



## The History of Shoes: Shoe Making

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Shoes both protect feet as well as, when incompatible in size and shape, present exciting factors in inflammatory conditions e.g. bunion. Despite the presence of pain, people are reluctant to change their footwear styles. The main function of modern footwear is to provide feet with protection from hard and rough surfaces, as well as climate and environmental exposure. To the wearer the appearance of their footgear is often more important than its (mis)function. Consumer resistance to change style is common. Informed decisions of shoe styles are thought to occur when the benefits of alternative shoe styles are carefully explained and footwear habits discussed in a culturally sensitive manner. The author, in the interests of intellectual exchange, explores the world of shoe making in an attempt to inform both lay person and health professional.

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## GLOSSARY OF TERMS

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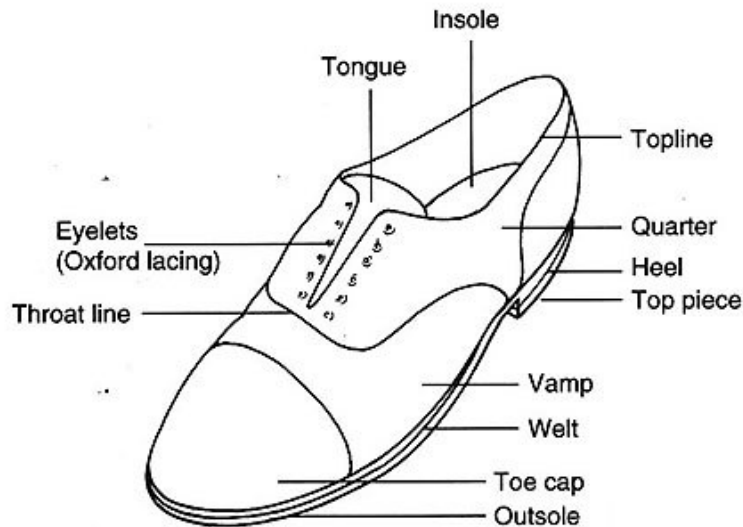
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## History of Shoes: Shoe Making

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### ***Anatomy of the shoe***

According to McPhoil (1988) the anatomy of a shoe can be divided in an upper and lower (or bottom part). Sections of the upper include vamp, quarter, toebox, throat, insole board, and topline. The sections of the lower shoe consist of an outsole, shank and heel.



### The Upper of the Shoe

All parts or sections of the shoe above the sole that are stitched or otherwise joined together to become a unit then attached to the insole and outsole. The upper of the shoe consists of the vamp or front of the shoe, the quarter i.e. the sides and back of the shoe, and the linings. Uppers are made in a variety of different materials, both natural and synthetic. Leather became the obvious cover of choice because it allowed air to pass through to and from the skin pores thereby providing an opportunity to keep the feet, cool. The plastic properties of animal skins further help mould the shoe to the foot beneath. The ability for leather to crease over flexor surfaces facilitate the function of the foot. Ironically synthetics used as uppers display elastic properties, which mean the shoe upper never quite adjusts to the foot, shape in the same way as natural leather. Synthetics are cheaper to mass-produce and are now found in most mass produced footwear. Synthetic uppers are more waterproof. Woven fabric such as cotton corduroy can be used as uppers. Classified as breathable fabrics these help aeration.

#### *Vamp*

The vamp covers the dorsum of the foot (includes the tongue piece) and superior aspects over the toes. This section i.e. the toe puff is reinforced which serves to give the shoe its shape as well as protect the toes. The vamp is often made of more than one piece, creating a decorative pattern. There are various types of vamps suited to different styles of shoes.

#### *Quarter*

The complete upper part of the shoe behind the vamp line covering the sides and backpart. The top edge of the sides and back of the quarter describes the topline of the shoe. In athletic shoes the topline is often padded and referred to as a collar. The medial and lateral sections join in a seam at the posterior end of the shoe. In Oxford style lacing shoes, the eyelet section is formed by the superior part of the quarter (while the underlying tongue is part of the vamp). In the Gibson style the lacing segment forms part of the vamp. The heel section of the quarter is frequently reinforced with a stiffener. This helps support the rearfoot. In boots the quarter is

often referred to as 'top'. In the Bal method, the front edges of both quarters are stitched together and covered with the back edge of the vamp. In the Blucher method the quarter panels are placed on top of the vamp, and the front edges are not sewn together. In comparison with the Bal method, the Blucher method permits the fitting of a larger foot girth by broadening the throat of the shoe. A convalescent shoe (open to toe) is a variation on the Blucher method in which the lacing extends to the front edge of the vamp. In athletic shoes the vamp and quarter panels are often one continuous piece of nylon or leather with additional leather pieces added to reinforce critical areas of the shoe. Reinforcement added to the region of the medial longitudinal arch are termed the saddle if it is added to the outside of the shoe or the arch bandage if it is added to the inside of the shoe.

The counter is a component of the quarter that stabilises the hindfoot in the shoe and retains the shape of the posterior portion of the shoe. Counters are usually made from fibreboard or heat moulded plastic. Foxing is an additional piece of leather that covers the counter externally. Sometimes a counter will extend medially to support the heel and prevent prolonged pronation. In some children's shoes and athletic footwear the stiffener is extended on the medial of the arch to provide an anti-pronatory wedge.

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### *Toecap*

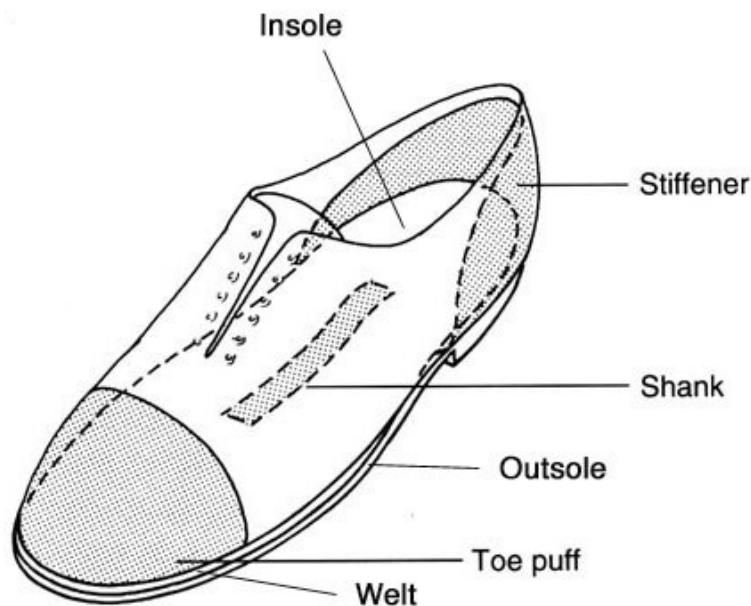
Many shoes incorporate a toecap into the upper of the shoe. Toecaps are either stitched over or completely replace the distal superior aspect of the vamp and can be made into a decorative features referred to as toe tips. The toe box refers to the roofed area over and around the part of the shoe that covers the toes. The function of the toe box is to retain the shape of the forefoot and allow room for the toes. The height and width of the toe box is dictated by shape of the last used to construct the shoe. Certain types of non-athletic and athletic footwear will offer extra depth in the toe box.

### *Linings*

In quality shoes the quarters and vamps are lined to enhance comfort and durability. Linings may consist of various materials ie leathers, fabrics, and manmade synthetics. The lining on the insole segment is called 'the sock' and may be full-length, three-quarter or just the heel section. Many linings are made of synthetic material and are usually confined to the quarters and the insock.

### *Throat*

The central part of the vamp just proximal to the toe box. The throat is formed by the seam joining the vamp to the quarter i.e. throatline. The position of the throat line depends on the construction of the shoe, for example a shorter vamp and longer quarters define a lower throat line. This gives a wider lower opening for the foot to enter the shoe. The throat is defined by the connection of the rear edge of the vamp and the front part of the quarter. The location of the throat will vary with the design of the shoe. Because the vamp and quarter panels are often one piece in the athletic shoe, the throat is at the eyestay. This refers to the point where the lacing is attached to the vamp. The throat of the shoe dictates the maximum girth permitted by the shoe.



### The Sole of the Shoe

The term sole derives from 'solea' a Latin word meaning soil or ground.

#### *Insole (inner sole)*

A layer of material shaped to the bottom of the last and sandwiched between the outsole (or midsole) and the sole of the foot inside the shoe. The insole covers the join between the upper and the sole in most methods of construction and provides attachment for the upper, toe box linings and welting. This provides a platform upon which the foot can operate and separates the upper from the lower. The insole board is necessary in shoes that are constructed using cemented or Goodyear welt techniques because it is the attachment for upper and lower components. The majority of insole boards are made of cellulose and are treated with additives to inhibit bacterial growth. Athletic footwear will often have a sockliner, a piece of material placed over the top of the insole board (glued in position or removable).

#### *Outsole*

This is the outer most sole of the shoe, which is directly exposed to abrasion and wear. Traditionally made from a variety of materials, the outsole is constructed in different thickness and degrees of flexibility. Ideal soling materials must be waterproof, durable and possess a coefficient of friction high enough to prevent slipping. Leather has poor gripping capabilities and synthetic polymers are much preferred. There are also an infinite variety of surface designs. Extra grip properties can be incorporated in the form of a distinctive sole pattern with well-defined ridges. Alternatively they can be moulded with cavities to reduce the weight of the sole. These cavities need to be covered with a rigid insole or can be filled with light foam to produce a more flexible sole. In some cases two or more materials of different densities can be incorporated into the sole to give a hard wearing outer surface and a softer, more flexible midsole for greater comfort. Synthetic soling materials will off the physical property of dampening down impact levels (shock attenuation).

#### *Shank*

The shank bridges between the heel breast and the ball tread. The shankpiece or shank spring can be made from wood, metal, fibreglass or plastic and consists of a piece approximately 10cm long and 1.5 cm wide. The shank spring lies within the bridge or waist of the shoe, i.e. between heel and ball corresponding to the medial and lateral arches. The shankpiece reinforces the waist of the shoe and prevents it from collapsing or distorting in wear. The contour of the shank is determined by heel height. Shoes with low heels or wedged soles do not require a shank because the torque between the rear and forefoot does not distort the shoe.

### *Heel*

The heel is the raised component under the rear of the shoe. Heels consist of a variety of shapes, heights, and materials and are made of a series of raised platforms or a hollowed section. The part of the heel next to sole is usually shaped to fit the heel, this is called the heel seat or heel base. The heel breast describes front face of the heel. The ground contact section is called the top piece. Heels raise the rear of the shoe above the ground. A shoe without a heel or midsole wedge may be completely flat. When the heel section sits lower than the forefoot the style is called a 'negative heel'.

### *Welt*

The strip of material which joins the upper to the sole. Most shoes will be bonded by Goodyear-welted construction. Some shoes use an imitation welt stitched around the top flat edge of the sole for decorative purposes, but it is not a functional part of the shoe.



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## ***Shoe Lasts and Metrology***

*Most shoes are made to a last. This is a foot model with dimensions and shape similar to the anatomical foot but sufficiently different to not be exact. Shoe fit and to some extent the last influences its durability.*



## Last

*"The close relationship between a man and his shoe maker was based on the shared secret of the client's measurements. The statistics of clients were never disclosed."*

*Traditionally before mass production, the original shoemaker started the process by taking a footprint outline of the sole. He whittled or chiselled a wooden last from the print. A last ( 'laest', Old English meaning footprint) was traditionally made from wood but are now available now in metal or plastic. They are complex structures made from many measurements (statistically determined). Lasts are not the same size and dimensions of the anatomical foot but instead an abstract form with specific functions. It is usually deeper in the midfoot region, has a sharp 'feather edge' where the upper surface meets the sole, is clipped in along the topline (around the ankle) and is flaired over and extended in the toe region. This provides shape, which applies appropriate tension when the shoe distorts to contain the loaded foot. Lasts provides a working surface on which flat leather components can be given plastic form. The physical dimensions accommodate the foot during activity and the last contains contemporary fashion and styles such as toe shape. To allow the last to be removed from the shoe they are often hinged around the instep. Shoe lasts are not made to resemble feet but instead to suit the shoe manufacture. Modern lasts are totally unlike the foot with the sole of the last, flat in order to assist in manufacture. Shoe making was classified under three headings: turned shoes, welted shoes and through-seam shoes.*

### *Turned shoe*

*The turned shoe is made inside out with only an outset sole between the foot and the ground. The upper and soles are very flexible. The last is designed in a single size and then a set is made in the range of sizes and widths in which shoes are to be manufactured. Marked sizes will vary slightly from one manufacturer to another. No longer a popular technique.*

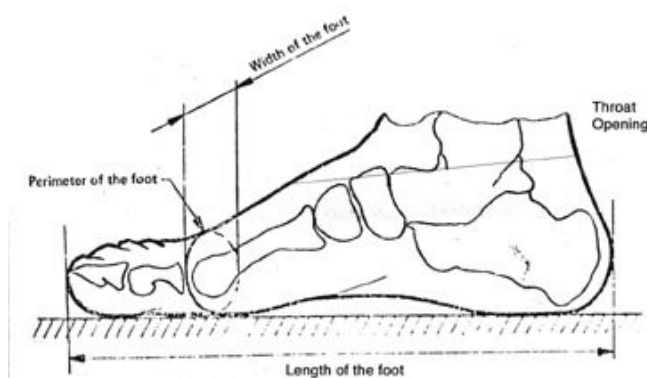
### *Welted Shoes*

*Any construction using a welting, either as an intrigal part of the construction or simply for imitative effect.*

### *Through Seam Shoes*

## *Anthropometry*

Studies show over 90% of people have different sized feet. Despite feet being the same length other dimensions vary with the individual foot. Activity of the foot will also change the shape of identical feet in accordance with the structure and function of the appendage. The idea of a perfect fit is not a reality. Because distribution or proportions of foot mass differ with individuals, which mean linear measurement such as length and breadth of the foot alone, are inadequate. It is important shoemakers consider mass and volume of feet if an exact fit is to be afforded. To ensure a best fit, measurements are taken at strategic locations and the shoemaker uses both linear as well volume measurement to construct a shoe. The modern last is made in three dimensions although it is not a direct replica of the foot. Instead it is made with production requirements, in mind. The lastmaker may take up to 35 measurements before the model last can be made. A shoe fitter may concentrate on length, ball width, heel, topline, arch and instep. The shoe is expected to wear well, feel well, keep its shape with wear, retain its style character, tread properly, allow for reasonable foot freedom, maintain both foot and shoe balance, remain structurally intact. These features are not always dependent on the quality of materials or components, or the manufacturing process. The design and multiple dimensions of the last provide the basis for the above.



Features built into a last include:

#### Measurements

The majority of measurements are volume rather than the traditional length and width associated with shoe fit.

#### Throat opening

The distance from the vamp point to the back seam tuck.

#### Length

The length measurement of the foot from the back of the heel to the tip of the longest toe.

#### Foot Girth

There are four girth and circumference measurements taken on a last. These are the ball, waist, instep and heel (back of heel to instep). Measurement requires careful assessment of the foot, which cannot be accomplished with the same precision as linear measurements. The modern last maker uses precision instruments to determine girth but the old shoemakers used the hand span to this same effect. Aspects of the foot were measured against the shoemaker's

hand, the ball of the foot was compared to the girth between the thumb and the middle finger. The instep was measured between the thumb and the little finger. This method was subject to enormous variations depending upon the size of the shoemaker's hand.

- *Ball girth* This is the girth measurement around the ball of the last to determine the width and volume allowance inside the shoe.
- *Waist girth* The girth at the waist on the last.
- *Instep girth* The circumference around the foot at the instep.
- *Heel girth* The distance around the foot from the rear base of the heel to the top of the instep.



### *Recede Toe*

This is the part of the last, which projects beyond the tip of the toes forming the rounded contour of the front of the shoe. A tapering recede such as in today's sharp shoes increases the overall length of the shoe. In a poorly designed last the recede may encroach on the toes increasing tension on the ends of the toes. This may be referred to as tight lasting.

### *Heel-to-ball*

This dictates the position of the hinge of the forefoot (metatarsal phalangeal joints) and the widest part of the shoe (across the metatarsal heads).

### *Toe Spring*

This describes the elevation of the undersurface of the sole at the toe to give a slight rocker effect to the shoe. The amount of toe spring (built into the last) depends on the shoe style, sole thickness and heel height. This is built into the last design and compensates for the stiffness of the footwear and provides a stress free take off into propulsion. The more rigid the soling material the greater the toe spring. Many shoes will also display a slight heel spring.

### *Tread*

This describes the width across the sole under the ball of the last and it should correspond to the dimension of the feet. The tread point on the last represents the bottom forepart just behind the ball and in contact with the base plane.



## Flare

*This describes the curve or contour of the last. The swing is determined by the position of the forepart when the last is bisected longitudinally forwards from the centre of the heel arc. With In inflare lasts there is an inward medial swing to the forepart and most modern shoes are made on an inflare last (banana last) because it is thought shoes are more comfortable. An outflare last describes the opposite with the swing lying to the lateral side of the forepart. Sometimes used in bespoke footwear for infants with diagnosed foot development problems. Straights last describe neither an inflare or outflare preference. The long axis of the last when drawn through the bisection of the heel curve describes two equal longitudinal halves. The normal foot has a straight axis and hence straight lasted shoes can be worn on either foot. Prior to the introduction of machinery to make heeled shoes it was common to have shoe made with a straight flare until the turn of the twentieth century.*

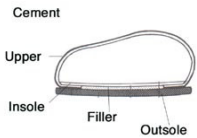
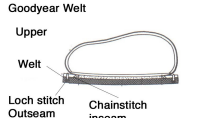
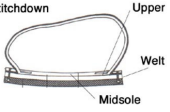

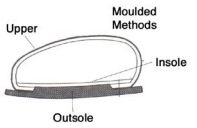


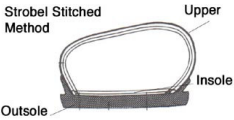
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## Methods of Shoe Construction

*There are many ways to attach the sole to the upper but commercially only a few methods are preferred. Shoes were traditionally made by moulding leather to a wooden last. Modern technology has introduced many new materials and mechanised much of the manufacture. Remarkable as it may seem the manufacture of shoes remains fairly labour intensive. No matter the type of construction the first stage in construction is to attach the insole to the undersurface of the last. Two main operations follow : Lasting describes the upper sections are shaped to the last and insole. Followed by Bottoming, where the sole is attached to the upper. The process of bottoming will determine price, quality and performance of the shoe.*

<p><b>Cement</b></p> <p><b>Alternative names</b></p>		<p>For lightweight and flexible footwear the outsole is stuck to the upper by an adhesive. Bonwelt is a variation with its distinguishing feature being a strip of welting attached by</p>
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<p><b>include:</b></p> <p><b>'Stuck on construction' (UK) and the 'Compo Process'.</b></p>	 <p>Cement</p> <p>Upper</p> <p>Insole</p> <p>Filler</p> <p>Outsole</p>	<p>stitching or cementing to the top edge of the insole. The shoe is then flat lasted. This is not a true welt construction wherein the welt is attached to the rib of the insole.</p>
<p><b>Goodyear Welt</b></p>	 <p>Goodyear Welt</p> <p>Upper</p> <p>Welt</p> <p>Loch stitch Outseam</p> <p>Chainsitch inseam</p>	<p>For high quality dress and town shoes the top section (or welt) is chain stitched to the upper and insole rib at the point where it curves under the last. This is supplemented by a lockstitch outseam bonding the welt and outsole. The outsole is then sewn to the welt around the edge. Goodyear Welt creates heavier less flexible footwear.</p>
<p><b>Stitchdown</b></p> <p><b>Alternative names include:</b></p> <p><b>Veldt or veldschoen</b></p>	 <p>Stitchdown</p> <p>Upper</p> <p>Welt</p> <p>Midsole</p>	<p>A cheaper method used to produce lightweight flexible soles for children's shoes and some casual footwear describes the upper turned out (flanged) at the edge of the last. This is then stitched to the runner. In some countries it is known as 'veldt' and 'veldtschoen.'</p>
<p><b>Mocassin</b></p>		<p>Thought to be the oldest shoe construction this consists of a single layer section, which forms the insole, vamp and quarters. The piece is moulded upwards from the Under surface of the last. An apron is then stitched to the gathered edges of the vamp and the sole is stitched to the base of the shoe. This method is used for flexible fashion footwear. The imitation moccasin has a visual appearance of a moccasin but does not have the wrap around construction of the genuine moccasin.</p>
<p><b>Moulded Methods</b></p>	 <p>Upper</p> <p>Moulded Methods</p> <p>Insole</p> <p>Outsole</p>	<p>The lasted upper is placed in a mould and the sole formed around it by injecting liquid synthetic soling material (PVC, urethane). Alternatively, the sole may be vulcanised by converting uncured rubber into a stable compound by heat and pressure. When the materials in the moulds cool the sole-upper bonding is complete. These methods combine the upper permanently into the sole and</p>


		such shoes cannot therefore be repaired easily. Moulded methods can be used to make most types of footwear.
<p><b>Force Lasting</b></p> <p><b>Alternative names include:</b></p> <p><b>The Strobel-stitched method (or sew in sock)</b></p>	 <p>The diagram illustrates the Strobel-stitched method. It shows a cross-section of a shoe's upper, insole, and outsole. The upper is labeled 'Upper', the insole is labeled 'Insole', and the outsole is labeled 'Outsole'. The text 'Strobel Stitched Method' is written above the diagram.</p>	<p>Force lasting has evolved from sport shoes but is increasingly used in other footwear. The Strobel-stitched method (or sew in sock) describes one of many force lasting techniques. The upper is sewn directly to a sock by means of an overlooking machine (Strobel stitchee) The upper is then pulled (force lasted) onto a last or moulding foot. Unit soles with raised walls or moulded soles are attached to completely cover the seam. This technique is sometimes known as the Californian process or slip lasting.</p>




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## Shoe Styles

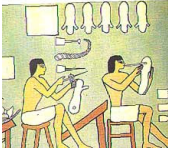

*According to Rossi (1997) there are eight basic footwear styles with the rest made up as variations on the basic themes. To comply with definition a shoe describes footwear with a mechanism capable of holding the foot in the heel of the shoe to facilitate support during push off. Hence there are two critical aspect of shoes i.e.. the band around the instep and the section corresponding to the human heel. To prevent unnecessary movement these need to be firm and fit the foot.*

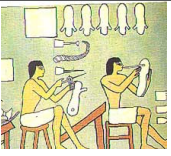


Style		Brief Description
<b>Boot</b>		Any footwear extending above the ankle. There are numerous

		designs and types for a variety of uses and made from a number of materials.
<b>Clog</b>		A thick soled wooden shoe sometimes with leather upper.
<b>Lace Up</b>	 <p>Oxford Shoe</p>  <p>Derby Style</p>	Any low cut shoe fastened by lacings, such as an Oxford or Blucher.

Style		Brief Description
<b>Moccasin</b>	 <p>Moccasin</p>	<p>The term moccasin originates from the Algonquian language for foot covering. The Algonquians were any of several North American Indian tribes formerly inhabiting the region along the Ottawa River and near the northern tributaries of the St. Lawrence River. The oldest form of shoe dates back to 14,000 years and was thought to originate from the</p>

	 <p data-bbox="618 554 748 625">Imitation Moccasin</p>	<p data-bbox="786 113 1172 1241">Mongol tribes who migrated along the Bering Strait into North America. Originally it described a simple one-piece hide, wrapped round the foot and held on with rawhide thongs. Later the Indians gradually stylised the moccasin by adding the moccasin plug, fringes and coloured beads, which depicted rank and occupation. Today moccasin shoes usually describe imitation moccasins, which had their origins in Norway. The Norwegian Peasant Slip-on (or weejun) was first imported to the US by tourists in the 1930s and later Gucci made a leather loafer in refined calfskin with a metal snaffle bit across the instep. Soon loafers were available in the spectator style (two colours). By the 50s Penny Loafers were all the rage with the campus Ivy League of the US. Made in ox blood they were also</p> <p data-bbox="786 1276 1172 1457">known as the Norwegian slipper. The Low vamp loafer was designed for females and was made from soft</p> <p data-bbox="786 1493 1078 1524">kid leather and cut low.</p>
<p data-bbox="477 1581 548 1612"><b>Mule</b></p>		<p data-bbox="786 1650 1172 1713">A backless shoe or slipper with or without a heel.</p>

Style		Brief Discription
<p><b>Sandal</b></p>	 <p>Hieroglyphics</p>  <p>Sport Sandals</p>  <p>Casuals</p>	<p>Originally a slab of leather sole attached to the foot by thongs. Today any open shoe who's upper consists of any decorative or functional arrangement of straps. A sandal can be foot low to knee high, or with any heel height, designed for simple utility or casual wear or as a fashion shoe.</p>
<p><b>Monks</b></p>		<p>Similar to Derby Shoes but with a cross over section to fasten the quarters with a side buckle.</p>
<p><b>Pumps</b></p>		<p>Heeled shoes with low cut fronts and usually no fastening.</p>

<p><b>Sandals</b></p>		
	<p>Hieroglyphics</p>	
		<p>Originally a slab of leather sole attached to the foot by thongs. Today any open</p>
	<p>Sport Sandals</p>	<p>shoe who's upper consists of any decorative or functional arrangement of straps. A</p>
		<p>sandal can be foot low to knee high, or with any heel height, designed for simple utility or casual wear or as a</p>
	<p>Casuals</p>	<p>fashion shoe.</p>



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## Shoe Size System

*A continual frustration to many who care for the foot weary is the absence of a standard shoe size system. Although metrology and reliable measurements have been in existence for approximately two hundred years, the concept of a shoe sizing system is relatively recent. Shoe sizing systems based on standard metrological measurements have been in existence for just over 100 years but shoes made in half sizes have only been available half that time. As part of the protection many craftsmen operated in early times, shoes were individually coded. Like a painter signing the canvas, shoemakers marked the inside of the shoe with their persona codes. This deliberately kept the size a secret from the customer and virtually ensured their return for new shoes. This is still in evidence today and many manufacturers maintain individual size systems in order to promote customer loyalty. The first US record of shoes marked with sizes dates back to between 1860 and 1870. The procedure soon followed in England. It was only full sizes recorded (half sizes did not appear until the late 1880s). In 1886 the Hanan Shoe Co. were the first manufacturer to stamp their name on their shoes. In 1888 the first fitting stool was introduced to the trade by Sollers Shoe Manufacturing Co., Philadelphia.*

*The Shoe Stick*

The origin of shoe sticks date back to antiquity. They were described in Ancient Egypt, Rome and Greece and used by shoe and sandal makers. For centuries there was no shoe size standards or systems and each craftsman was free to use his own method. It was common to use their own bodies particularly their hands as gauges. An English yard for example was the length of the arm i.e. shoulder to fingertips or sometimes nose to fingertips. The problem was not everyone was the same size and when a human foot was used to measure footage of land, much depended on the size of the individual as to how much the purchaser bought and the seller sold. In Rome, the inch (which was one twelfth of a foot) measured the width across the interphalangeal joint of the thumb. By the 7th century in England, the barleycorn became a standard measurement with three ears of corn, laid end to end, equalling one inch. It took until the thirteenth century before the inch was officially sanctioned. Under pressure, Edward II (r. 1307-27) eventually succumbed to appeals from scholars and tradesmen to issue a decree to standardise measurement (Ledger, 1985). Henceforth an English inch was the distance measured across three barleycorns taken from the centre of the ear and placed end to end equalled an inch. Thirty nine (39) barleycorns laid end to end became a foot and 117 laid end to end became a yard. Whilst the barleycorn decree of Edward II had nothing to do with shoe sizes per se many shoemakers began to use shoe sticks. Tradesmen had traditionally used the handspan method of measurement, which preferred the quarter of an inch unit, but after the introduction of the barleycorn measure, many began to adopt the third of an inch unit. With 39 barley corns approximating the length of a normal foot, this was graded size 13 and became the largest shoe size. Other sizes were graded down by 1/3 rd of an inch or one barleycorn. It took until 1850 before the first uniform shoe stick using the English size system appeared. Ironically this took place in France and shoe sticks were not accepted in North America, until after 1900.

Today shoes are marked according to one of three different length sizing systems depending on where the shoes were made. The three major systems are United Kingdom, American and Continental (or Paris Point):

### UK System

The first description of a shoe sizing system was made and recorded by British genealogist Randle Holme in the Academy of Armory and Blazon in 1688. The UK System starts from zero, at 102 mm with 8.4mm (1/4 ") between whole sizes (4.2mm between half sizes). Adults sizes range from size 1 to size 15 (equivalent to 12"). The UK System for children is divided into 13 parts. Sizes start at five inches long and every fourth part of an inch thereafter until, size 12. Size 13 or short 13 and consists of length of 8 inches and a quarter. This also starts the Adult size 1.

### Third Inch Scale (Barley Corn)

0	3	6	9	12	15	18	21	24	27	30	33	36	39
	1	2	3	4	5	6	7	8	9	10	11	12	13

### UK System Quarter Inch Scale

#### Child Sizes

0	5.25	5.5	5.75	6.0	6.25	6.75	7.0	7.25	7.5	7.75	8.0	8.25	8.5
	1	2	3	4	5	6	7	8	9	10	11	12	13

### Adult Sizes

8.5	8.75	9.0	9.25	9.5	9.75	10.0	10.25	10.5	10.75	11.0	11.25	11.5	11.75	12
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

### Children's Shoes

*Until the time of Queen Victoria , children's shoes were made as miniature adult shoes, with no special feature for growing feet. The children of the Middle Class in Victorian times wore shoe styles more akin to fancy dress which may account for why the design of today's shoes contain motifs which refer to previous ages and classic periods of history. Going barefoot is still within living memory and many children went without footwear as a normal practice and not through poverty. Work shoes were often handed down with the better off wearing them before passing them to siblings.*

*It is not clear why a unit of 13 was used to judge a critical point between child sizes and adults. The origins of this remain clouded but there are several theories. It is understood early English shoemakers started with the smallest size (0 or 1) at four inches. Four inches was an easy measure to record because it was the width across the knuckles which happened to correspond to the size of a child's foot needing their first pair of shoes. By coincidence 4.22 " measured 13 barleycorns. The next easy measure was the span of the hand or 9". Measure across the knuckles (4") plus the span of the hand (9") gave 13". This measured the average length of a child's foot at puberty. Adult sizes would logically start at the end of the child's size. Another belief is based on a foot measuring practice at the time. Some historians believe shoemakers accepted 13 as the base unit for measuring feet. The shoemaker's size stick was twelve inches long with the units measured from zero. This meant twelve became thirteen. There have been several attempts to standardise measurements of shoes and adopt the quarter inch unit, however arguments have always failed due to costs and problems of changing to a new system. As early as the seventeenth century, according to Holme, a "guild of shoemakers" had agreed on a common size scale based on a quarter inch rather than the third of inch. However little had changed by the nineteenth century when Gardener described in 1856 a shoe sizing system based on one-third inch, scale. The barleycorn , for all its metrological shortcomings, continues to be used in both American and English sizing systems.*

### American System

*The first shoe sizing system with detailed proportional measurements for lasts and shoes came from North America. The instigator, Edwin B Simpson of New York, prepared the first chart of standardised last measurements in 1880. This included shoe widths but it was another seven years before the Retail Boot and Shoe Dealer's National Association adopted the system. Much of the impetus to introduce a size system had arisen during the American Civil War (1861-65) where mass produced shoes were made in left and rights for the first time. As the main shoe manufacturers were in the North then orders for soldiers required a size system. To make it easier for the Army to order*

shoes for their servicemen, each soldier was allocated a shoe size as well as a nametag. Despite the availability of inflare footwear, these were not comfortable and many complained. The Confederacy fought barefoot. Right and left shoes were not commercially available for another half century. Although North America legalised the use of the metric system the industry did not adopt it as the only means. Regular reviews of regulation have meet similar non-compliance. Consequently there remains little standardisation of shoe sizes within the US. Ironically the industry continues to use Imperial measurements and each manufacturer determines how large a certain size will be. The only standardisation is each full size is 1/3 of an inch longer than the previous size. Women's shoes are marked 1 1/2 sizes different than men's (a size 9 women's shoe is equal in length to a size 7 1/2 men's shoe). In the American (or Standard) System the first number in the code represents the width (1 = A, 2 = B) The second number followed by a zero denotes the whole size: when the second number is followed by a 5 it indicates a half size.

### Adult Sizes

8.5	8.75	9.0	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

### Continental System (Paris Point metric)

The Europeans used a metric system and hence each full size (or two thirds of a centimetre) is less than a full size but more than the half size. North America is one of the few countries, which is still using imperial measurement whereas most other countries have adopted a metric system. Gabriel Mouton, a French vicar, first introduced the metric system in 1670. In 1801 after several modifications the French officially adopted the measurement system. The French system does not support half sizes. Infant sizes start at size 15 (equivalent to 0) and each size then progresses by two thirds of a centimetre. By 1875 several nations had got together to discuss adoption of the Paris Point System and whilst countries like North America legalised the use of the metric system, the industry refused to adopt it as the only means.

### Mondo Point

This was a proposed international shoe sizing system based on the metric system. The idea originated in Australia and was intended to replace English, French, Italian and other size systems. Mondopoint provided a uniform system of shoe sizes among the nations of the world. The sizes were based on millimetres. Shoes were described as 255/98 or 255 millimetres long and 98 millimetres broad. Sizes progressed from the smallest to the largest, from children's through to adults without interruption. Foot size was determined with the person weight bearing.

### Size Conversion Charts

#### Male Adult Sizes - Conversion

UK	1	2	3	4	5	6	7	8	9	10	11	12	13	UK
US	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	US
PP	33	34	35.5	36.5	38	39.3	40.5	42	43	44.5	46	47	48	cm
Mondo	220	227	236	245	252	260	270	278	286	298	305	312	320	mm.

### Female Sizes - Conversion

UK		1	2	3	4	5	6	7	8	9	
US		3	4	5	6	7	8	9	10	11	
PP		34	35	36	37	38	39	40	41	42	
Mondo		227				252					278

### Children's Sizes - Conversion

UK		1	2	3	4	5	6	7	8	9	10	11	12	13	UK
US		2	3	4	5	6	7	8	9	10	11	12	13	1	US
PP		18	19	20	21	22	23	24	25	26.5	28	29	30.5	31.5	PP
Mondo		108	125	132	139	146	153	160	167	175	185	195	202	210	Mondo

### Width Fitting

Shoe width represents both the linear and girth measurements at the ball, and is determined by the last. Several standard and width fittings are available in the UK size system to accommodate differences in three-dimensional girth. In women's shoes, A is the narrowest and G the widest. For children the range is A to H; and for men it is from 1-8. The girth increase between fittings is normally 6.5mm. Most lines are only available in one size usually women's D and men's 4. The girth around the ball of the foot of the foot increases by 5mm for whole sizes up to children's size 10 1/2 and 6.5mm for whole sizes above this. In the American system it is two less, eg AAA is the equivalent to the UK A. There is no equivalent Continental width fitting system and the shoes are generally narrower than in the UK. In the American (or Standard) System the first number in the code represents the width (1 = A, 2 = B) The second number followed by a zero denotes the whole size: when the second number is followed by a 5 it indicates a half size. In the American (Arithmetic

standard width measurement) this ranges from AAAAA to EEEEE.

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### **Assessing Footwear**

*Most clients attend for treatment wearing dress shoes, which are not always their normal footwear. In those situations where shoe costume and foot are considered incompatible, practitioners may tactfully request the client bring the footwear worn for the majority of the working day. In situations where client's shoes contribute to subjective symptoms but no apparent conscious acceptance is obvious then the practitioner may accept the clients personal choice is a life style decision. Adverse shoe conditions can excite pathologies, compromise prognosis and inhibit satisfactory practice but the choice of footwear always remains with the client. Under these circumstances negotiated care is required where neither party is compromised.*

*It is important to ascertain a client's shoe wearing habits. Information about when, where, and how often shoes are bought can be very useful. To avoid a 'halo effect', however, assessment should involve tact and sensitivity, combined with a healthy scepticism. People will often report shoe-wearing habits they consider appropriate to a healthy life style especially in the presence of a foot physician. When gathering information tolerance is a virtue, with discretion and understanding essential assets. A sad fact in this day and age is not everyone can afford shoes, especially where multiple children are involved.*

*People buy shoes to meet specific purposes and all gain benefit from well informed advice. Most obtain perfectly adequate footwear from general or specialised retail outlets. For some, shoes require minor modification to accommodate specific requirements, such as a short leg, whereas a small minority need shoes made specifically to fit their feet ie. bespoke footwear. Made for feet shoes are classified as modular ie a type of footwear fabricated using stock lasts to which minor adjustments can be made; and True, bespoke footwear, which is, made form a customed last. These are available privately or with assistance from medical funds when prescribed. Mass produced or stock footwear is available single size/width or half size multi-width fittings. The former is usual for adult sizes and the latter more common in children shoes.*

*A list of good habits is in itself inappropriate and it is important to have reference to an appropriate portfolio ie shoe catalogue and suppliers if you wish to inform clients. Most fashion shoes are bought in self-service outlets, including the World Wide Web. Socio-economics determine the vast majority of shoe buyers can ill afford quality footwear associated with personal fitting or made to measure footwear. Most people prescribed orthopaedic footwear require some financial assistance.*

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### **Problems with fit**

*The problems are rarely single and often are multifactorial. Asymmetry and anatomical variation mean challenges for people seeking ideal fit. The style and pattern of a shoe bear an influence on size. The distribution of mass or volume within the shoe affects size and fit. The height of the heel can affect deportment and function, hence the shape of the foot. Shoe types such as fashion footwear and work boots may be fitted with a bit more size allowance than the slightly snugger fit of an elegant fashion or dress shoe. The type of shoe construction can bare an influence. e.g. welts, cements, slip lasted, stitchdown, injection-moulded etc, will show slight differences in fit on the foot. Some manufacturers or brands apply their own particular specifications of dimensions on their lasts e.g. backpart, forepart, tread, etc. and this makes a difference in fit among different brands on a given size. The foot fitted in the morning will be smaller than the foot fitted in the afternoon. Toe shape of the shoe may influence the fit. Shoes with narrower toes may need to be worn a half size longer (when available).*

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### **Discussion**

*The concept of shoe fit is largely a subjective and person al matter on the part of the fitter or the customer or both. Size alone is not the only determining factor. Research form the Battelle Institute has shown there are at least 38 individual factors influencing or involved in shoe fit. Many of the 38 factors were subjective involving the opinion and attitudes of consumer and fitter alike. In the end it was the customer who determined whether the shoe fitted or not.*

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