon, where the tendon has been more or less severed. It affords by far the safest and most convenient method of raising the heel under such circumstances.

The staple is rather more than 3 inches in height.

## STAMPED PATTEN (OR 'STAPLE') HIND SHOE (FIG. 394).

*Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.*

This shoe is only for animals which are resting, either in the stable or in, say, a straw yard. Its purpose is similar to that of the other staple shoe described.

The staple is three inches high, and spreads outwards as it approaches the ground, so as to give a wide base of support. With this object the sides are bent outwards and the bottom is set on obliquely, so that when the shoe is affixed and the animal stands upon it the whole of the bottom bar is in contact with the ground.

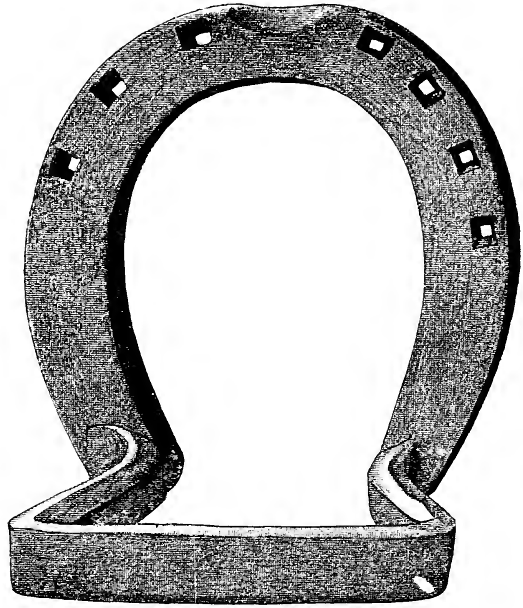


FIG. 393.—Stamped patten fore shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

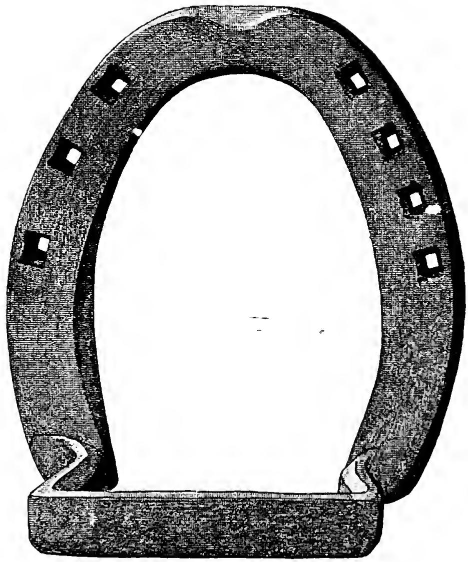


FIG. 394.—Stamped patten hind shoe. Made from $\frac{3}{4} \times \frac{1}{2}$ inch iron.

[*To face p.* 412.

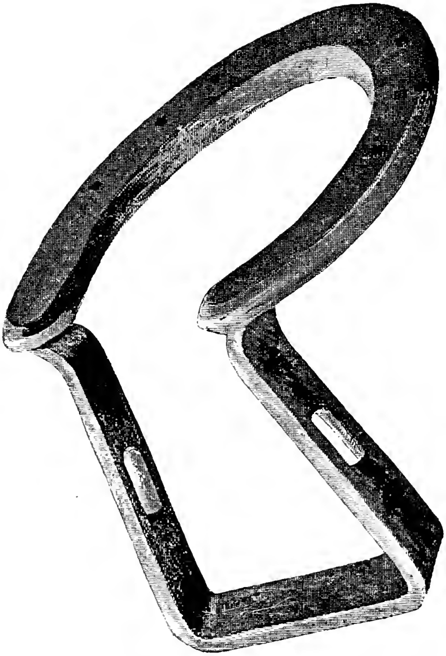


FIG. 395.—Patten hind shoe. Made from $\frac{3}{4} \times \frac{3}{8}$ inch iron.

FIG. 396.—Fullered seated fore shoe. Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.

*To face p.* 413.]

## PATTEN HIND SHOE (FIG. 395).

*Made from $\frac{3}{4} \times \frac{3}{8}$ inch iron.*

The shoe from which this illustration is made was for a foot $4\frac{3}{4}$ inches in width. The patten is 4 inches in height, and has two holes in the uprights through which straps are passed and secured, through the medium of a pad, above the hock. The pad which is fixed on the hock has a buckle on either side to receive the straps.

This shoe is for cases where the flexor tendons of the hind leg have been partially divided, as happens in race horses when they are struck by the fore-foot of the animal immediately following, and in other animals under a variety of circumstances. The horse must necessarily be placed in slings.

## FULLERED SEATED FORE SHOE (FIG. 396).

*Made from $\frac{7}{8} \times \frac{1}{2}$ inch iron.*

To prevent horses bruising their elbows, and so producing the unsightly swelling termed capped elbow, the shoes must be sloped off very obliquely at the heels, which should be kept of a rounded form, and should closely follow the contour of the foot, *i.e.*, should be fitted 'fine.' This is, in fact, one of the few conditions in which 'fine' fitting at the heels is necessary or desirable.

# APPENDIX A.

# THE SHOEING OF OXEN.

## CHAPTER I.

### THE STRUCTURE AND FUNCTIONS OF THE OX'S FOOT.

As it is sometimes necessary to shoe oxen employed for work, a short anatomical description of the foot may not be inappropriate. The ox's foot differs from that of the horse in possessing two distinct toes, each consisting of three bones, like the single toe of the horse, but presenting certain special anatomical features of its own. The rounded or triangular horny appendages at the posterior surface of the fetlock joint are termed after-claws. They need not occupy our further attention.

The lower end of the metacarpal bone is divided by a deep cleft into two distinct parts, an inner and an outer, each of which comports itself to its particular toe just as the lower end of the great metacarpus of the horse to its single toe. In other words, each portion of the lower end of the metacarpus presents an articular surface, which forms, with its special pastern and two sesamoid bones, a distinct ginglymoid joint; the ox in fact has, at the point where the horse's fetlock joint occurs, *two* fetlock joints. With regard to individual bones, the two first bones of the toes or phalanges in form and relation resemble to a considerable extent the first phalanx of the horse, though they are comparatively shorter and weaker. The same is true of the two coronet bones or second phalanges, which are comparatively somewhat longer than the horse's coronet bone, and differ from it in that their two lateral surfaces, which meet in front, are of a more triangular form. The upper articular surface of each coronet bone is concave, the lower is convex, and extends almost as far backwards as the middle of the posterior surface.

The third phalanx, or bone of the claw, however, differs markedly from the horse's pedal bone. The claw bone is peculiarly formed, having been compared to a wedge or three-sided pyramid, the point of which is directed forwards and downwards. Each claw bone presents an upper or articular surface, an outer turned away from the cleft of the hoof, an inner turned towards it, a lower surface, an anterior and a posterior end, and three margins. The articular surface is

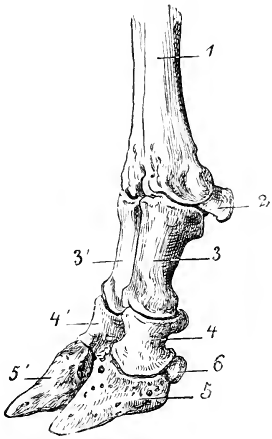



FIG. 397.—Antero-external view of ox's left fore-foot. 1, lower end of metacarpal bone; 2, external sesamoid bone; 3, external, and 3', internal pastern bone; 4, external, and 4', internal coronet bone; 5, external, and 5', internal claw bone; 6, left navicular bone.

concave and extends forwards and upwards as the pyramidal process. The outer surface is slightly convex, with numerous small apertures and with a flat groove or furrow running from behind forwards. The slightly concave inner surface exhibits at its upper posterior part a large aperture, corresponding to the plantar foramen (see p. 29), and extending into the interior of the bone. The lower surface slopes away from the cleft of the hoof towards the outside. It is comparatively smooth and provided on its lower part with a shallow groove. The anterior margin formed by the union of the outer and inner surfaces is blunt, the outer margin sharp and curved, the inner margin, in consequence of the groove above it, exhibits a ledge at its anterior part. The front end is pointed, the back is blunt, and exhibits a transverse furrow, covered with cartilage, for articulation with the navicular bone. In oxen the prolongations corresponding to the wings of the horse's pedal bone are absent and there are no lateral cartilages.

In oxen, as in horses, the joints are completed by other small bones, which, in general, resemble the sesamoid and navicular bones but are somewhat smaller. Each fetlock joint has two sesamoids and each claw joint a navicular bone.

Broadly speaking, the connections of the joints with one another and with the bones named resemble those of the horse, especially in regard to the lateral and capsular ligaments.

The chief differences are as follows. The suspensory ligament of the sesamoid bones or superior metacarpo-phalangeal ligament exhibits more muscular fibre than in the horse. As it serves both fetlock joints it is divided at the posterior surface of the great metacarpal into three parts, two lateral, small in size, and a strong central ligament. The two lateral ligaments extend to the two outer sesamoid bones and send in addition a cord (ligamentum extensorum) to the extensor tendons of their respective claws (fig. 398, 4′). The middle and strongest limb divides a short distance below into three parts, the two lateral of which run to the two inner sesamoid bones. The middle portion, on the other hand, passes in a forward direction through the groove on the lower end of the great metacarpus, then divides into two branches, which join the extensor tendons of the inner and outer claws respectively (fig. 398, 4″).

The inferior sesamoideal ligament is absent.

The suffraginis or pastern bone and the bone of the claw are connected by external and internal suffragino-pedal ligaments, which are particularly strong and unite with the ligamentous tissues arising from the coronet bone.

The cruciform ligament or transverse ligament of the toe connecting the two claws consists of two cords, which arise from the postero-superior parts of the coronet bones turned away from the cleft of the claw, run obliquely downwards, become more or less intimately fused at the point where they cross, and are finally inserted into the inner (*i.e.*, opposing) surfaces of the claw bones and into the inner extremities of the navicular bones. They cover the posterior surfaces of the perforans tendons of the claw, and serve principally to prevent the claws being too widely separated.

The movements of the joints of the toe are effected by muscles lying in the region of the fore-arm, and arranged in general like the analogous muscles of the horse. As, however, in the ox the muscles and tendons are attached to a double limb below the fetlock, some differences necessarily exist.

Each of the two claws has a separate extensor muscle, as well as a muscle which is common to both claws. The muscle corresponding to the extensor suffraginis of the horse is, in

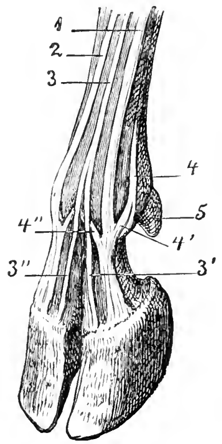



FIG. 398.—Antero-external view of ox's left fore-foot. 1, extensor tendon of outer claw; 2, extensor tendon of inner claw; 3, extensor tendon common to both claws; 3', limb of do. attached to left, and 3'', to right claw; 4, superior sesamoideal ligament; 4' and 4'', reinforcing slips from same to extensor tendon; 5, left 'after-claw.'

the ox, the extensor of the outer claw. From the compound extensor of the foot, which consists of several masses of muscle, two tendons spring; one passes to the bones of the inner claw becoming the extensor tendon of the inner claw, the other passes down the centre of the great metacarpal bone and at its lower end divides into two parts, one of which is attached to the pedal bone of the outer, the other to the pedal bone of the inner toe.

The arrangement in the hind-foot is similar. The extensor (peroneus), whose tendon in the horse runs parallel with that of the extensor pedis, is in the ox the extensor of the outer claw. The extensor pedis becomes the extensor of the inner claw and also acts in common on both claws.

The arrangement of the flexor pedis perforans and perforatus tendons is rather more complicated than in the horse. Suffice it, however, for our purpose to say that the tendon of the superficial flexor perforatus of the toe forms a sheath for the tendon of the deep flexor (perforans). This sheath divides on either side, forming a kind of channel, which surrounds each limb of the deep flexor after its division. The tendons of the superficial flexor, which are pierced by those of the deep flexor near the upper end of the suffraginis bone, become inserted into the lower end of the suffraginis, and (chiefly) the supero-posterior part of the coronet bone of either claw. Each of two limbs of the tendon of the deep flexor of the toe (perforans tendon) is attached to the postero-inferior surface of its respective pedal bone.

The tendons of the flexor muscles are held in place by a tendino-ligamentous apparatus and by strong transverse ligaments. The limbs of the flexor pedis tendons are also supported by the cruciform inter-digital ligaments.

As already stated, lateral cartilages and plantar cushion are absent in the ox.

In relation to the blood-vessels it should be noted that in the fore-foot the main artery passes from behind forwards between the two after-claws towards the cleft of the foot, whilst that passing down the anterior surface of the great metacarpal runs in an opposite direction, that is, backwards, towards the same space. The inner digital arteries are far larger than the outer. The veins do not form such rich plexuses as in the horse.

The digital nerves in their general distribution resemble those of the horse.

With a few exceptions the protective structures of the terminal digits correspond with those of the horse. The skin is specially modified as in the latter to form a horn-secreting structure in which a perioplic band, coronary band, sensitive wall and sensitive sole may be distinguished; the sensitive frog is absent. The perioplic band lies between the skin and coronary band and surrounds each toe like a ring. Posteriorly it becomes much broader and forms slight bulbs, which may be connected with those of the opposite claw by a more or less well-marked bridge. The coronary band lies between the perioplic band and sensitive wall. It is comparatively broad but flat. At its broadest spot it may measure, according to the size of the animal, as much as $1\frac{1}{4}$ inches. In the direction of the bulbs it first becomes slender and then totally disappears.

The sensitive wall covers the two lateral surfaces and the anterior margin of the bone of the claw; it extends from the coronary band downwards to the plantar margin, and backwards as far as the bulbs. It exhibits a large number of parallel laminæ, which decrease in length towards the bulbs and to a more marked degree on the inner than on the outer surface of the claw. The number of laminæ may be estimated at about a thousand.

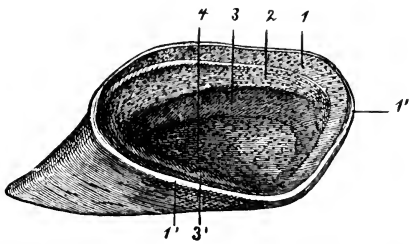



FIG. 399.—Supero-posterior view of an ox's hoof removed by maceration (seen from the inner side). The inner wall is foreshortened owing to the point of view. 1, periople, which at 1' becomes continuous with the bulbs; 2, furrow for reception of coronary band; 3, laminal sheath of the outer wall, and 3', of the inner wall; 4, upper surface of sole.

The sensitive sole covers the under surface of the bone of the claw and extends in a backward direction, becoming continuous with that portion of the coronary band forming the bulbs, there being no distinct boundary between the two structures.

With the exception of the sensitive wall the portions named display a number of very small papillæ from which the horn of the claw is secreted, the best marked and largest appearing at the perioplic band. In the ox the laminæ of the sensitive wall exhibit no secondary laminæ such as have been described as existing on the sensitive laminæ of the horse.

The horny claw is the product of this specially modified corium. It may, in general terms, be compared with the half of a horse's hoof, from which, however, the frog is absent. We distinguish in it a wall and a sole. The wall can again be divided into an outer and an inner part. The portion furthest from the cleft of the foot, *i.e.*, the outer part, is convex and somewhat curved inwards at the toe. The portion towards the cleft is smooth and usually slightly concave. The two sides of the wall meet in a blunt, somewhat elongated anterior border. The upper part of the horny wall or perioplic ring is formed by the perioplic band and runs backwards to form the rounded horny bulbs. The coronary band rests in a flat, broad furrow at the upper part of the wall. The horny laminæ of the wall correspond in number and size to the sensitive laminæ. The space below marginated by the wall is enclosed by the horny sole, which in front is pointed and very strong and towards the back becomes continuous with the horny bulbs. The horny bulbs of the two toes are sometimes connected by a bridge of soft horn. The wall is united to the horny sole through the medium of the white line as in the horse. Needless to say that in oxen, in which the walls are not bent inwards as in the horse, the bars are wanting. The claws of the hind-foot are somewhat longer and more slender than those of the fore-foot.

# CHAPTER II.

## THE SHOEING OF OXEN.

The shoeing of oxen differs essentially from that of horses, because the ox's foot is cloven, while the pastern, coronet, and pedal bones are in duplicate. The ox, therefore, may be said to have on each limb two hoofs, termed claws, which can be distinguished as an outer and an inner. The walls are thinner than those of the horse. The sole is thin and the bulbs low. As a consequence the shoe must be thin and broad. The nail

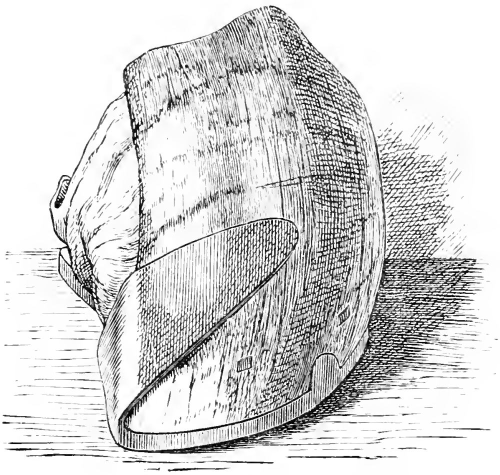


Fig. 400.—Ox's claw with shoe attached.

holes should be punched fine and the nails should be short but strong. Each shoe is provided with a long thin clip at the inner margin of the toe, which is bent upwards and outwards around the point of the claw (fig. 400). A clip on the outer margin of the shoe increases the hold. In the Saxon Voigtland the inner clip, which lies in the cleft of the claw, starts from the posterior third of the shoe and is then bent forwards, upwards, and outwards over the wall of the toe. The smaller clip is at the outer part of the toe, close to the anterior margin of the shoe. This shoe (fig. 401) is more difficult to fashion, but when well made fits better than any other. To apply a single shoe to the two claws would, of course, prevent the natural movement of the parts.

The fixing of the foot for shoeing is often very difficult. It is first necessary to fasten the animal's head to a tree or wall. The fore-foot is then secured with a broad piece of webbing, which is thrown over the withers and held on the opposite side. The hind-foot is lifted by means of a round piece of wood thrust in front of one hock and above the other and grasped by two men, or may be kept bent by applying a leg twitch above the hock. Oxen may also be shod in an ox

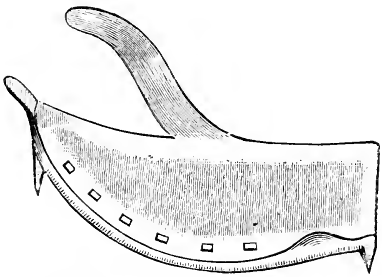


FIG. 401.—Voigtland shoe for oxen.

travis—the foot being secured in a grooved wooden arm and the ox's body supported by a sling.

In places where many oxen are shod a travis is very useful (fig. 402). This travis consists of four strong posts 11 feet high (of which 3 feet is firmly fixed in the earth) and 8 inches square (*aa*, *bb*), fastened together by longitudinal and transverse stays (*cc*, *d*). In the middle of the two front posts is the head post (*e*) of equal height and strength. Five feet above the ground this is provided with an aperture, 4 inches broad and 20 high, in which revolves a pulley (*i*); below this is a windlass (*k*) with ratchet and pawl for the purpose of winding up the rope fastened round the animal's horns. Each pair of posts have, on their front or back surface, a deep slot about 3 inches broad (*n*) within which run two rails (*o* and *p*), capable of being raised and lowered or fastened at any point by means of iron pins. The two posts to the right are provided with a revolving eight-sided axle, to one end of which is attached a ratchet and pawl. On one of the eight surfaces of this axle are six iron hooks, to which the belly piece can be attached.

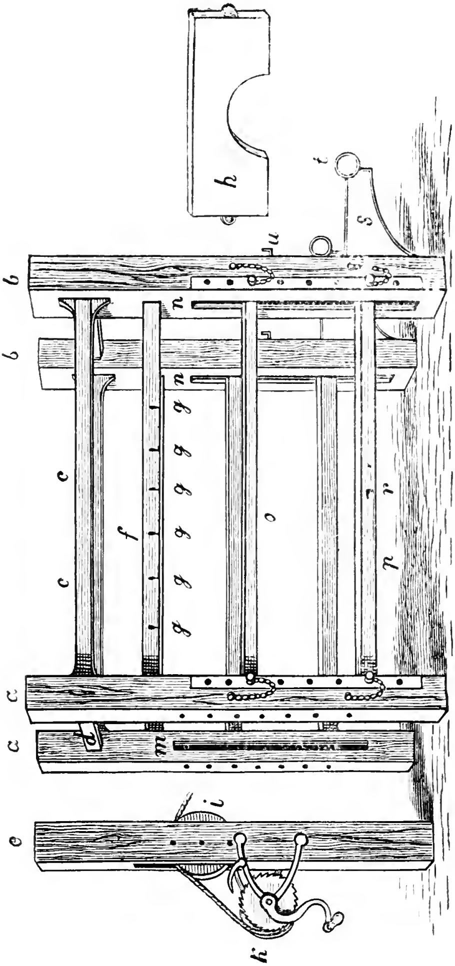


Fig. 402.—Travis for cattle. (This travis is used at Alfort for horses also.) The explanation of the letters is given in the text

Opposite the axle and at the same height is a fixed baulk (*f*) with six hooks (*gg*). The belly piece, 6 feet in length and 6 inches in breadth, carries at either end cords $2\frac{1}{2}$ feet in length, provided with iron rings at their free ends. On the inner side

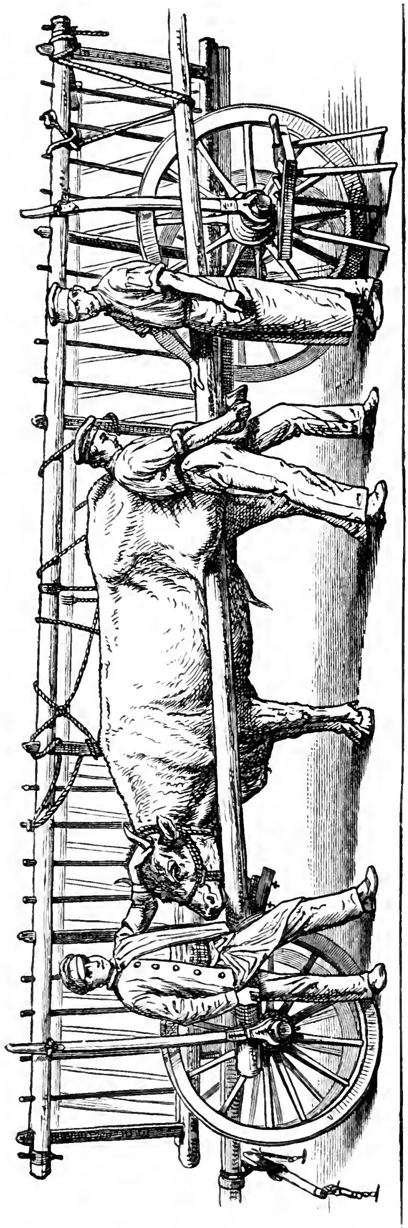


Fig. 403.—Improvised travis.

of the two front posts is a neck piece ($h$) and breast piece, which by means of slots and iron pins may be raised or lowered. Each of the two hind posts has at the back an iron bearer 18 inches in length ($s$), the free ends of which carry rings 6 inches across ($t$). Through these a stout rod, padded at the centre, may be thrust and fixed by two pins. Above this bearer are two iron hooks for fixing the breeching.

Before the animal is placed in the travis the neck piece is raised, the breast piece depressed, and the belly piece allowed to hang from the fixed cross piece. The animal is then placed in position, a rope thrown over its horns and the end passed over the pulley ($i$) fixed to the hook on the windlass and drawn up sufficiently tight to fix the head. The neck piece and breast piece are then respectively lowered and raised, the breeching fastened to the point marked $u$ and the belly piece attached to the axle, so that this latter may be drawn far enough up, if necessary, to completely support the animal's weight.

The front feet during shoeing are fastened to the side bars by means of a cord attached to the fetlock. The cord is passed a few times round the bar and fixed to the hook ($r$). The hind-feet are fastened by a slip-knot passed round the fetlock and drawn up over the cross bar, so that the front surface of the fetlock lies on the padded part of the bar, the foot being fixed in this position by passing the cord a number of times around the bar and there knotting it.

When no travis is at hand one may be improvised out of very simple materials, as, for instance, the waggon shown in fig. 403.* The ox is fixed by the head to the side of the waggon between the front and hind wheel. A strong bar is then slipped under one hind leg and between the axle and upright of the front wheel; the opposite end of the bar is then lifted until the animal is thrown somewhat towards the other side and leans heavily on the pole. The pole can then be fastened to the waggon by means of a rope and the outer leg lifted as usual. In this way, with one assistant and without any particular difficulty, the most troublesome ox can be controlled.

* Although this form of waggon is not used in England the illustration has been inserted, as, with its assistance, a similar travis may readily be improvised, though necessarily with different apparatus.

Berkshire County Council's School.

To face p. 427.]

# APPENDIX B.

## I. FARRIERS' TEACHING SCHOOLS.

THE farriers' trade in England being still open to all comers, and not restricted, as in Germany and certain other Continental countries, to duly instructed and certificated persons, it is not always easy to induce those desiring to enter its ranks to fully qualify themselves for their life's work. Nor indeed are the opportunities afforded them. At the present time the old system of apprenticeship is fast dying out, and we cannot help again expressing our regret that the Worshipful Company of Farriers should have so neglected their opportunities as to entirely forego the exercise of the powers they took to encourage and revive it. Apprenticeship still represents the only system under which youths can become good workmen. The acquisition of a few half-understood phrases about the anatomy of the foot is of no value, and the fullest knowledge of anatomy and physiology is absolutely useless unless conjoined with a thorough mastery of the craft, and that education of the eye and hand which only comes by years of steady practice under a master's supervision.

It is a fact, we believe, that at the present time no school, competent to convey this *instruction*, exists in England. But for those who have already made some progress two public bodies at least, viz., the Berkshire County Council and the Bath and West of England Agricultural Society, have provided much needed assistance by instituting travelling schools. A photograph of the Berkshire County Council's School, with the demonstrator and class, forms the frontispiece to this volume, and another view, showing the van, etc., is given here. The van contains two fires, with anvils, vices, and all necessary appliances. The demonstrator is a man of proved ability, and is supervised and assisted by a member of the Royal College of Veterinary Surgeons, who delivers a course of lectures on the anatomy and physiology of the foot. As stated, instruction is not given to beginners, but only to those already possessing a fair knowledge of the trade. In the cases of the West of England Association, the course consists of ten lectures, for which a fee of 2s. 6d. is charged. The classes contain four pupils each, and as these cannot always attend on consecutive nights, two classes are formed and receive instruction on alternate nights. Instruction begins at 6 P.M.

The pupils are shown the correct methods of shoeing every kind of horse they are likely to meet with, and how to adapt shoes to abnormal feet. A typical collection of shoes and hoofs is always on exhibition at the school. In addition to the apparatus contained in the van, the Society provides all necessary tools and appliances for pupils' use.

In the practical course the pupils work in pairs, each pupil making one or more shoes, which are examined and criticised by the instructor, who points out the defects and the methods of avoiding or remedying them. Sometimes it is even necessary to show the pupil how to handle his tools so as to obtain the best results.

The first shoes made are usually fore and hind cart, and the pupil gradually passes on, as he becomes adept, to the making of riding and carriage horse shoes, concave fullered shoes, bar shoes, 'dub-toed' shoes, 'cradled' shoes, 'set-heeled' shoes, 'diamond-toed' hind shoes, and in fact every kind of pathological shoe.

One or two evenings a week are usually set aside for shoeing such horses as can be obtained in the neighbourhood, when instruction is given in handling animals, picking up feet, taking off shoes, preparing feet for shoeing, and (after making satisfactory shoes) nailing-on.

From the foregoing it will be seen that, despite the public-spirited efforts of our County Councils and Agricultural Societies, England is still far behind Continental countries in providing technical education for farriers, and it is greatly to be desired either that a stimulus be given to the system of apprenticeship, or that proper teaching schools for farriers (which could be attached to the Veterinary and Agricultural Schools) be instituted. In London, the excessive pressure of work and the introduction of machine-made shoes and nails have dealt a death-blow to 'skill' of the highest kind. Shop-boys graduate into doormen in the course of a couple of years without having seen, much less practised, one half of their craft; and were it not for the constant influx of country workmen into the Metropolis, efficient doormen, capable at a pinch of fitting or making a shoe, would cease to exist.

## II. SHOEING COMPETITIONS.

For competitions at shows temporary sheds are required, and the arrangement of forges, stands, and enclosures for the public requires some care and forethought. The Plan herewith shows one method of utilising a space about 70 feet square, and obviates the necessity for a long description.

The sheds are formed of skeleton wooden frames covered with canvas, except in the case of those containing the forges, where wood should be used for the sides and corrugated iron for the roof, to avoid the chance of ignition by a flue becoming overheated or of sparks flying from the anvils. The stalls for horses should be floored with wood, and, to protect the workers in case of rain, roofed with canvas (see Plan); in very wet weather a layer of sawdust spread on the floor will be found to prevent horses or men slipping. A stout wooden rail should be provided at the end furthest from the anvils, to which the horses can be fastened.

The open ends of sheds containing the anvils should, if possible, look towards the north, so as to secure a good light without the sun shining in the face of the fireman.

A stand for the public will be found of advantage, as many persons interested in the competitions do not care to be jostled by the crowd which usually collects on these occasions, and will gladly pay a small sum for the privilege of a seat.

Competitors should be required to bring their own tools and nails, and to provide a striker, but the show committee should find everything else. An experienced farrier should be in attendance to keep the fires going when not in use, and to clean out the sheds.

There are generally two classes, nags and heavy horses. The horses required should be carefully selected by the stewards or judges the day previous to the competition, care being taken to provide animals fairly representing each class, and to exclude those with broken or defective feet, or which are known to be difficult to shoe.

On the day of the competition neither members of the public nor competitors should be allowed access to the animals until work actually begins, otherwise the 'old hands,' if they see a horse with bad feet, will hold back and so delay progress.

Numbers having been attached to each horse's mane or halter, a corresponding series is drawn by the competitors, each of whom afterwards takes the horse thus assigned him. The men are then assembled, and the steward in charge recites the conditions of the competition, and explains that each man must be prepared to start when called on, failing which he will be put last on the list or disqualified. The judge or judges may add a few words, and should claim the right to stop any competitor at any stage without assigning to him a reason. All preparations being complete, the men's numbers are suspended above the shoeing sheds (a common practice is to take odd and even numbers alternately), the horses are brought from the stable, and work commences. Men who have finished should at once return to their room, and should not be allowed to walk about or in any way interfere with those at work.

The competitor is usually asked to make a fore and a hind shoe, and to put on the fore shoe in a given time. In the greater number of instances this is a sufficient test, but, as shown by the appended form of marking-book, it is not uncommon to require the hind shoe also to be nailed on. Most judges prefer to divide the operations into three parts: (1) Taking off shoe and preparing foot; (2) Making shoe; (3) Fitting and nailing-on. The question of time is of minor importance, though the total time allowed should not be exceeded. In a close competition the saving of a few minutes may serve to mark out the winner. The system of marking varies. Some judges use numbers, others terms, like fair, good, very good, etc. It is difficult to say which is the better. It is very difficult to judge to one point, and we suspect that in most cases judges make their awards less by the strict reading of their notes than by the general impression derived from watching the competitor. Numbers awarded at any early stage may be quite discounted by some glaring error committed later. We refrain from offering further suggestions on the matter of judging, as the very fact of a person occupying the position of judge presupposes him possessed of a full and intimate knowledge of the technique of horse-shoeing.

## SHOEING COMPETITIONS.

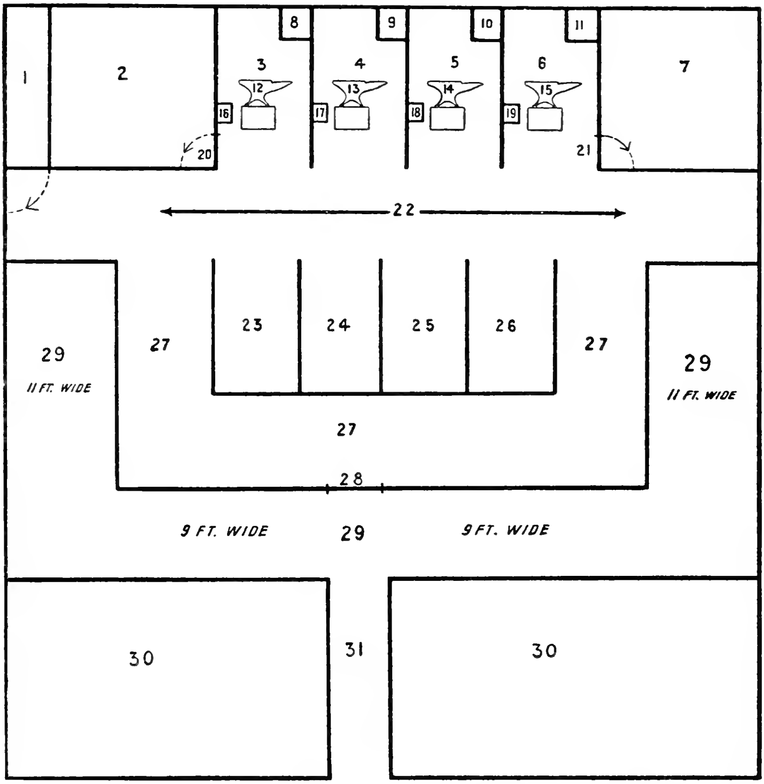
| No. | Taking off Shoes and preparing Feet. | | Making Shoes. | | Fitting Shoes. | | Nailing on Shoes. | | Time. | Oral. | Remarks. | Awards. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fore. | Hind. | Fore. | Hind. | Fore. | Hind. | Fore. | Hind. | | | | |
| | | | | | | | | | | | | |

FORM FOR JUDGE'S MARKING-BOOK.

# GROUND PLAN OF BUILDINGS REQUIRED FOR SHOEING COMPETITION. GROUND 24 YARDS SQUARE.

*Scale ½ inch to the yard.*

REFERENCE TO NUMBERS ON PLAN.




1. Doorway, 4 ft. wide, leading to stabling for horses.
2. Competitors' room, 16 ft. by 15 ft.
3, 4, 5, and 6. Blacksmiths' shops, 9 ft. wide.
7. Judges' and Stewards' room, 16 ft. by 15 ft.
8, 9, 10, and 11. Forges, 3 yards square.
12, 13, 14, and 15. Anvils.
16, 17, 18, and 19. Benches and vices.
20. Doorway, 3 ft. wide.
21. Doorway, 3 ft. wide.
22. Space for Judges, 9 ft. wide.
23, 24, 25, and 26. Shoeing sheds, 8 ft. wide, 7 ft. 6 in. high to eaves, and 12 ft. long, boarded up to 4 ft. 6 in. at front, and with wooden floors.
27. Space between shoeing sheds and standing place for public, 9 ft. wide all round as shown.
28. Drop rail, for admitting to shoeing sheds and smiths' shops, 3 ft. 6 in. high.
29. Standing room for public.
30. Grand stand for public, 18 ft. wide.
31. Entrance, 6 ft. wide.

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