MARKS OF INDUSTRY

in series:

MARKS OF THE PRINTER

Taken from a 1929-vintage catalogue, this shows some of the prize medals obtained prior by Petters Ltd, a maker of internal-combustion engines.

MARKS OF INDUSTRY

external characteristics
as a guide to the identification
of artefacts

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AUTHOR'S PREFACE

Identifying and dating the products of industry are helped by many things. The marks found on an artefact are often of vital importance; so, too, may be the printer's or order code on a manual, a handbill or an advertisement. Yet there are also many pitfalls. Printers often used the same basic illustrations for twenty years or more, persisting with obsolescent blocks long after a particular item had ceased to exist, and the interpretation of many individual marks may not always be obvious.

This booklet suggests how a variety of markings may be used to assist dating. Of course, the history of many individual industrial artefacts has been widely documented, and detailed research has been undertaken into the work of many engineer-inventors. Yet there are still many areas in which knowledge is scant or non-existent. If the information in the pages that follow stimulates interest in even one of these topics, it will have done its duty.

The booklet grew out of a hand-out accompanying a lecture I delivered to students enjoying the University of Brighton Conservation of Industrial Heritage course in 2000–1. The lecture also included a practical test, under the watchful supervision of Dr Jonathan Minns, then chief executive (and guiding light) of the British Engineerium. This showed how problems arose unexpectedly even when mature, well-educated and intelligent students were confronted with items which they could not immediately identify.

At the end of a particularly challenging day, therefore, I was asked if the hand-out could be enlarged to answer some of the problems that had been encountered. This I agreed to do, and the hand-out had become a booklet by the time the first course concluded. Unfortunately, lack of demand at postgraduate level soon led to the demise of Conservation of Industrial Heritage, but I continued work in the hope that, some day, another use could be found for the information.

My special thanks are due to Dr Jonathan Minns and the staff of the late, lamented British Engineerium—Susan Wadbrook, Peter Fagg, Alan Roberts, Philip Dalton (who, sadly, died in 2009)—for supporting the project in its earliest days. When the museum closed, all seemed lost until Ian McGregor

and the staff of the Canadian Museum of Making not only came to the rescue but also quickly made me feel ‘at home’. It is to them that this new edition owes its genesis.

I also owe a debt of gratitude to Dr Bruce Babcock of Amanda, Ohio, who has generously supplied information and debated the finer points of markings and design for many years; and to my ex-colleagues in the University of Brighton Faculty of Science and Engineering, in particular to Professor Fred Maillardet, Dr Mark Jones and Dr Mathew Philip. Mathew was given the doubtful privilege of acting as my mentor (a precipitous learning curve!) when my role changed unexpectedly from passively organising to actively leading the course, and his patience and support will always be a happy memory. His expertise in the identification of materials has proved to be particularly valuable.

Our students Claire Barrett, Tom Cinderey, Mike Hill and Philip Marini must also take some of the blame for encouraging me to continue my work beyond the point at which I had been keen to stop. Philip Marini’s M.Sc. thesis on the identification and conservation of plastics remains a source of inspiration.

However, depite the help I have been given, responsibility for errors and omissions is entirely mine. Publication should (I hope) allow me the chance to correct them in a future upgrade…

John Walter, Portslade, England, 2012

INTRODUCTION

Picture the scene. You have been appointed by the Saudi Arabian government to locate exhibits for the Hedjaz Railway Museum, soon to be opened in Medina, the one-time southern terminus on the pilgrim route to Mecca. One of your tasks is to retrieve and catalogue relics from the desert, where they will have lain since Lawrence of Arabia and his allies cut the line in 1917.

You already know that a 'train' stands in Hadiyah Siding; more accurately, that an 0–6–0 tank engine heads a burned-out skeleton of a train. A visit reveals that many fittings have gone and the boiler plates have wasted through, but also that the entire unit would make a good exhibit if supporting information can be provided.

Ethical considerations—should restoration be attempted? should the display be 'as found'?—are temporarily put aside. Close examination reveals that a small plate had once been fixed on the surviving cab-sheet, beneath a number; four holes clearly held bolts, and one survives. No sooner have you decided that the plate was probably taken as a souvenir than the shadow thrown by the setting sun reveals that it had been hit, perhaps by a bullet or a fragment of a shell. This is confirmed by a fractured remnant trapped behind the surviving bolt.

You look around. The train stands in a siding. This suggests that it had been attacked while stationary, and also that fragments of the maker's plate may be buried in the sand. So you decide to dig for clues; sand shifts too easily, but, with the assistance of a coffer-dam made of wood, you begin a slow process of sieving. Of course, you have established a datum point and are diligently recording, tagging and bagging the finds as they occur.

Slightly behind the left side of the locomotive, a few feet from the line of the cab sheets, you have a piece of luck: a tiny piece of the maker's plate is found. What story can the tiny plate-fragment tell? That the railway was constructed in 1900–8 is well known; the Hedjaz was under Ottoman control at that time, but the rolling stock was supplied from Germany and the remnants of the 0–6–0T show Teutonic origins quite clearly. But which of the several contractors built it?

Most of the plates used by locomotive manufacturers around the world were rectangular or oval, retained by four and two bolts respectively; exceptions to this generalisation, even in Britain, were rare. Some designs were circular, however, and the flattened-diamond plates fitted by Henry Dübs of the Glasgow Locomotive Works were perpetuated by the North British Locomotive Co. Ltd ('NBL') on most of the products of the Dubs factory made from amalgamation in 1903 to eventual closure.[1] William Beardmore of Dalmuir used a diamond with sides curved to suggest a superimposed oval; and the engraved works-plates fitted by Robert Stephenson & Hawthorns Ltd of Darlington and Newcastle upon Tyne often took the form of attenuated hexagons.

Consequently, the size and proportions of the plates, and the location of the bolt-holes, can identify a manufacturer even if no other details remain. We are fortunate with our Hedjaz locomotive. Though only a small fragment has been retrieved, it has the remnants of a boss around the bolt-hole, a distinctively curved lower edge, and small decorative indents where the plate edges meet the boss. Enough survives to deduce that though the bottom of the plate was curved, the vertical edges were straight.

The four bolt-holes suggest symmetry, and it is obvious from the edging and two fragmentary letter-tips that the details were cast in relief within a decorative border. Luckily, there are faint marks on the cab-sheet to show where the plate had been pushed inward before breaking. The trace left by the upper edge of the plate seems to lie closer to a line drawn between the centres of the upper two bolt-holes than the mark left by the lower edge of the plate in relation to the lower holes. The plate had two curved and two straight sides, but the curve was greater on the lower edge than the upper one.

A hypothetical reconstruction can now be attempted. The shaping of the mid-points of the curved edges is unclear, but most other characteristics of the plate-shape can be defined. This particular example is unusual, and, as the locomotive is known not only to be German but also to date from 1900–14, it is simply a matter of research to trace a plate of similar type.

Though many German manufacturers preferred rectangles, Oranstein & Koppel often used a circular plate prior to 1914, with a central scroll and the mounting bolts offset on opposite sides of the horizontal centreline; Berliner Maschinenbau AG vorm. L. Schwartzkopff used a plate with straight

1. The North British Locomotive Co. Ltd, Britain's largest manufacturer, was formed in 1903 by amalgamating three of Glasgow's most famous businesses: Dübs, Neilson Reid & Company and Sharp, Stewart & Company. Dübs' Glasgow Locomotive Works diamond and Sharp Stewart's Atlas Works oval plates were retained (though the NBL name replaced those of the original companies), and the plate signifying the Hyde Park Works of Neilson, Reid & Company changed from oval to circular. These distinctions were retained—with one or two exceptions—for the life of the company.

Plate 1. Taken from a German filing/sawing machine by Gebr. Thiel GmbH of Ruhla, this was applied by an importer. E.H. Jones traded independently until becoming the promotional arm of CVA, later Kearney & Trecker Ltd. Canadian *Museum of Making collection.*

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vertical edges and plain, but symmetrically curved upper and lower edges; and Hannover'sche Maschinenbau AG, vormals Georg Egestorff, used plates of the type once fitted to the Hedjaz engine prior to 1914.

As the fragmentary letters could easily be reconstructed as the terminal '-EN' of Hannover-Linden, the identity of the locomotive has been finally been established beyond reasonable doubt. Details provided by records in Germany, compiled by railway enthusiasts, refine the search first to a small class of similar locomotives and then link it with a single machine…

This hypothetical example employs just one of many ways of identifying industrial artefacts. But it is clearly necessary to search for information purposely supplied by the manufacturer to identify the item or promote its existence. Clues may be gained from the trading name at that particular moment in time; from the factory address; from the existence of branch offices; and from date.

This may all seem straightforward. Yet many marks will have been defaced—sometimes deliberately—and others will be damaged so badly that large parts of the inscriptions will be lost. Manufacturers' plates may have

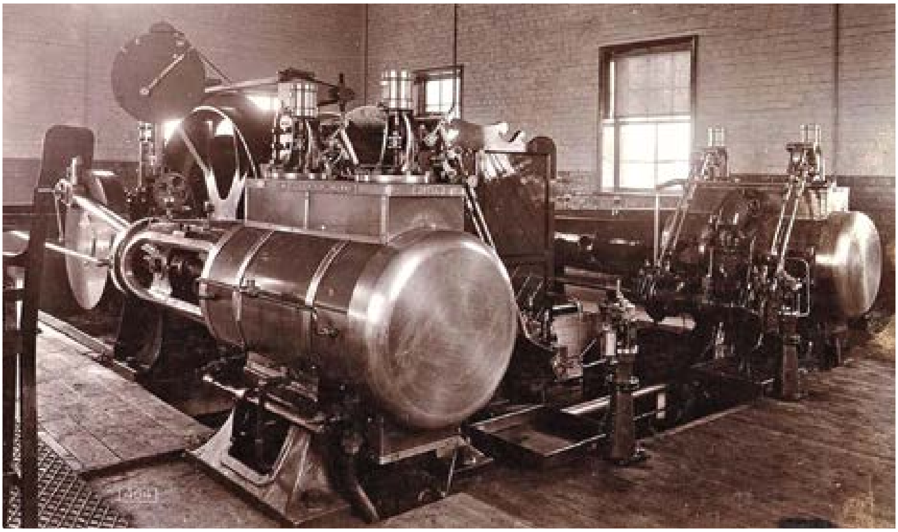

Plate 2. A twin horizontal-cylinder mill engine by Robey & Co. Ltd of Lincoln, fitted with patent drop valves and marked accordingly. These engines bear the order-book numbers '28711' and '28712' on the end of the valve chests above the cylinders; other examples of this general type, however, will bear names—commonly taken either from classical mythology or provided by the wives and daughters of mill owners and local politicians.

had dates erased, to disguise the age of a particular piece of machinery or, if another date has been substituted, to record a major modification. Marks have been altered to reflect a change in ownership or corporate structure. A few have even been effaced to disguise their origins. Motor vehicles are regular targets for this particular treatment, especially if they have been stolen or used in a crime. Removal of serial/registration numbers from the chassis and the engine blocks is another example of deliberate erasure, though these marks can often be reconstructed by specialist forensic examination.

Specialist knowledge may also be necessary to fill identification gaps; for example, manufacturers' names may be deduced from nothing but a trademark, a brand name or even a telegraphic address (see below). Dates may be resolved if the plate includes a 'works number', as long as the numbering sequence is known. Sometimes even an educated guess will be permissible…as long as the justification for this is explained.

Another problem may be posed by the intercession of licensees, wholesalers, retailers and entrepreneurs. Most trades depended on sales for their existence, and, to secure orders, most manufacturers happily applied (indeed, still apply) marks desired by the purchaser. This is particularly true of cutlery, hand tools, scientific instruments and domestic equipment, and can be very difficult to detect.

One of the most important of the German cutlery makers, Weyersberg, Kirschbaum & Co. ('WK&C') of Solingen, was claiming in 1910 to have eight thousand outlets for its wares, and distribution networks of this magnitude are by no means unusual. Though most of these particular swords, bayonets, cutlery, knives and bladed tools bore Weyersberg, Kirschbaum & Company's registered trademarks,[2] many displayed nothing but a Brazilian distributor's name or the marks of an importer trading in British India who wished to hide the German origins of his wares. The French were not keen to import goods made in Germany, particularly in the years immediately after the end of the Franco–Prussian War in 1871 and the First World War in 1918, and so the items sold there often went unmarked.

Ships, bridges, aircraft, railway locomotives, vehicles, power tools, radio sets, computers and virtually all other multi-part fabrications embody parts supplied by specialist subcontractors. These may not always be marked, and are regularly attributed to the 'manufacturer' (often little more than the assembler) of the item on which a particular name appears.

The nationality of a motor vehicle may determine the supplier of individual components, as essentially similar designs can be made in factories separated by hundreds or even thousands of miles; General Motors of Detroit, the parent of both Vauxhall and Opel, has made comparable cars (e.g., the Vauxhall Cavalier and the Opel Ascona) in Britain and Germany. But though the body shells may look similar, near-identical parts may have been bought from separate suppliers—electrical equipment from Lucas in Britain and Bosch in Germany, or piston-rings from the British Piston Ring Co. Ltd of Coventry or Kolbenschmidt in Germany.

Aircraft manufacturers do not make their own radar, nor have they made the weapons with which their products are armed (excepting a few cases, such as British Aerospace, where large conglomerates have swallowed a group of specialist sub-contractors). And very few British railway locomotives ever carried brake-pumps or injectors made by the railway's own workshops, preferring instead to buy them from the Westinghouse Brake Co. Ltd and Gresham & Craven Ltd. Mechanical lubricators may have been made by companies such as Wakefield; spark plugs by KLG; carburettors by Solex or

2. An 1883-vintage amalgamation of two of the principal Solingen-based sword-cutlers, WK&C used marks ranging from a king's head and a knight's helm (together or alone) to a road range of brand names in an assortment of languages.

Plate 3. This small high-speed steam engine was made by Ashworth & Parker to drive a blower or fan. It is typical of the 'enclosed' designs that were current in the 1930s. Note the makers' monogram cast into the access door on the engine body. *Museum of Making collection.*

Weber; pressure gauges by Schaeffer & Budenberg. Unfortunately, many subcontractors marked the products with the name of an assembler, and origins may easily be mistaken unless some quirk of marking or construction is visible. Taking measurements may reveal that a screw-thread is metric instead of imperial; pressures (often most obvious in a test-mark) may be marked in kg/cm^2 instead of lb/in^2; graduations may be in millimetres instead of thousandths of an inch—all these hold clues to origin, though the possibility that they have been altered or made for export should be considered.

Another problem can be posed by the addition of an owner's name giving the appearance of a maker's mark. This is commonly encountered on hand tools, where the owner marked them to prevent loss or theft in a working environment where the tools were common. Scratched marks on a blade and names carved crudely into wooden hafts are easily identified with individual users, but marks which have been applied with letter punches are often much more difficult to resolve.

Punching letters individually may sometimes be betrayed by noticeably uneven depth or irregular spacing, but one-strike applications from a single die can be impossible to distinguish from the manufacturers' marks that were applied in the same way. The absence of qualifiers such as '& Son' or a town name may sometimes be significant, but not all individual cases can be assessed as simply: plenty of variation is to be found.

Plate 4. This cast-brass plate graces a belt driven radial-arm drilling machine dating from about 1870. *Canadian Museum of Making collection.*

MATERIALS

It may seem strange to begin a book dealing principally with identification of markings with a chapter on constructional materials, but it is difficult to have one without the other. Like markings, materials come in great variety and it is often useful to have gained ideas of the 'order of materials'—their chronology, effectively—and some of their characteristics.

Great strides have been made in recent years with the dating of objects, thanks to the introduction of highly sophisticated diagnostic tools such as electron microscopes and new types of spectrometer. However, these are expensive, almost always confined to the laboratory, and require training to use effectively. Consequently, they cannot help the novice unless specialist support is available. It is also true to say that the usefulness of some techniques in a recent historical sense is limited: carbon dating, for example, may be of real value to the archaeologist or palaeontologist, but inherent inaccuracy (insignificant if the timescale is measured in millions of years) hinders the analysis of items from the more recent past.

Of course, spectrographic analysis can be very helpful, giving an accurate guide to the constituents of items; it is possible to correlate particular types of mineral inclusion with specific geographic locations, but, unfortunately, the diversity of manufacturing industry—a habitual importer of raw material—reduces the significance of the data. Pre-mediaeval metalwork is still often identified more by reference to samples of known provenance or attribution than to spectrometric yardsticks.

None of this helps the inexperienced researcher, collector or enthusiast to establish the age or material of an item. All that is left are the principal senses: sight, smell, touch. The goal of this chapter is to explain how a start can be made on basic non-destructive and non-interventional identification, using only readily available tools.

Unfortunately, the senses of smell and touch rarely assist the identification of artefacts, excepting where some of the perfumed woods have been used. Smell can be a useful arbiter in the identification of synthetic material, but burning usually has to occur before characteristic odours can be released: at odds with the ideals of non-interventional analysis. This leaves only visual inspection as a useful tool. Yet many metals look very similar—'steel grey', 'silverish'—and electro-plating, usually with nickel or chromium, can often disguise the base material.[3] Wood can be stained, varnished or lacquered, hiding its true colour; and synthetic material can be made in virtually any colour a client specifies.

What is left? One answer can be found in 'specific gravity' ('SG'), a measure of density compared with a standard base: water, which weighs one gram per cubic centimetre. Specific gravities can range from only 0·15 for Balsawood, fifteen per cent of the weight of a comparable volume of water, to more than 20 for the heaviest metals.

But there can be serious complications. The density of wood taken from the same tree can vary, depending on whether it is heart- or sap-wood, or on the environmental factors that shaped its growth. Figures obtained from pure metals are not the same as those from alloys, and the density of castings may not duplicate samples which have been forged or rolled. And results are easily distorted by the presence of impurities.

The specific gravity of cast iron can range from 7·6 to 7·9, and variations found in alloys depend on the degree to which their composition has been altered in pursuit of hardness or resistance to corrosion. For example, Mushet Steel, the first to allow tools to be made to cut hard metal, typically contained 9 per cent of tungsten, 2·5 per cent of manganese and 1·9 per cent of carbon. An acid-resisting alloy sold under the brand names 'Duriron' and 'Tantiron' contained more than fourteen per cent of silicon; 'Invar' alloy contained 35–36 per cent of nickel, reducing heat-related expansion to a minimum; and chrome-nickel steel, once used for the production of armour plate, contained 1·5–3·5 per cent of nickel and 0·6–1·5 per cent of chromium.

The ease with which the chemistry of synthetic materials can be adapted also promotes fluctuations in specific gravity, but this is not to suggest that determining specific gravity is a waste of time—only that it can be an imprecise arbiter. However, specific gravity can provide a comparatively easy way of eliminating possibilities. This is partly because differing classes of material occupy different SG bands: woods range from 0·15 for Balsawood to 1·03 for Ebony; plastics (excluding lightweight foamed compounds) range from about 0·8 to 2·2; and metals range from 0·585 for lithium to 22·48 for osmium.

3. Electro-deposition had been suggested as early as 1805 by an Italian experimenter, Luigi Brugnatelli, but little came of his studies. The first practical use was made in 1839 by Moritz-Hermann Jacobi, a German working in Russia, who successfully produced printing plates by 'electrotyping'. In England in 1840, John Wright and the Elkington brothers, George and Henry, patented a method of electro-deposition using potassium cyanide as an electrolyte. Their intial successes quickly developed into a commercial enterprise in Birmingham.

Consequently, an item with a specific gravity above 2·5 will be metal or metal alloy, and anything in the 1–1·5 range is likely to be synthetic…however much it looks like wood or bone.

The most common way of assessing specific gravity is water-displacement, particularly useful if the shape of an object is irregular. Weight is easily obtained by weighing, but volume is much more difficult to calculate. If the object is immersed, however, the volume of water displaced is directly equivalent to the volume of the object. If this is divided into the weight, a specific-gravity figure can be obtained.

There are, of course, several provisos: the object must be solid, or hollowed in such a way that water can fill all internal spaces; it must not be absorbent; and it must be denser than the water in which it is to be immersed.[4]

CONSTRUCTION MATERIALS

The differences between ceramics, wood, metal and polymers are usually obvious, but identification within each category can present problems. This is particularly true of the countless types of steel alloys, or the seemingly endless parade of polymers. And it is difficult for even an experienced observer to identify wood, particularly as there are so many ways of cutting, processing or finishing it. In the antiques trades, the term 'fruitwood' can encompass superficially similar, but botanically unrelated material—for example, apple, cherry and pear.

It is also difficult to classify constructional materials. In his classic study *Chemistry of Engineering Materials*, published in the U.S.A. in several editions prior to the Second World War, Robert Leighou divided them into fuels; refractory materials for furnace linings; non-ferrous metals; non-ferrous alloys; iron and steel; foundry sands; building stones; lime and gypsum products; Portland and other cements (and concrete); clay and clay products; and then a variety of lesser paints, varnishes, stains, fillers, lubricants, glue, and rubber. However, several of these have no great relavance to the identification of industrial artefacts and only wood, ceramics, glass, metals and plastics are considered below.

The natural world. This group includes all the material supplied by plants and trees, capable of being processed without changing the basic characteristics.

4. Lightweight items, including virtually all woods and some synthetics, will float. To obtain a specific gravity in these cases, an auxiliary weight of known dimensions can be attached.

Though the raw material can be cut, shaped, specially dried or given a protective finish, it nonetheless retains structural integrity—unlike haematite ('kidney ore'), for example, which must undergo considerable chemical transformation to produce iron.

Wood is undoubtedly the most important of the natural materials, and has been worked for tens of thousands of years. This is partly due to the ease with which it can be cut and shaped, to durability, and to almost universal availability. Many of the earliest freestanding dwellings had a wood frame, and none of the mediaeval voyages of discovery would have been possible without wooden ships. In addition, decorative qualities of colour, figure and grain have always encouraged the use of wood in the production of artefacts. Desirable qualities, ironically, can also be found in diseased or damaged tissue, such as bird's-eye maple, brown oak or burr walnut, when scars or discolouration can provide additional visual interest. The wood of trees that have been 'pollarded', when the top growth is removed regularly to promote spread, can also be attractively figured.

An obvious guide to identification is provided by use: structural timber is usually comparatively common—beech, birch, elm, oak or pine, often depending on local availability. Conversely, most of the hardwoods valued for decorative qualities are uncommon and, therefore, expensive. They can also lack strength and may even be applied as thin veneers to a substrate of stronger wood. Among these so-called 'precious woods' are bird's-eye maple, brown oak, bubinga, ebony, pearwood, purpleheart, rosewood, satinwood, many forms of walnut, and zebrawood.

Physical characteristics can suit specific woods to particular uses. The very tight grain of boxwood, though usually lacking decorative figure, ensures that it can be worked easily and polishes well; consequently, boxwood has been extensively employed in the manufacture of boxes and furniture. Walnut has always been preferred for gun-stocks, particularly blanks in which grain or figure may be evident, as it allies a special lustre with an ability to absorb recoil forces without distorting.

Tree-wood consists of a series of growth rings, comprising light *springwood* and darker *summerwood*, each cycle creating a single ring. The walls of individual cells are made of cellulose, hemi-cellulose and fibrous tar-like lignin. The 'growing'section of the tree is confined to the cambium, immediately behind the bark and bast, where vertical tracheids and horizontal parenchyma (located in the rays) convey sap upward and store food respectively. The walls of each cell thicken at the end of growth ('sapwood'), and ultimately bond together in a lignin-rich mass ('heartwood'). Softwoods, generally trees with narrow or




Plate 5. Typical wood samples showing diversity of colour and grain. Clockwise from top left: burr ash, elm, burr walnut and European oak. 'Burrs' are usually caused by damage or an inclusion. Though they often reduce the strength of the wood, their decorative qualities are greatly prized in cabinet-making. *Courtesy of the Art Veneers Co. Ltd, Mildenhall.*

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needle-like leaves, have a large number of tracheids; hardwoods, usually broad-leaved, have far fewer, their role being taken by vessel- and fibre-cells.

Herbert Edlin, author of *What wood is that?* (1969), advocated a system of identification based on one proposed by Alfred Schwankel in *Welche holz is das?* (Franckh'sche Verlagshandlung, Stuttgart, *c*. 1959). Based almost entirely on observation, this was sub-divided as 1, primary colour (usually that of the sapwood); 2, secondary colour (usually of the heartwood); 3, rings; 4. pores; 5, grain on longitudinal surfaces; 6, rays; 7, relative hardness; 8, weight (specific gravity); 9, smell; 10, bark; 11, leaf shape; 12, country of origin; 13, sapwood definition; and 14, class of use. Though these arbiters look vague, they work surprisingly well when considered together. Groups 1 and 3–8 are sufficient to serve the purposes of *Marks of Industry*, largely as the bark and leaves will have been removed long before artefacts were made.

Edlin subdivided colour, group 1, into six deliberately vague categories: 'whitish'; 'yellowish'; 'purplish or crimson'; 'reddish or pinkish'; 'brownish'; and 'black or greyish'. Rings (group 3) were limited to 'distinct' or 'obscure'; pores (group 4) to 'absent' (all coniferous softwoods), 'in rings' or 'diffuse' (scattered). Grain (group 5) could be 'distinct', 'faint' or 'obscure or invisible'. Rays (group 6) were 'distinct' or 'obscure'. Hardness was simply 'soft' or 'hard'; and density was generally given as 'very light' (SG below 0·49), 'light' (SG 0·50–0·64), 'heavy' (SG 0·65–0·79) or 'very heavy' (SG above 0·80).

Unfortunately, a handicap to the identification of individual types of wood can be provided by the regularity with which the timber trade (particularly prior to 1945) has concocted spurious or misleading names, or grouped together trees with little or no botanical relationship under a general name.[5] The term 'cottonwood', for example, can embrace several North American trees, particularly *populus trichocarpa* ('black cottonwood') and *populus heterophylla* ('swamp cottonwood'). But it can also include the botanically unrelated Indian cottonwood *bombax malabaricum* and Nigerian cottonwood *ceiba pentandra*. As the Indian and Nigerian trees are also known as 'simul' and 'araba' respectively, and as the term 'cottonwood' has been applied indiscriminately to the tulip

5. Botanical names come in three parts: first the genus, or family to which the tree belongs; then the individual species, and lastly the name of the botanist responsible for the particular classification. Circassian Walnut, therefore, is '*Juglans regia*, Linnaeus' (or '[L.]'), as it was first classified by the Swede Carl Linnæus (1707–78).

TABLE ONE: CHARACTERISTICS OF SELECTED WOODS

Based on Herbert Edlin, *What wood is that?* (1969). The particular species are ash, *fraxinus excelsior*; beech, *fagus sylvatica*; birch, *betula alleghanensis*; bird's-eye maple, *acer saccharum*; bubinga, *guibortia demeusei*; Western Red cedar, *thuja plicata*; cherry, *prunus avium*; Douglas fir, *pseudotsuga menziesii*; ebony, *diospyros celebica*; elm, *ulmus procera*; lime, *tilia europaea*; Honduras mahogany, *swietenia macrophylla*; European oak, *quercus robor*; pearwood, *pyrus communis*; Brazilian rosewood, *dalbergia nigra*; sapele, *entandrophragma cylindicum*; sycamore [-maple], *acer pseudoplatanus*; teak, *tectona grandis*; Circassian walnut, *juglans regia*; and American or black walnut, *juglans nigra*. Values given for specific gravity ('SG') are for properly seasoned 'air-dried' timber; owing to variations in heartwood, however, SG can vary by up to ten per cent of these averages.

Name	Heartwood colour	Rings	Pores	Grain	Rays	Hardness	SG
Ash	whitish	distinct	in rings, coarse	distinct	obscure	hard	0·69
Beech	reddish/pinkish	obscure	diffuse, fine	faint	distinct	hard	0·67
Birch	yellowish	obscure	diffuse, fine	faint	distinct	hard	0·67
Bird's-eye maple	whitish[1]	distinct	diffuse, fine	distinct	distinct	very hard	0·69
Bubinga	purplish/crimson[2]	distinct	diffuse, fine	faint	distinct	hard	0·91
Cedar	reddish/pinkish[3]	distinct	absent	faint	obscure	soft	0·38
Cherry	brownish	distinct	diffuse, fine	distinct	distinct	hard	0·63
Douglas fir	reddish/pinkish[4]	distinct	absent	distinct	obscure	soft	0·50
Ebony	black/greyish[5]	obscure	diffuse, fine	obscure/invisible	obscure	very hard	1·08
Elm	brownish	distinct	diffuse, coarse/fine	distinct	distinct	soft	0·51
Lime	yellowish	obscure	diffuse, fine	obscure/invisible	obscure	soft	0·56
Mahogany	reddish/pinkish	obscure	diffuse, coarse	faint	distinct	soft	0.50
Oak	yellowish	distinct	in rings, coarse	distinct	distinct	hard	0·69
Pearwood	reddish/pinkish	obscure	diffuse, fine	obscure/invisible	obscure	hard	0.69
Rosewood	brownish[6]	distinct	diffuse, coarse	distinct	obscure	hard	0·88
Sapele	reddish/pinkish	distinct	diffuse, coarse	faint	obscure	hard	0·67
Sycamore	whitish	obscure	diffuse, fine	obscure/invisible	obscure	soft	0·56
Teak	brownish	distinct	in rings, coarse	faint	obscure	hard	0·65
Walnut (Circassian)	brownish[7]	distinct	diffuse, coarse	faint	distinct	hard	0·63
Walnut (American)	brownish[8]	distinct	diffuse, coarse	faint	obscure	hard	0·66

1: also has distinctive circles around small dark knots, gving a two-tone appearance. 2: has dark bands or mottling. 3: usually combines reddish or reddish-brown summerwood with yellow-brown springwood, giving a subdued bi-colour appearance. 4: bi-coloured, combining reddish-brown summerwood with notably contrasting yellowish-pink springwood. 5: may be jet-black, or black streaked with brown or greenish-grey. 6: may have patches of red-, gold- or violet-brown, with 'marbled' figuring. 7: has a lustrous appearance, brown or greyish-brown with streaks of dark-brown or dark grey. 8: may be chocolate-brown or even purplish, with infrequent light or dark-brown streaks.

poplar *liriodendron tulipifera* ('canary wood') and the cucumber tree or mountain magnolia (*magnolia acuminata*), the problems of identification become clear.

At least sixty woods have been sold under the trade-name 'mahogany', though only three genera are currently recognised as having reasonable claim to the name. Decorative pearwood has been cut from a variety of trees, including the European pear *pyrus communis* and the Chinese pear *pyrus sinensis*. But the group also includes the unrelated South African hard pear, *olinia cymosa*; the Tasmanian dogwood pear *pomaderris apetala*; and the West Australian native pear, *xylomelum occidentale*, rarely seen outside its native country, with wood of a lustrous deep-red colour and distinct rays. The wood of the close-grained white pear of Kenya and southern Africa, *apodytes dimidiata*, usually grey-brown with purplish streaking, despite a common association with furniture, has even been used locally to make the frames and bodies of wagons.

Ceramics. This group contains a variety of material derived largely from clay, including pottery, bricks and tiles. Artefacts are now generally classed as *earthenware* if fired at low temperature, or *stoneware* if fired at high temperature. Raising temperature reduces moisture content, providing a harder frost-proof material. Porcelain or 'porcelain stoneware' was made by mixing fine-quality clay with quartz, feldspar and special fluxes to provide exceptional resistance to wear, particularly when glazed.

The first bricks were made from mud in areas where permanence could be guaranteed by baking them in the sun. The earliest examples are thought to have been made in the Tigris region and in Anatolia prior to 7500 BCE, but it would soon have become clear that mud bricks were vulnerable to moisture; this confined them largely to arid areas. By 4500 BCE, however, the merits of firing pottery in an oven had been discovered—perhaps in the Indus valley, though the precise location is still disputed. Firing reduced moisture content, strengthening the clay internally and providing a tough external skin. It also encouraged the creation of bowls, jugs and containers.

By Roman times, bricks were being made in large numbers. Individual legions maintained portable kilns to facilitate the erection of permanent fortifications, and individual bricks often bore the marks of units responsible for their creation. The same was generally true of bricks made in China, which often displayed ideographs recording the name and date of birth of the firer.[6]

Bricks and tiles, made of much the same basic material, gained popularity in Europe in the fourteenth century. This was especially true of low-lying areas (e.g., the Baltic states or what is now the Netherlands) in which alluvial clays abounded but stone suitable for building was uncommon. Part of the attraction was fire-resistance, and a healthy industry was created.

Bricks were moulded by hand from a mixture of sand (silica) and clay (alumina), sometimes with the addition of iron oxide and lime. Makers' initials

6. This derived ultimately from an edict issued during the Q'ing dynasty (221–206 BCE) ordering weapons to be marked so that suppliers of inferior products could be identified and punished.

Plate 6, right. A selection of decorative tiles made in the nineteenth century by Craven Dunnill of Jackfield. The range of designs was limited largely by the skill of the artists, as production techniques ranging from simple two-colour 'clay and slip' to multi-colour transfer printing and relief modelling could be used. *By courtesy of the Jackfield Tile Museum.*

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or trademarks could be impressed either by incorporating them in the mould or by the use of dies before the bricks were fired. The precise chemical content, firing temperature and the atmosphere within the kiln controlled brick-colour: increasing the iron content produced a pink body, whereas more lime created yellow. Raising temperature converted pink to red, then dark red, purple and finally dark brown or grey.

The use of decorative tiles had a lengthy pedigree, and tin glaze had originated in what is now Iraq by the ninth century. Blue and white Delftware flourished in Holland from the sixteenth century, for about two hundred years, and the advent of a Brick Tax in Britain in 1784 gave popularity to so-called 'Mathematical Tiles', generally glazed, which were pinned to laths to simulate coursed brickwork. Increased several times, usually to pay for foreign wars, the tax was abandoned in 1850 when it began to hamstring industrial development.

Much more important industrially, however, was the rapid rise in demand for consumer goods in the mid-eighteenth century. Attempts had been made to re-create the fine-quality white porcelain imported from China, and, in 1710, a 'hard paste' version was perfected in the Meissen factory in Dresden. Experiments with a soft-paste form, begun in Rouen in the 1680s, ended with the creation of the commercially-successful Sèvres factory in 1756. An English Patent granted in 1749 to protect bone china was exploited by Josiah Spode, and the large-scale manufacture of 'creamware' was begun in the same period by Josiah Wedgwood. Wedgwood is also usually credited with the perfection of transfer printing, patented in England in 1756 by Sadler & Green of Liverpool.

The Gothic Revival of the early nineteenth century was the catalyst of true industrialisation: the introduction of machinery to undertake many of the tasks that had previously been undertaken manually. Though the so-called encaustic tiles—a Victorian term for heat-sealed inlaid decoration—sold in huge quantities by Maw & Co. or Craven Dunnill were usually made by hand, processing the raw material was helped by machinery. Decoration was improved by the introduction of metal blocks (usually zinc) to transfer multi-coloured images to tiles, a method introduced in 1848 by Collins & Reynolds, and the advent in 1863 of an efficient screw-press, patented by Boulton & Worthington of Stoke on Trent, facilitated the mass-production of so-called 'dust-pressed tiles'.

The introduction of steam-powered stamping machines allowed 25000 tiles to be made daily, and the output of the 'Broseley District' (the principal English manufacturing centre) has been estimated as 750,000 tiles weekly by the 1890s.

Markings are easily applied to ceramics. They can be impressed into the material before firing; painted, before or after firing or glazing; applied with transfers; or added in the form of a label. Most are readily visible—except those applied to the backs of tiles, which were obscured when cemented in place. The interpretation of some marks is obvious when used in the form of a name or a recognisable trademark; initials, monograms and cyphers may require additional research. Some manufacturers (e.g., Worcester) even hid the dates of manufacture in symbols or code, but these can usually be deciphered with the help of the specialist works listed in the Bibliography.

The history of glass stretches back into the third fourth millennium BCE. Most glass is now classified as 'soda-lime', as it contains 70–75 per cent of silicon dioxide, a substantial amout of sodium carbonate ('soda'), and calcium oxide ('lime'), magnesium oxide and aluminium oxide to reduce the glass-transition temperature—the point at which its becomes translucent—and enhance durability. Other forms of glass have been developed for apecial purposes, including the highly refractive lead-oxide glass, favoured for high-quality tableware, and heat-resistant borosilicate glass.

Though glass has been produced on an industrial scale since Roman times, greatly assisted by the development of plate-glass manufacture during the ninteenth century, very little of it has been marked; even the finest glasswork in mediaeval cathedrals rarely displays identifiers. However, notable exceptions must be made of 'art glass' of the type produced since the late nineteenth century by Lalique, Gallé or Tiffany, and modern 'stained' glass (often achieved by over-painting) which may bear the name of the artist.

Metals. Metalworking has had a lengthy pedigree, first with the most readily available materials (such as copper) and, later, once technology had advanced sufficiently, by exploiting new techniques of extraction. Yet identifying metals is fraught with unexpected hazards.

'Not earlier than' dates can sometimes be ascribed to individual artefacts on the basis of material, but the value of this is greatly compromised by the exploitation in prehistoric times of copper, lead, iron and tin—the 'historic metals'—and by the process of alloying copper and tin to produce bronze, which dated back before 2000 BCE.[7] Use of metals exploited only since 1700

7. Native copper (i.e., copper found in naturally pure state) was first worked in what is now western Iran sometime prior to 8700 BCE; copper smelting was being practised by 3500 BCE; and iron smelting by 1350 BCE.

can sometimes give a clue to the age of an item: aluminium, for example, was not isolated by the German chemist Friedrich Wohler (1800–82) until 1828 and was exploited commercially only from 1887.

Few metals have characteristic odours, excepting a few isolated instances evident only when the material has been heated. In addition, owing to the temperatures required to melt metals such as gold (1060° C) or iron (1525° C), analysis is neither simple nor entirely without danger. Identification by colour is usually only possible in the case of distinctive metals such as copper, as too many of the others are usually termed simply as 'grey', 'greyish', 'silver grey' or 'whitish grey'. Identification by weight is complicated by the way in which several of the principal metals and their alloys group together. Hardness is also difficult to assess, although the ductile materials such as copper, lead and tin are easily distinguished from zinc or iron.

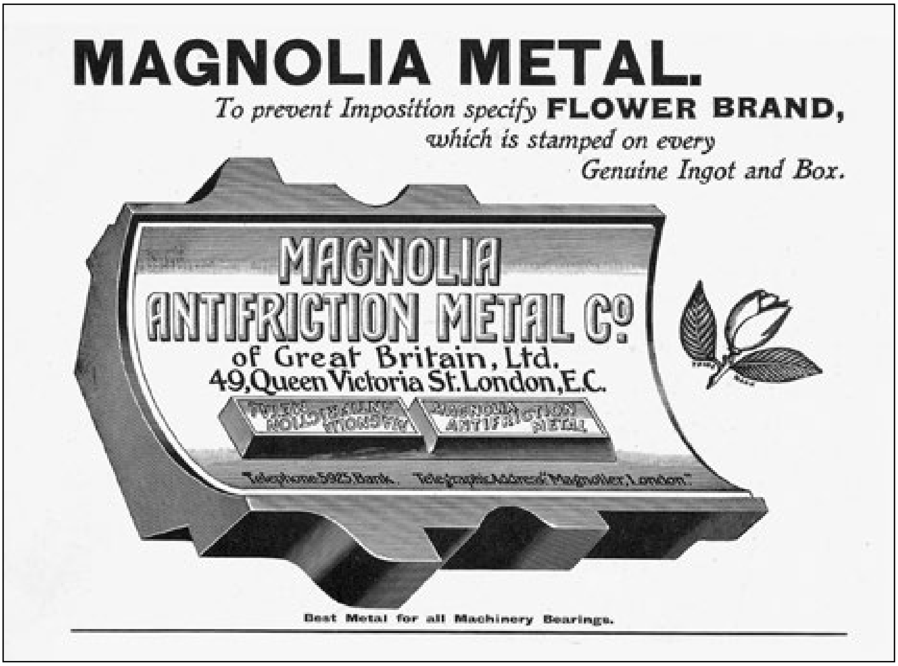
Specific gravity of metals ranges from 0·585 for lithium, which will float on petrol, to 22·48 for osmium. Analysis of this type can be useful if the metals are unusually light (aluminium or magnesium, for example) or particularly heavy (tungsten or gold). However, problems are posed by materials such as brass, a generic name given to alloys of copper and zinc. The proportions can vary from the two parts copper and one part zinc that together make 'common brass' (calculated SG 8·31): 'brazing brass', for example, contained about 87 per cent copper, 12 per cent zinc and 1 per cent lead (SG 8·62) and 'red brass' or 'steam metal' contained 87 per cent copper, 7 per cent tin, 3 per cent zinc and 3 per cent lead (SG 8·82). Both of these specialist alloys had a distinctively reddish hue, owing to the high percentage of copper.

Bronze, similar to brass (but usually harder), is basically an alloy of copper, zinc and tin, but the constituents can vary according to intended use. Gunmetal or 'soft bronze', widely used for cannon-founding and instrument-making, was usually 90 per cent copper and 10 per cent tin (SG 8·75); 'diamond bronze', hard but brittle, contained 88 per cent copper, 10 per cent aluminium and 2 per cent silicon (SG 8·15). But there are surprises such as 'Emerald brass', used for ornamental castings, which contained 50 per cent copper, 49 per cent zinc, and 1 per cent aluminium (SG 7·97); 'Cornish bronze', used as an anti-friction metal, which was usually about 78 per cent copper, 10 per cent tin and 12 per cent lead, with a trace of iron (SG 9·04); and 'Chinese bronze' or *shakudō*, often with a patina of stunning beauty, which was usually about 95 per cent copper alloyed with about 4 per cent of gold, a small amount of silver and often also an almost undetectable trace of lead (SG 9·34).

The so-called anti-friction metals represent another 'problem group'. The first of them originated in the nineteenth century, when the ever-increasing

Plate 7, left. These near-relic gun parts, including flintlocks, were part of a consignment found in Kathmandu. Their provenance is still unclear, but it is hoped that detailed metallurgical analysis will eventualy show if the locks were made in Nepal or shipped from Britain. *Courtesy of International Military Antiques, Inc., New Jersey, U.S.A.*

Plate 8, below. Placed in the British edition of *Cassier's Magazine* in August 1903, this advertisement extols the virtues of 'Magnolia Metal', a low-friction white-metal alloy developed specifically for use in bearings. Widely favoured for railway and marine-engine use, it contained 78 per cent of lead, 16 per cent of antimony and 6 per cent of tin.



work demanded of steam engines—and a steady increase in running speeds—led to overheated bearings, which were originally simple brass shells interposed between iron surfaces. The search for something better led to the misleadingly named 'white metals' (so-called because of colour): soft alloys which could withstand the dual threats of friction and pressure. Practise eventually showed that white-metal alloys could be used to line bearing-shells of brass or bronze, and that renewal could be undertaken simply by melting-out the residue of the worn liner and substituting a new one.

Unfortunately for today's analyst, inventors were eager to offer something better; and a search of patent or trademark registers reveals a huge variety

TABLE TWO: CHARACTERISTICS OF THE PRINCIPAL METALS

Name	Chemical Symbol	Date of discovery or exploitation	Specific Gravity	Melting point
Aluminium	Al	1828[1]	2·58	660° C
Chromium	Cr	1797[2]	7·14	1900° C
Copper	Cu	prior to 8700BC	8·92	1083° C
Gold	Au	in antiquity	19·3	1062° C
Iron	Fe	prior to 2850BC	7·86	1525° C
Lead	Pb	prior to 6400BC	11·35	327° C
Magnesium	Mg	1808[3]	1·74	651° C
Manganese	Mn	1774[4]	7·39	1220° C
Molydbenum	Mo	1781[5]	10·2	2625° C
Nickel	Ni	17th century[6]	8·9	1450° C
Platinum	Pt	*c.* 1750	21·45	1774° C
Silver	Ag	prior to 3500BC	10·5	960° C
Tin	Sn	prior to 2850BC	7·3[9]	232° C
Tungsten	W	1783[7]	19·1	3370° C
Zinc	Zn	1746[8]	7·12[9]	418° C

1: not exploited commercially until 1887. 2: first isolation of metal by Vauquelin. 3: date of preparation of the first impure sample by Davy. 4: date of preparation of first sample by Gahn. 5: date of first preparation by Hjelm. 6: the name was not applied until a sample of reasonably pure metal was prepared by Cronstedt in 1751. 7: date of first isolation of what is also known as 'Wolfram', by Elhuyar. 8: date of first preparation as pure metal by Marggraf, but known in India prior to the thirteenth century. 9: owing to purification difficulties, SG values of 5·8–7·3 and 6·8–7·2 have often been given for tin and zinc respectively.

of proprietary anti-friction alloys. Some were named for their originators, others to highlight perceived advantages, and a few to appeal to patriotic instincts. They included *Ajax Metal* (composition: 80·3 per cent copper, 12 per cent tin, 7·3 per cent lead, and 0·4 per cent arsenic or phosphorus to act as a hardener), *Babbitt's Metal* (66·7 per cent tin, 22·2 per cent antimony, and 11·1 per cent copper), *Bahnmetall* (98·7 per cent lead, 0·7 per cent calcium, 0·6 per cent sodium and a trace of lithium), *Dewrance's Metal* (44·4 per cent antimony, 33·3 per cent tin, 22·3 per cent copper), and *Stephenson's Alloy* (31 per cent iron, 31 per cent tin, 19 per cent copper, 19 per cent zinc).[8]

The constitution of even these five examples is so different that calculated specific gravities vary from 7·32 for Babbit's to 11·20 for Bahnmetall. Yet some of the most complicated anti-friction alloys are almost indistinguishable from their principal constituent, and attempts to identify them by deducing specific gravity can be difficult even in a well-equipped laboratory. Satco Metal, used in the twentieth century by the U.S. railroad industry, was a complex mixture of 98·05 per cent lead, 1 per cent tin, 0·5 per cent calcium, 0·25 per cent mercury, and about 0·05 per cent each of aluminium, lithium, magnesium and potassium. But the calculated specific gravity of Satco Metal (11·25) is too close to that of lead (11·35) to facilitate identification without careful measurement.

The development of the science of metallurgy in the eighteenth century also encouraged the production of ornamental metalwork. Alloying could facilitate fine-quality casting, or persuade onlookers that the items were made of silver or gold. Lustrous white *German Silver* or 'Nickel Silver'[9] was typically 58 per cent copper, 20 per cent nickel and 20 per cent zinc, with small amounts of cobalt, lead or iron. *Hamilton's metal*, a brass made by Hamilton & Parker from equal amounts of copper and zinc, could be polished to resemble gold; silver-white *Homburg's Alloy* (equal parts of bismuth, lead and tin) was used to cast medals; whilst *Minargent* (56 per cent copper, 40 per cent nickel, 3 per cent tungsten, 1 per cent aluminium) and Ruolz's Silver, *Argent de Ruolz*, patented in France in 1853 (typically 50 per cent copper, 35 per cent nickel, 20 per cent silver), were passable imitations of true silver.

And there was also *Fahun Brilliant*, an alloy of three parts lead to two of tin, which was used to make theatrical 'jewellery'; the harshness of the limelight or arc-lighting used in the nineteenth century reflected from faceted castings to give diamond-like lustre.

Pewter is another comparatively common alloy, with origins in pre-history but first standardised in twelfth-century France. In England, the Worshipful Company of Pewterers of the City of London, a trade first regulated in 1348, controlled production in three grades: 'fine metal' (99 per cent tin, 1 per cent copper), 'trifling metal' (95 per cent copper, 4 per cent lead, 1 per cent copper) and the later 'ley metal' (85 per cent tin, 15 per cent lead). These grades are difficult to distinguish, though the specific gravity of ley metal is substantially greater and the material generally tarnishes to a darker grey than the others. Concerns about health ensure that modern pewter no longer contains lead.

8. Babbitt's Metal, dating from 1839 and named after engineer Isaac Babbitt (1799–1862) of Taunton, Massachusetts, was the oldest of the 'white metals'. The precise constitution of the original bearings are not known, but is widely considered to have been about 93 per cent tin with 3.5 per cent each of antimony and copper. The analysis given here is taken from *A Dictionary of Metals and their Alloys* (1940). 'Bahnmetall' was introduced for the German railways (*Eisenbahnen*) during the First World War, principally to conserve supplies of copper and tin. Used to line axleboxes, it proved to be surprisingly successful. Dewrance's Metal was named after the English railway engineer John Dewrance (1803–61), and was also used to line axleboxes.

9. Nickel silver was known to the Chinese prior to the Q'ing dynasty, travelling first to the East Indies and then to Euope as 'paktong'. A broadly comparable alloy was produced in Suhl in the 1770s, and a competition was organised in Germany in 1823 to perfect an alloy which could duplicate the appearance of silver. This was achieved simultaneously in the mid 1820s by Gebr. Henningen in Berlin and Ernst-August Geitner in Schneeberg. The material was known generically as 'alpaca' or 'alpaka' in German, largely owing to the registry of a trademark by what ultimately became Berndorffer Metallwarenfabrik. The commercial introduction of electroplating in the 1840s greatly increased the demand for nickel silver, owing to its lustre and durability.

Identification of metals can also be complicated by over-plating. The idea of reducing costs by placing a thin skin of a noble metal over base-metal was old, deriving from long-established use of inlays and encrustation, but was not exploited industrially until the development in England in the early 1740s of 'Old Sheffield Plate' by cutler Thomas Boulsover (1705–88). The novelty lay in the way in which a silver veneer was bonded to a plate of copper, brass or comparable base-metal (Britannia metal, an inexpensive alloy typically comprising 93 per cent tin, 5 per cent antimony and 2 per cent copper, eventually became a popular substrate). The edges of the silver veneer, once sealed to the base-plate with solder, were subsequently laced with iron wire sealed with borax paste. The plates were sweated together in a furnace, then hammered or rolled to the requisite thickness after they had cooled.

Boulsover's Sheffield Plate was originally single-sided, but a double-sided 'sandwich' version had been introduced commercially by 1780. The material was exceptionally successful, as it allied many of the decorative qualities of silver with far less expense. Engraving ornamental designs into Old Sheffield Plate posed problems, however, as copper was exposed if the cut went too deep. German Silver proved to be a popular base-plate from the 1830s onward, as a silver tone still showed if the plating wore down or was cut through during engraving. Edges and joints between two single-side copper base-plates were originally burnished and tinned, but were generally covered with strips of soldered silver wire after 1785. 'Close Plate', which attached silver indirectly to iron,[10] allowed cutlery to be made to 'take an edge'; this was not possible with Boulsover-type plate, as the base metal was far too soft.

Old Sheffield Plate enjoyed widespread popularity until the advent of electro-plating, which was devised in England in the late 1830s by a surgeon, John Wright, and then patented in 1840 by George & Henry Elkington of Birmingham.[11] The process allowed surprisingly pure metal to be deposited on a suitably conductive surface, allowing decorative base-metal castings to be plated with gold, silver, nickel or chromium. The ease with which this could be achieved sent the Sheffield Plate industry into terminal decline, even though Plate, which acquired a work-hardened surface during manufacture, was much more durable than comparatively soft electro-plated equivalents.

10. The process had been known for hundreds of years, but was not exploited commercially until the end of the eighteenth century. The lack of an affinity of silver for iron or steel was overcome by bonding molten tin to the face of the base-plate and then pressing silver foil into the surface of the tin before it had solidified. Close Plate was an effective way of proving a durable edge, but wear could expose a three-colour band.

11. Electro-deposition had been demonstrated as early as 1805 by the Italian chemist Luigi Brugnatelli, but the commercial possibilities only became evident when Wright discovered that gold and silver could be deposited with the assistance of an electrolyte of potassium cyanide.

Electro-deposition compromised the traditional method of plating iron sheets with tin, 'hot dipping', which dated back at least to sixteenth-century Bohemia and had been improved by the introduction in England of rolled-iron sheets in the late seventeenth century. In addition, it also brought 'fire gilding' to an end. This had relied on a paste-like amalgam of mercury and powdered gold, applied to the surface of an artefact. Applying heat then drove off the mercury to leave the gold behind. Quality was outstanding, but the mercury vapour was so poisonous that the life expectancy of the gilders was very short.

The strength and resilience of metal goods suits them to permanent methods of marking. These can range from marks incorporated into castings, impressed or in relief, to those applied by punching, scribing, rolling or engraving. Alternatively, separate plates—themselves often made of metal—can be attached by screws, bolts, solder or adhesives. Most British-made electro-plate work can be distinguished by marks such as EP ('Electro Plate'), EPNS ('Electroplated Nickel Silver') or EPBM ('Electroplated Britannia Metal'), though the metalsmiths often did their best to make them as similar as possible to traditional silver hallmarks.

Plastics. The pedigree of this group dates back to the work of the English metallurgist Alexander Parkes (1813–90) and a British Patent granted to him in 1856. 'Parkesine' was made by treating cellulose with nitric acid, creating cellulose nitrate to be mixed with camphor, dissolved in alcohol and hardened into an elastic material. This was then melted, coloured with suitable pigments, and poured into a mould to harden as it cooled.

Successfully exhibited in the 1862 Great International Exhibition, where it was awarded a bronze medal, Parkesine proved to be a financial disaster. Two ill-fated attempts were made to exploit the material commercially: one by the Parkesine Company in Hackney Wick, and another by "Daniel Spills' Ivoride Works" in Homerton, north London. Not only was Parkesine very expensive to make, but quality was too poor to convince sceptics of its merits.

The first commercially successful synthetic material is generally accepted to have been celluloid (a brand name adopted in 1872). This was introduced near-simultaneously in 1869 in Britain and the U.S.A., where John Wesley Hyatt (1837–1920) is regarded as the inventor. Hyatt had acquired rights to the Parkes patent with the intention of making billiard balls of something other than ivory, which was becoming increasingly difficult to obtain. On 6th April 1869, John Hyatt obtained U.S. Patent 50359 for a method of coating balls with a mixture of cloth, ivory dust, shellac and collodion, and promptly formed the Albany Dental Plate Company in Albany, New York, to make billiard balls,

Plate 9. Synthetic material can come in a variety of textures, colours and types. These samples have been cut into small sizes to facilitate analysis. *From* The World of Plastics *(British Plastics Federation publication, 1986).*

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piano keys and false teeth. In 1870, John and Isaiah Hyatt patented a 'horn-like' material made from cellulose nitrate and camphor.

Parkes and his collaborator Daniel Spills had already made use of camphor in the production of Xylonite (1869), but the Hyatts were the first to realise the value of camphor as a plasticiser.[12] The billiard-ball project was exceptionally successful, even though celluloid was flammable and the balls were prone to explode; ease of moulding allowed complicated shapes to be made, especially decorative handles for cutlery and razors. Hyatt even patented the essence of an injection-moulding process in 1872, but almost a half-century was to elapse before suitable machines could be perfected.[13]

The earliest plastics were derived from natural materials: casein, a protein found in milk, and cellulose from wood or cotton. Initially, there was no scientific understanding of the processes involved in their creation, merely a series of trial-and-error steps. That celluloid was such a great success was largely due to the ease with which it could be moulded.

By 1900, however, the first steps were being taken towards the creation of an entirely synthetic plastic. Leo Baekeland (1863–1944), a Belgian chemist, had begun development of the phenolic resin that was to become Bakelite; a casein-based 'artificial horn' had been introduced commercially in Germany in 1904, and Friedrich Kipping had discovered silicone. The Viscoloid Company of Leominster, Massachusetts, soon began to make plastic hair-combs, and Eastman Kodak abandoned the flat-table method of cinematic-film production in favour of a 'wheel' which could make continuous rolls.

Most of the solid 'plastic' artefacts made prior to the Second World War were Bakelite, a phenol-formaldehyde perfected in 1907 (the grant of a patent was delayed until 1908) and first moulded by the Boonton Rubber Company of Yonkers in 1909. By the time the First World War began in 1914, cellophane had also appeared. Production improved with the advent of a compression press (1916) and the first effectual injection-moulding machine (1921).

12. Daniel Spills resorted to litigation to have the Hyatt patents revoked, on the grounds that he had a preceding claim to novelty. The first ruling found in Spills' favour, but Hyatt appealed to higher authority and the case, which had begun in 1877, was not concluded in 1884—when the judge found that Parkes had been the first to describe the use of camphor in the manufacturing progress. Consequently, neither Spills nor Hyatt could be victors; and both were allowed to continue their manufacturing activities.

13. See U.S. Patent 133229 of 10th November 1872, granted to 'I. Smith Hyatt and John W. Hyatt, of Albany, New York, Assignors to the Celluloid Manufacturing Company, of Same Place', to protect 'Improvements in Processes and Apparatus for Manufacturing Pyroxyline'.

Plate 10

This 'McInnes-Dobbie' engine indicator, no. D-480, dates from the very early 1900s. The insulating sleeves on the body-barrel and the union (or 'connecting nut') are sometimes catalogued as bakelite…but the indicator was made several years before bakelite was marketed commercially. Patent specifications confirm that the material is actually 'vulcanite' (ebonite), a horn-like substance made by heating rubber with approximately half its weight in sulphur.

Canadian Museum of Making collection.

The German chemist Hermann Staudinger (1881–1965) finally made sense of the chemistry of synthetic plastics by proposing the existence of a basic building block in the form of a 'macromolecule', an elongated repetitive chain ('polymer') of individual molecules ('monomers'). His theory was mocked at the time it appeared, but slowly gained acceptance. The award of a Nobel prize to Staudinger in 1953 was the ultimate validation of his ideas.

Many techniques have been used to make synthetic materials, including extrusion, injection moulding, casting and thermo-forming. Markings have often been applied during moulding, when they are simply part of a die and may be incised or raised at will; some artefacts have separate mark-plates held by screws or simply glued in place.

But it is often the type of material that assists identification, if only by providing the earliest date on which the item could have been made. The earliest celluloid items date from 1870 (disregarding those made of Parkesine); the first Bakelite artefacts date from 1909; polystyrene appeared commercially in Germany in 1930, followed by polyvinylchloride (PVC) in Germany in 1938, polytetrafluoroethylene (PTFE) in the U.S.A. in 1941, Cycolac (an ABS plastic) in the U.S.A. in 1957, and polypropylene (PP) in Italy in 1963.

The brand-name 'Nylon' was adopted by DuPont in October 1938 for a synthetic fibre previously known as 'Polymer 66'; and on 15th May 1940, 'Nylon Day', the first nylon stockings were sold commercially. This was a major landmark in the popularisation of synthetic material.

The application of heat to plastics provides a useful identification technique, as thermoplastic material will melt whereas thermosetting compounds cannot. Clues will also be evident in the way in which a small sample can be cut. If the sample disintegrates into coarse powder, it is likely to be a thermoset; a one-piece sliver will usually reveal a thermoplastic.

Owing to the considerable difficulties involved in visual identification, particularly when artificial colours have been used, carefully burning a small sample can be the easiest means of identifying plastics. For example, moulded phenol-formaldehyde (PF, 'Bakelite') and PTFE do not burn; neoprene burns with a sooty yellowish-orange flame, extinguished when removed from the igniter-flame, and leaves a black residue; polythene burns slowly with a yellow-tipped blue flame, continues to burn after the igniter-flame has been extinguished, then drips like sealing wax. In addition, the odours are characteristic: phenol-formaldhyde smells of carbolic soap, neoprene has an astringent burnt-rubber smell, and polythene reeks of paraffin.

MANUFACTURERS' PLATES

The advent of these is difficult to date with certainty, as few of the earliest machines bore details other than (perhaps) names carved into woodwork or cast into frames in acknowledgement of their origins. Only with the advent of series production did the need to individually identify large numbers of similar products arise.

Many of the first English railways—e.g., the Stockton & Darlington, Liverpool & Manchester or London & Birmingham—gave names or running numbers to their locomotives and rolling stock, necessary to keep track of progress. The 0–4–0 locomotive *Liverpool*, built for the London & Birmingham Railway by Edward Bury in 1830, bore an oval brass plate engraved with a large cursive 'No. 1', placed centrally, with the name of the railway company in smaller Roman lettering around the periphery.

A major catalyst in the development of makers' plates was clearly the ordering of large classes of similar locomotives from several manufacturers simultaneously, but it is equally clear that the parts of these machines were rarely exchangeable even among engines of the same make. Railway administrators keen to facilitate maintenance needed, if interchangeability of parts could not be guaranteed, to know the origins of a particular machine just as much as they needed to know its running number.

In an era in which purchases of locomotives in ones and twos were commonplace, the acquisition in 1840–2 by Great Western Railway of more than sixty representatives of the 2–2–2 'Fire Fly' class represented a great leap of faith. Six engines were the work of Jones, Turner & Evans of Newton-le-Willows; ten came from Sharp, Roberts & Company of Manchester; twenty from Fenton, Murray & Jackson of Leeds; two from G. & J. Rennie of Blackfriars, London; six from R.B. Longridge of the Bedlington Ironworks; two from Stothert & Slaughter of Bristol; sixteen from Nasmyth, Gaskell & Company of Manchester. None of them were built to precisely the same design; details varied appreciably, and virtually nothing would interchange. Problems multiplied as soon as carriages and wagons had been introduced to service in hundreds rather than handfuls.

Plate 11. This was applied to a compound beam engine installed in an English pumping station by James Watt & Company, successors to Boulton & Watt. By this time, the once-eminent company was finding competition hard to resist.

Owing to the absence of early photographs and the low survival of pre-1850 rolling stock, irrefutable documentary evidence for the pioneering introduction of railway-type manufacturers' plates is hard to find. Reliance has instead to be placed on secondary sources, such as the line drawings and three-dimensional views that filled the pages not only of the early textbooks, such as Daniel Kinnear Clark's *Railway Machinery* (1855), but also of the engineering Press. Many of these engravings were brilliantly executed, particularly those that dated from the 'Golden Era', *c*. 1870–1910, but care may be needed to sift fact from fiction. Details that had never appeared on the items themselves could easily be added to a printing block, even manufacturers' marks,[1] and the blocks could be used and re-used for many years. Yet it is obvious that a few enterprising manufacturers were identifying their wares prior to 1840.

The Dundee & Newtyle Railway 0–4–2 locomotive *Earl of Airlie*, if an engraving published in *The Engineer* is to be trusted, bore a plate marked 'J. & C. CARMICHAEL', '1833' and 'DUNDEE' on the right side of the frame behind the bell-crank drive lever. *North Star*, built for export to the New Orleans Railway by Robert Stephenson & Company of Newcastle upon Tyne, but delivered to

1. This often occurred with a change of company ownership, when the new regime, seeking to save money, altered the original printing blocks to show another name. The changes are usually easy to detect.

the Great Western Railway in November 1837, still bore a small oval maker's plate on the right side of the frame above the driving-axle box when withdrawn in 1871.[2] And there are many other pre-1840 references. For example, *The Engineer* reproduced a drawing of a 2–2–2 made in the late 1830s, with a small rectangular plate on the left side of the frame, above the driving-axle box, which read 'NO. 245', 'R. & W.', and 'HAWTHORN' in three lines. A 2–4–0 made in 1848 for the Leeds & Thirsk Railway had a decorative elongated plate marked 'MANF[D].' above 'KITSON, THOMPSON & HEWITSON' and 'LEEDS'.

Another interesting locomotive, a 4–2–0 built for the Maryport & Carlisle Railway in 1848, bore small brass plates on the driving-wheel splashers in the form of curvilinear rectangles with semi-circular indents at the corners. The legend read "CRAMPTON'S PATENT", acknowledging the work of Thomas Russell Crampton (1816–88), above 'MANUFACTURED BY', the name of the makers 'TULK & LEY', the factory name 'LOWCA WORKS', and the location of the factory in the Cumbrian town of 'WHITEHAVEN'.

2. The eleven locomotives of the 'Star' class that followed *North Star* in 1839–41 differed in detail. However, all of them seem to have borne rectangular maker's plates instead of the original oval pattern.

Plate 12. A manufacturer's plate applied to a feed-water pump installed in the Goldstone Pumping Station, Hove, England, in 1875.

Plate 13, *left*. Marks on a pressure gauge attached to a horse-drawn fire engine made in the 1880s by the English company Shand & Mason. These gauges, despite their markings, were acquired from specialist suppliers—principally Schaeffer & Budenberg of Manchester.
Plate 14, *right*. This elaborate cast-brass plate was taken from a tub-type washing machine patented by Englishman William Kent in the 1860s. Note the suggestion of the Royal Arms in the design, owing to the presence of the lion and unicorn.

By then converted from 2–2–2 to 2–2–2T, *Vulcan* was photographed in the mid 1850s with a prominent rectangular plate on the right side of the frame ahead of the driving-axle box; this bore the name of Charles Tayleur & Company of the Vulcan Foundry, Newton-le-Willows, suppliers of the locomotive to the Great Western Railway in 1837.

Many of the GWR 'Fire Fly' class of 1840–2 also survived to be photographed, and there is no doubt that they bore maker's plates. *Centaur*, an 1841-vintage product of Nasmyth, Gaskell & Company, had a small oval plate on the right side of the frame underneath each end of the driving-wheel splasher. And the wreck of *Leopard* (1840), pictured immediately after the boiler exploded in Bristol in 1857, clearly displays two small oval plates on the right side of the frame—one ahead of the driving axle indicating GWR ownership and the other, behind the axle, recording the manufacturer to have been Sharp, Roberts & Company of Manchester.

Another 'Fire Fly', *Argus*, delivered to the GWR from Fenton, Murray & Jackson of Leeds in August 1842, was photographed in the same period with an oval 'G W R' plate on the right side of the frame above the leading axle-box and a slender rectangular maker's plate held to the frame immediately above the trailing axle-box by four bolts.

NATIONAL CHARACTERISTICS

British plates had resolved into traditional oval or rectangular shapes by the 1850s, though idiosyncratic survivors were still to be found at the end of the nineteenth century. The London & North Western Railway usually cast information into the brass beading of the splashers, a typical example on an Allan 2–4–0 giving the location of the works—'CREWE'—between 'L. & N.W. RLY. CO.' and 'AUG^{T}. 71' for the date of completion, August 1871.[3]

The locomotives built in the U.S.A. were often marked differently from their British equivalents. Prior to the American Civil War (1861–5), decoration was applied in a climate of riotous anarchy. Individual machines were given gaudy paintwork, complicated lining, great areas of polished brass, and could even bear polychrome illustrations of the founder of the railroad or the land traversed by the track!

Typical was 4–4–0 *Phantom* built in 1857 'for the account' (as a commercial speculation) of William Mason & Company of Taunton, Massachusetts. Mason is renowned for some of the most elegant of the locomotives to run in the U.S.A. prior to 1860, often eschewing the wagon-top boilers favoured by most other American manufacturers; however, even *Phantom* retained the decorative casting between the driving wheels, with 'WM. MASON & CO.' above an oval plate bearing the details of manufacture—'TAUNTON', '1857' and 'MASS.' for the State of Massachusetts.[4]

A similar 4–4–0 made by the Rogers Locomotive & Machine Works of Paterson, New Jersey, bore its maker's marks on an elaborately decorated circular plate between the driving wheels, the two central lines of the inscription curving around an ampersand. The cylinder blocks of the Rogers machine also displayed 'R.L. & M.W.', typical of many US-made locomotives.

The American Civil War not only inflicted great damage on the people of the U.S.A. but also greatly upset the national economy, especially in the ravaged lands south of the Mason–Dixon line. Post-war railroad locomotives reflected this trend, as all the sinuous curves and glitter of pre-1865 days gave way to the austerity of straight lines and ultra-plain finish. However, makers' names still appeared on the cylinder blocks, often in abbreviated form, and a move began

3. See Daniel Kinnear Clark, *Railway Machinery*... (1855), Plate XXI.

4 . See Daniel Kinnear Clark and Zerah Colburn, *Recent Practice in the Locomotive Engine*... (1870 edition), plate XLVII.

Plate 15. The elegant 4–2–2 'Spinners' of the Midland Railway were designed by Samuel Johnson. This particular example was built in Derby Works in 1893 and is marked appropriately on the wing plate beneath the smokebox saddle. The Midland Railway Arms on the cab sheet and the number '663' show that the photograph was taken after 1907, as the locomotive was originally '182'. *From a pre-1914 photograph in the author's collection.*

towards small circular plates on the smoke-box sides. A 'camelback' 2–8–0 made for the Philadelphia & Reading Rail Road had a plate marked 'BALDWIN LOCOMOTIVE WORKS' and 'PHILADELPHIA' around its periphery; 'BURNHAM' above 'PARRY' above 'WILLIAMS & C^{O}.' in the centre, above the maker's number 'NO. 4935'; and the date '1880'. A more modern 4–4–0, built for the Illinois Central Railroad by Brooks, had a circular smokebox-side plate bearing 'BROOKS LOCOMOTIVE WORKS' and 'DUNKIRK. N.Y.' around 'BUILDERS' above 'NO. 2716' and '1896'. The word 'BROOKS' was also cast integrally into the cylinder block.

European manufacturers used a variety of plates, often, but not invariably placed on the cab sheets. Rectangular designs were the most popular—oval examples are, surprisingly, very rare—though the sinuous curves of the Art Nouveau movement had an effect on design at the end of the nineteenth century, particularly in Germany. Typical of the older generation of marks was applied to 2–4–0 *Wetzlar*, built for the Württemberg State Railway, which bore an unusually large rectangular plate, riveted to the casing of the steam dome, marked No. 1488 above 'MASCHINENFABRIK ESSLINGEN/EMIL KESSLER' (split into two lines by a short horizontal divider) and the date '1875'.

PLATE CONSTRUCTION

Many of the earliest manufacturers' plates bore information which was either cast in relief or engraved into the surface by hand or pantograph. This asked much of the skill of pattern maker or engraver, but lettering often existed as pre-cut or pre-cast blocks and alternative methods of supplying information may be found.

Etching became commonplace in the twentieth century, as it was not only cheaper than engraving (being much less labour-intensive) but also capable of handling complex designs with ease. The process usually began with the application of a coat of wax, then the design was scribed into the wax and the plate was immersed in an acid bath; the acid ate away the unprotected metal, the wax was cleaned to reveal the design, and the acid-cut lines (which were rough bottomed) were filled with pitch-like paint. Exposure through photographic negatives onto a coated plate eventually replaced hand scribing, but the results were very similar. Light-gauge aluminium can be chemically blacked and then 'eaten through' by acid to leave a negative image.

Other manufacturers' marks may be cast integrally with major components, typically machine-beds or casings. However, though they may often include a date, serial numbers are normally absent; number-groups, assuming they are not dates, are more likely to refer to the 'pattern number'—identifying either the category of the machine or an individual casting pattern to guide replacement.

Integrally-cast marks may be accompanied by a wealth of other detail. For example, an electric motor made at the end of the nineteenth century bears the marks of its manufacturer, 'EASTON ANDERSON & GOOLDEN L^D', cast into both edges of the casing, together with '4½' (horsepower) and 'LONDON & ERITH' above '1898' on both ends. However, this particular machine also displays a cast plate noting that it had been rebuilt in September 1901 by Rosling, Appleby & Fynn, 'Electrical Engineers' of Bradford, in accordance with Fynn's Patents 13532 and 25307.

A third plate gives side-headings 'NO.', 'VOLTS', 'AMPS' and 'REVS', the individual positions being filled with '9493', '230–115', '20' and '1600–800' respectively. These show that the machine had been designed to run on two differing voltages (230v and 115v) and at two different speeds (1600rpm and 800rpm). Taken together, the marks give a surprising amount of information about this particular motor, though the patents are not accompanied—as they could have been—with their year-date.

Simple marks could be stamped, either letter-by-letter, painstakingly, or in a single strike; alternatively, they could be rolled into the surface in one pass

Plate 16. A sturdy 'Triplex' (triple throw) marine feed-water pump by Tangye Ltd of Birmingham, England. Note how the manufacturer's name has been cast into the frame and the valve-chest covers. A small etched-brass plate gives dimensions and other salient details. *Museum of Making collection*

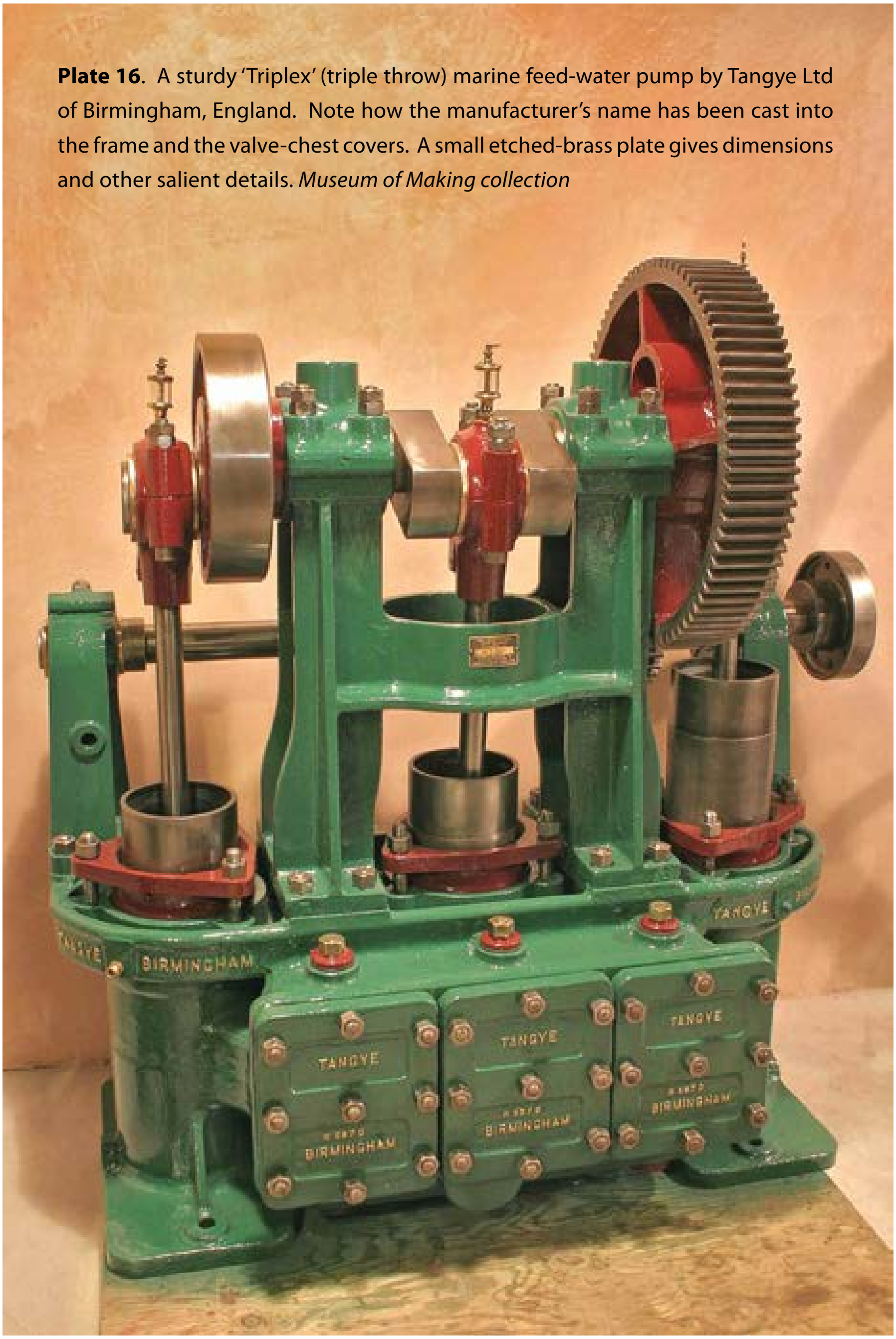

Plate 17. This historically significant plate was recovered with the wreck of *Holland No. 1*, the first submarine to serve the Royal Navy. Though the power-plant has often been identified as a Wolseley petrol engine, the plate confirms that an American-made Otto gas engine was being used at the time of loss (1913). *By courtesy of Ian M. Clark.*

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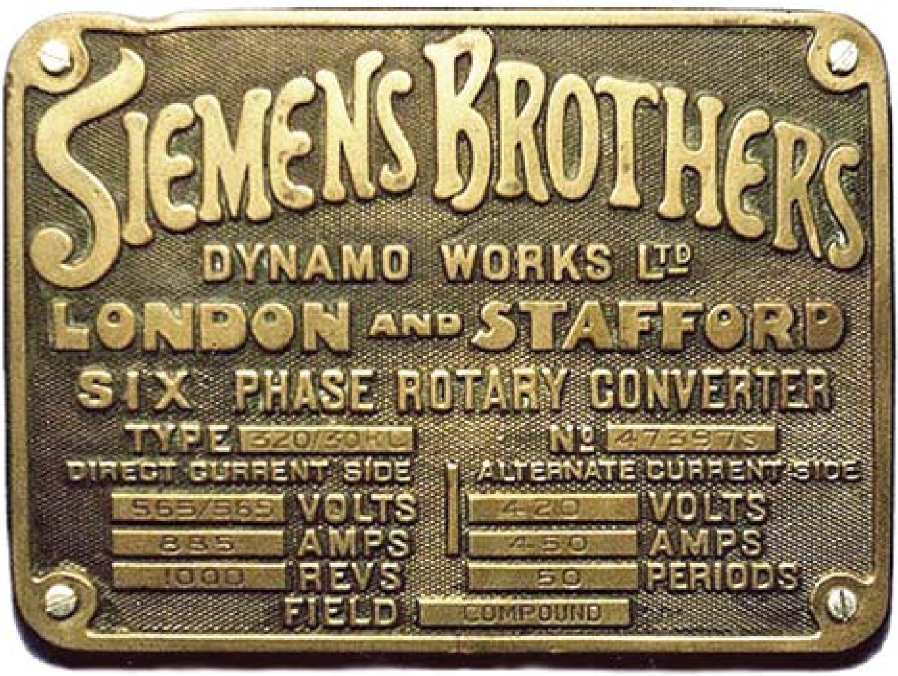
or embodied in castings. Unfortunately for the researcher, manufacturers' markings of these types can be difficult to distinguish from those applied by retailers, distributors and individuals. Etched maker's marks have been particularly favoured for cutlery, bladed tools and razor blades, and the aluminium-sheet plates that have been applied to electrical equipment or aero-engine components: any application, indeed, where the strength of a thin metal plate or blade can be compromised by stamping. And the etching process, as explained previously, not only allows surprisingly complex marks to be used, but also facilitates series production of plate-blanks.

Plates may be made of plastic; others have been printed on tin or tin-foil; and a few have even been manufactured from paper or card, as durability can be more of a handicap than an asset. Many manufacturers have chosen to use less permanent identifiers than metal plates, and though doubtless often most true of parsimonious and cost-conscious agencies, this sometimes reflects nothing more sinister than a keen interest in marketing. The ease with which elaborate colour schemes could be used had an obvious appeal. Typical of this approach could be seen in the gas- and oil-engines that rapidly attained popularity at the end of the nineteenth century. These were initially promoted conventionally, and were invariably marked accordingly. A water-cooled Crossley oil engine, dating from the early 1900s, for example, has ‘CROSSLEY • BROS, LIMITED’ and ‘MANCHESTER’ cast into its base; a large oval plate on the rear of the casing, with ‘CROSSLEY BROS. LIMTD’ and ‘MANCHESTER’ curving around the periphery above the central ‘CROSSLEYS’ and ‘PATENTS’ in two lines.

A small oval plate marked ‘J.B.’ lies on the front side of the cylinder, which is fitted with a Longuemare carburettor supplied from France and a German-made low-tension oscillating magneto marked ‘UNTERBERG-HELME’ and ‘DRGM 200987’. The serial number ‘55792’ appears on top of the cylinder casing and on the connecting rod above the crankshaft bearing. The marking ‘DRGM’ refers to a German design number or *Deutsches Reichs Gebrauchs Muster* (q.v.), showing that the magneto had been registered in Germany in 1903.[5] The accompanying four-pole dynamo displays a plate identifying its manufacturer

5. Marks of this class did not always extend protection to Britain, France or the USA, and it could sometimes be necessary also to seek additional protection in specific countries. As this involved fees, many smaller manufacturers never bothered to do so.

Plate 18. A plate from a Siemens rotary converter, dating from about 1900. Note the blank panels into which the details of the individual apparatus have been struck. *Electricity Museum collection, Christchurch, Dorset.*



as the 'ELECTROMOTOR & DYNAMO COMPANY, LONDON, W.C.', together with details in two lines of part-cast, part hand-punched lettering: 'TYPE 2, NO. [blank]', and 'AMP. 25, VOLT. 100, REV. 1200, and H.P. [blank]'.

The market soon became extremely competitive and some engines, though often given small metallic information plates, also displayed their makers' names in large painted letters; others relied on transfers, and a few had designs printed onto the thin metal-plate of fuel or coolant tanks.[6] None of these finishes were especially durable, and could easily be covered by repainting. However, though printing, painting, silk screening and transfers were essentially flat, they still had a measurable thickness unless carefully removed before refinishing. Painted lettering and the outline of individual transfers, therefore, may be detectable beneath new finishes.

Colourful transfers, once popular on stationary gas- and oil-engines, bicycles and motorcycles, can still be obtained largely as a result of the enthusiasm of individual restorers. They can acknowledge little more than a brand name and the manufacturer, such as a cursive 'The Lister Junior' above 'MANUFACTURED BY R.A. LISTER & CO. LTD. DURSLEY, ENGLAND' in three lines, but some of the marks applied by Bamfords included 'BAMFORDS LIMITED', with the looped lower bowl of 'B' forming the tail of 'S', above the Royal Arms and the legends (each in two lines) 'AGRICULTURAL ENGINEERS' and 'TO HIS MAJESTY KING GEORGE V'. Transfers applied to the Blackstone Oil Engine usually included patent details that were absent from many other designs.

A printed aluminium plate, attached to a hydraulic pump, bears the name of the maker—Plessey Dynamics and a circular logo—together with 'SWINDON ENGLAND, HYDRAULIC PUMP'; two boxes labelled 'TYPE' and 'SER. NO.'; and two lines of patent information in lettering too small to have been applied by stamping. The details are all white on a black field, which is characteristic of etched or printed marks. The patent numbers range from 572967 to 815504, granted in 1945 and 1959 respectively, and pattern numbers, e.g., '567-3-00024', are cast into the body components.

Lettering styles may give a clue to date, but founders were notoriously conservative and could use 'master letters' of the most popular styles for decade after decade. *Marks of the Printer*, to be produced in series with this book, gives additional details.

6. The process of printing on tin, patented in 1875 by Robert Barclay, was first applied to containers for Bryant & May matches.

EVIDENCE OF LANGUAGE

The language in which a mark has been phrased is often a most important clue to identification, but the task may be complicated by the unfamiliar style of the lettering. Conventional ('Latin') type is most commonly encountered in the English-speaking world, of course, but many other ('non-Latin') forms will be found. These include Arabic, Chinese, Cyrillic, Bengali and Siamese. Only rarely can these be read by the investigator, though, often with surprising ease, their origins can be identified from the characteristic letter forms. Some systems—such as Arabic or Chinese—also have unique numbering systems.

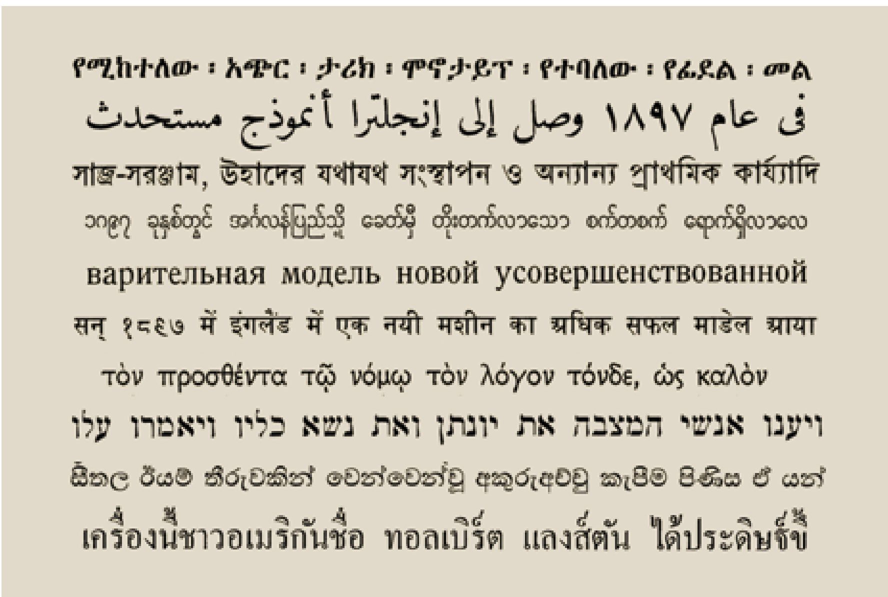


Plate 19. These 'non-latin' fonts give a hint of the complexity and unfamiliarity that can hinder interpretation. Top to bottom—Amharic; Arabic; Bengali; Burmese; Cyrillic; Devanagari; Greek; Hebrew; Sinhalese; Thai. From *Specimen Book of 'Monotype' Non-Latin Faces*, c. 1972

Classifying alphabets is so contentious that several differing taxonomies have been offered, though it is generally agreed that there are two major categories: Semitic and Chinese—respectively phonographic (based on sound) and logographic (derived from pictures).[1] The Semitic group is now customarily divided into four classes: Canaanite, Aramaic, South Semitic and Greek. Aramaic has provided the basis for modern Hebrew, Arabic and virtually all modern Indian alphabets; South Semitic survives in the form of Amharic; and Greek has, by way of Etruscan and Roman Latin, provided the basis for almost all European alphabets—including Cyrillic and perhaps also Runic, though the origins of the latter are still argued.

This classification may seem to be very simple, but identification is complicated by detail. Arabic, essentially a cursive alphabet, may take many forms; the multitude of Indian scripts may seem indistinguishable to the untrained eye; individual variants of Cyrillic reveal the products of Russia, Bulgaria and Serbia (Yugoslavia) if the differences are known; and Greek may be confused with Cyrillic if only the similar characters have been used. Chinese and Japanese *Kanji* were once very similar, until the Japanese introduced simplified *hiragana* ('easy kana') and *Katakana* ('side kana'). The Kanji alphabet would be difficult to distinguish from Chinese were it not for regular substitution of hiragana and the presence of Katakana ideographs either highlighting individual topics (in much the same way as Western typography uses italic) or representing non-Japanese words phonetically.[2]

IDENTIFICATION OF LANGUAGE

Subordinate to overall form is language. Even though the lettering may be obviously roman, the content of even the smallest inscription may hold clues of its own. Even 'on/off', 'left/right' and 'oil here' may take the identification a stage farther if the language is something other than English.

Most languages are easily assessed, though goods are often exported with manufacturers' plates in either the language of origin or that of the purchaser. This is potentially problematical with Spanish, the official language not only of Spain but also of all the many one-time Hispanic colonies that dominate South and Central America.

1. There are exceptions. The Korean alphabet, known as *Hangul*, was effectively a spur-of-the-moment creation by the king and bears no discernible relationship to Chinese or any other oriental prototype.

2. Complexity continues to dog the Kanji alphabet, which was standardised at 1850 characters in 1946 and amended to 1945 in 1981; hiragana and katakana each have 46 symbols, plus two diacritical marks. And, in recent years, the Japanese have begun to use *Romaji*—the classical roman or 'Latin' alphabet—in addition to their own systems.

Once ruled by Portugal, Brazil is the major exception to the otherwise all-pervading Hispanic influence in the Americas. However, though the two languages are very similar in many respects, the inclusion of 'ã' or 'õ' distinguishes marks in Portuguese as easily as 'ñ' characterises Spanish.

Accented characters habitually betray their origins. The four basic accents commonly encountered in French—acute ('é'), grave ('à'), circumflex ('ô') and cedilla ('ç')—are perhaps the best known, though the German umläute ('ä', 'ö', 'ü'), known in English as 'diaresis', and the *eszett* ('ß') are also readily identified. The Scandinavian alphabets include a variety of accented letters as well as diphthongs, once common but now rarely encountered in English; and many central European languages, such as Czech and Polish, have distinctions of their own.

Accents and diacritical marks

Source: *The Oxford Dictionary for Writers and Editors*, 1981, p. 4.
Majuscule characters are identical with minuscule unless noted otherwise.

Czech: á č ď (majuscule Ď) é ě í ň ó ř š ť (majuscule Ť) ú ů ý ž
Danish: å æ ø
Finnish: ä å ö
French: à â ç è é ê ë î ï ô œ ù û ü
German: ä ö ü ß
Hungarian: á é í ó ö ő ú ü ű
Norwegian: å æ ø
Polish: ą ć ę ł ń ó ś ź ż
Portuguese: à á â ã ç è é ê ì í ò ó ô õ ù ú
Romanian: à â ă è ì î ş ţ ù
Spanish: á é í ñ ó ú ü
Swedish: ä å ö
Turkish: â ç ğ ı (majuscule İ) î ö ş ü û

DISTINCTIVE WORDING

The nationality of an individual manufacturer may be highlighted by the content and style of a name, or by the inclusion of a place-name. However, the interpretation of some marks can be less obvious; in these cases, the accompanying abbreviations may provide clues.

The most popular addition, '& Co.', customarily signifies an English-language user, though as likely to be in North America and the British Empire (or Commonwealth) as in the United Kingdom and possibly even in Germany. The inclusion of 'Inc.' ('incorporated') or 'Pty' ('proprietary') refines interpretation to the U.S.A., or Australia, New Zealand and South Africa

Plate 20. This interesting plate has a considerable tale to tell. Found on a single-cylinder Corliss horizontal engine once installed in Hôpital Emile Roux, Paris, it reveals a surprising amount of detail. The manufacturer's name at the time the plate was made was 'Crepelle & Garand' of Lille, in north-eastern France, successors to 'V. Brasseur'. Brasseur (a maker of American-style engines with Corliss and Wheelock valves) had succeeded the 'former operations' (*anciens Ateliers*) of Le Gavrian. A check of the catalogues of the 1889 Exposition Universelle reveals that the Grand Prix had been awarded to Brasseur. This in turn shows not only that the hospital engine post-dates the change in company structure, but also that this change dates later than 1889. *Courtesy of the British Engineerium, Hove, England.*

respectively. Manufacturers using 'Companie' ('et Cie', '& Cie') will be French or Belgian; 'Compañía' will be Spanish—if the tilde [˜] is present—or Italian; 'Companha' will be Portuguese; 'Compagnie' or 'Kompagnie' will be German, Austro-Hungarian, or possibly from one of the German-speaking cantons of Switzerland. 'Kompanij ' is Dutch; 'Kompagni' is Danish.

The introduction of limited liability, where the risks taken by promoters were restricted in law, brought new abbreviations. Limited partnerships were formed by a general partner, who accepted complete liability, and a series of sleeping partners whose risk was limited only to their capital investment—but only if they took no part in the running of the business. These were known as *Société en commandité* in France, often abbreviated to 'SNC'; as *Società in accomandita* ('SIA') In Italy; and as *Kommanditgesellschaft* ('KG') in Germany.

True limited-liability operations in Britain were distinguished by 'Ltd' or 'Co. Ltd', though public companies have been identified as 'plc' ('public limited company') since 1977. Similar businesses operating in the Netherlands are *naamloze vennootschap* ('NV'), and are *Aktiebolag* ('AB') in Sweden; Danish and Norwegian equivalents are usually identified as 'AS' or 'A/S'.

Private trading companies formed in accord with national rules, include *Société à responsabilité limitée* ('SARL', 's.a.r.l.') in France, *Gesellschaft mit beschränkter Haftung* ('GmbH') in Germany, and *Società a responsabilità limitata* ('SRL', 's.r.l.') in Italy. Any French company described as *Société Mixte* ('SM') is a partnership of private individuals and government agencies.

Public companies in France and Belgium are classed as *Société anonyme* ('SA'), the latter often gaining the additional qualification 'Belge' ('SAB'); comparable terms include *Società per azioni* ('SPA', 'SpA') in Italy and *Aktiengesellschaft* ('AG') in Germany. Additional information may appear as 'Brothers' (or 'Bros') and equivalents such as *Fratelli* ('F.lli', Italy, Italian Switzerland), *Frères* (France, Belgium and French Switzerland) and *Gebrüder* (Austria[-Hungary], Germany, and German-speaking parts of Switzerland).

Among the variants of 'Son' are 'Sohn' (plural *Söhne*, German), 'Zoon' (plural *Zonen*, Dutch), 'fils' (French or Belgian), 'Figle' (plural *Figli*, Italian), and 'Hijo' (plural *Hijos*, Spanish). Abbreviations for 'Proprietor', often itself listed simply as 'Prp.' or 'Prop.', include *Inhaber* ('owner', German: *Inhaberin* if female); *Witwe* (German) and *Veuve* (French) both mean 'widow'.

The Francophone countries, France, Belgium and the French-speaking cantons of Switzerland, marked patented items with 'BREVET' ('Patent') or 'BREVETÉ' ('Patented'), often accompanied by 'S.G.D.G.' for *Sans Garantie du Gouvernement* ('without governmental [statutory] guarantee). Marks of this type may also be accompanied by 'DEPOSE' or 'DEPOSÉ', indicating that the marks had been 'deposited' or registered with the authorities. However, 'Depose' alone does not necessarily indicate a patent; it could refer as easily to a registered design or a trademark.

Marks 'BREVETTO' and 'BREVETTATO' are Italian; 'DRP', 'D.R.P.' and 'D.R.PA.' are German—*Deutsches Reichs-Patente*—representing the highest category of protection a design could receive. Care is needed to distinguish 'D.R.PA.' and 'D.R.P.A.', as the latter, more commonly 'D.R.P. ANG.' or 'D.R.P. ANGEM.', signifies *Deutsches Reichs-Patent Angemeldet* (i.e., that the patent had been sought but not yet granted). 'D.R.P. ANG.' marks were customarily used only for a short time before being replaced with 'D.R.P.', and can provide a useful dating aid.

The individual identifiers that reflected the heritage of the medieval guilds may be encountered in a variety of forms. Those that were effectively a surname (with or without initials) are easy to decipher if suitable directories are available, but those that comprise initials, symbols or cyphers present far more interesting problems.

Marks of this type can be found on a vast number of artefacts, especially those where space is at a premium: small articles of jewellery, the silver mounts of good-quality pistols, or the smallest parts of a steam engine. But they can also be found in much more impressive applications—such as the marks applied to the fabric of cathedrals and other medieval buildings by master masons.

Silversmiths, cutlers and gunmakers (to name but three crafts) have a long tradition of regulation, and documentary evidence of their marks can be easily found. Their wares can also be identified by the hallmarks (see page 82), though a mark of this type found on a gun will usually only indicate the maker of the decorative mounts.

NATIONAL IDENTIFIERS

The application of markings has often been influenced by perpetual redrawings of the world map, with the creation of new states by the fragmentation of 'superstates' or through the influence of local ethnic and linguistic differences. Supra-national groupings—nothing new—have included the *Deutscher Bund* or 'German Confederation', created in 1815 to supersede the Holy Roman Empire of the German Nation that had been torn apart by Napoleon in 1806.

The confederation of Austria, Prussia, Bavaria, Saxony, Württemberg, Baden, Hessen, more than twenty lesser states and the four 'Free Towns' (Bremen, Frankfurt, Hamburg and Lübeck) was dissolved after the troubles of 1848, then reconstituted in 1850 only to fall apart when rivalry between Austria and Prussia led in 1866 to the Seven Weeks War. The northern German states then found refuge in the *Norddeutscher Bund*, or 'North German Confederation' (1867–71), effectively a federal state dominated by Prussia, which in turn lasted until the *Deutsches Reich* or 'German Empire' was formed towards the end of the Franco–Prussian War of 1870–1.

The confederation of Canada, in accordance with the British North America Act, took effect when the provinces of Ontario and Quebec were joined by Nova Scotia and New Brunswick on 1st July 1867. However, the country owes its present form to the incorporation of other provinces: Manitoba in 1870, British Columbia in 1871, Saskatchewan and Alberta in 1905. Newfoundland was not officially admitted until March 1949. The Commonwealth of Australia Constitution Act, which duly received the assent of Queen Victoria in July

1900, grouped the previously-independent territories of New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia with effect from the first day of 1901. With a few border adjustments and the admission of the Northern Territories in 1911, the arrangement has lasted to the present time.

The end of the First World War that had seen the collapse of tsarist Russia also brought the imperial dynasties in Germany and Austria-Hungary to a close. This created a patch-work Europe: Finland, Poland and the Baltic States (Estonia, Latvia, Lithuania) seized independence from Russia; Austria and Hungary broke apart, freeing Czechoslovakia; and the Kingdom of Serbs, Croats and Slovenes ('Yugoslavia' after 1929) broke away from the shackles of the Habsburg empire. The pattern repeated after the Second World War, with the partition of India and Pakistan (1947) and the fragmentation of British and French Africa into the 1950s and 1960s. The more recent fall of Soviet communism has conferred independence on states such as the Ukraine, Belarus and Uzbekistan. The Czech Republic has parted from Slovakia, and it is probable that other changes will come—even in Belgium, where a move to split the French-speaking districts from those that are culturally Flemish is regularly debated.

Some manufacturers had always been keen to promote the geographical origins of their wares—especially if the location was deemed to have prestige: England or 'Great Britain', for example, especially during Victorian industrial heyday. It is often claimed that marks such as ENGLAND, BAVARIA and MADE IN GERMANY will prove to have been applied in accordance with restrictive legislation adopted in the U.S.A., but many actually owe their origins to the Merchandise Marks Act passed in Britain in 1887, which forced distributors of goods originating outside the British Isles to mark them clearly: e.g., MADE IN GERMANY. The aim was largely to discourage imports by associating them with inferior standards of 'foreign' manufacture in an era when the British prided themselves greatly (but often mistakenly) on the high standards of their craftsmanship.

Implementation of the British mark was controversial and antagonistic, but the long-term effects were unexpected. Concerned by the restrictions being placed on trade by British protectionism, the German parliament, the *Reichstag*, appointed an investigating commission. In their report, made in 1894, the commissioners concluded that loss of trade had not only been small, but had also been confined to the few years immediately after 1887. Many German manufacturers reported that MADE IN GERMANY, far from being a drawback, was serving to highlight the good quality of many German products;

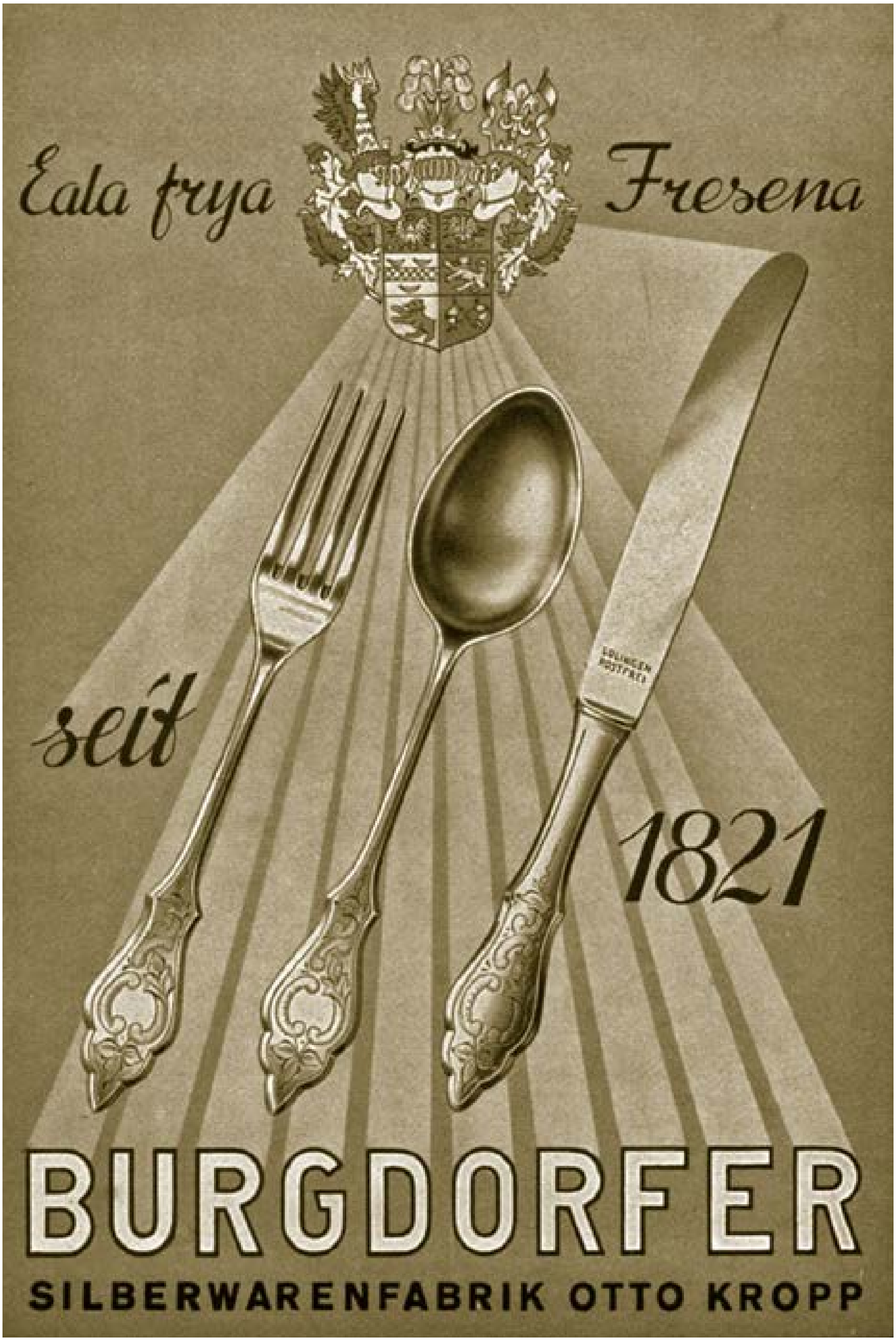

Eala frya Fresena
seit
1821
BURGDORFER
SILBERWARENFABRIK OTTO KROPP

Plate 21, preceding page. Unlike Plate 20, which provided a considerable amount of information, this advertising leaflet holds very few clues. There are no printers' marks; the traditional style of the cutlery is no real help; nor do the design and content of the lettering refine the dating process—other than to show that it is later than 1821, and emanates from a German-speaking country! The only real clues lie in the use of the word ROSTFREI ('rust free', stainless steel), which suggests the 1920s or later, and in the printing technique, offset lithography, which usually indicates a post-1960 product. The leaflet actually dates *c.* 1971, Kropp's 150th anniversary.

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many individual traders were happily applying it voluntarily to goods being marketed throughout the world. The mark is still in use, proscribed by many landmark court judgments. In 1974, the *Bundesgerichthof* (the Federal court of justice) ruled that the mark was not sufficiently specific, promoting the use of MADE IN WEST GERMANY and MADE IN G.D.R. (German Democratic Republic, 'East Germany'). These distinctions lasted only until the re-unification of Germany in 1990.

The bill approved by the U.S. Congress on 1st October 1890 ('Ch. 1244, Sec. 24, 26 Stat. 617') forced imports entering the U.S.A. from 1st January 1891 to be marked with the country of origin in English. Now universally known as the 'McKinley Tariff Act' after its principal proposer, Congressman William McKinley (later President), this act increased duty on imports by an average of nearly fifty per cent.

McKinley sought not only to improve sales of American-made goods but also to explore foreign markets, hoping to negotiate reciprocal trade agreements (using the Tariff Act as a bargaining tool) and assure American manufacturers of supplies of cheap raw material. However, the immediate results were catastrophic—particularly in agriculture, where ever-increasing costs of equipment and labour could not be recouped by raising prices in a market where the underlying trend was already downward. Yet the McKinley Act had a long-standing effect on markings, and the U.S. Revenue Act of 23rd November 1921 ('Ch. 136, 42 Stat. 227') amended the rules to ensure that the prefix 'MADE IN…' was added to the country of origin from 1st January 1922. These requirements are still enforced.

National marks are usually self-explanatory, even though 'Nippon' was sometimes used instead of 'Japan' (particularly prior to 1920) and 'Bavaria' was sometimes preferred to 'Germany' prior to 1914. Uruguay was once known as 'Republíca Oriental' and the quirky 'North Britain' was widely applied to goods made in Scotland prior to 1900, lingering until the First World War began and even, in a few instances, into the 1920s.

The marks MADE IN CHINA and MADE IN R.O.C. ('Republic of China') refer to the People's Republic of China and Taiwan respectively, though the products of the provinces of Macau and Hong Kong, parts of the People's Republic, are often marked with their own names. Occasional marks include the town instead of the country—e.g., MADE IN BIRMINGHAM—but usually indicate sale within a national market. A mark of this type would not be acceptable in the USA (cf., Birmingham, Alabama).[3]

Some products sold in Britain after the 1887 Merchandise Marks Act, including firearms, have been seen marked MADE IN GOTHA to disguise their German origins. Gotha was an old city-state in Saxony, part of the Deutsches Reich or 'German Empire' after 1871, but also a component of the pre-1915 family name of the British monarchy: 'Saxe-Coburg-Gotha'.

Identification and dating may also be assisted by components of national Arms, which can include shields, crests and mottoes. This subject is explored in greater detail in *Marks of Distinction* (devoted to personal, civic and corporate heraldry), but the Arms of Brazil provide a good example of how subtleties can be used productively. The Brazilian crest, customarily accompanied prior to 1968 by ESTADOS UNIDOS DO BRASIL (or simply 'E.U. do Brasil') comprises a large five-point prismatic star impaled on a sword with its point uppermost, often within a wreath of laurel and coffee leaves superimposed on a stylised sunburst. A constellation of five stars, known as the Southern Cross, lies within a circlet of small stars on the centre of the prismatic star. If any detail can be seen on the circlet, dating may be helped in an unexpected way. There were originally twenty stars, one for each of the founding provinces of Brazil. However, the incorporation of new territory and subsequent civil reorganisation has increased the total to 21 in 1960; 22 in 1962; 23 in 1977; 24 in 1981 and to the still-current 27 in 1989.

The number of stars included in the canton of the national flag of the U.S.A. can also be used to assist dating. A design incorporating fifteen stars and fifteen bars was approved in 1795, then came four stars and four bars to raise the total of each to nineteen. The ever-increasing complexity of the flag (especially the proliferation of stripes) was addressed in April 1818 by reducing the stripes to represent the thirteen original founders and adding a star for each new state. Consequently, the star-rows have changed from the five rows of three of 1795 to the fifty (five rows of six, four rows of five) used since the admission of Hawaii to the Union.

3. The use of the Japanese of MADE IN USA (named after the city of Usa, on the southern island of Kyushu) is sometimes cited as an underhand way of exploiting the good reputation of MADE IN U.S.A. There is little evidence to show that this ruse, if exploited at all, lasted any significant time.

The twentieth star was added in 1818; the 21st in 1819; the 22nd and 23rd in 1820; the 24th in 1822; the 25th in 1836; the 26th in 1837; the 27th in 1845; the 28th in 1846; and the 29th in 1847. The thirtieth star appeared in 1848; the 31st in 1851; the 32nd in 1858; the 33rd in 1859; the 34th in 1861; the 35th in 1863; the 36th in 1865; the 37th in 1867; and the 38th in 1877. Five more states were admitted to the Union in 1890 to raise the total to 43. Then came the 44th (1891), the 45th (1896), the 46th (1908), the 47th and 48th (1912), the 49th (1959) and, finally, the 50th in 1960.

Economic union forms another type of grouping which can help with the identification and dating of individual items. As early as 1818, Prussia had abolished the internal tariffs and local taxes that had hindered trade, and sufficient states had joined the scheme by 1834 to form the *Deutscher Zollverein* ('German customs union').

Wrecked in 1866 by the brief (but unexpectedly conclusive) Seven Weeks War, this was re-formed in 1867 and continued to expand: the province of Elass-Löthringen ('Alsace-Lorraine') was admitted in 1871, and the Hansa towns of Bremen and Hamburg joined as late as 1888. The union lasted until the end of the First World War, and in it and similar schemes (such as a trade agreement between Belgium and Luxemburg in 1921) can be seen the genesis of the organisations that dominate today's trade.

The first steps towards European unity were taken before the Second World War had ended, when representatives of the governments-in-exile of Belgium, the Netherlands and Luxembourg proposed the Benelux Customs Union as a way of repairing their shattered wartime economies. Implemented in 1948 and replaced in 1960 by the Benelux Economic Union (which had been ratified in February 1958), the organisation still represents the interests of its founders and BENELUX marks will still be encountered.

A rival grouping, the European Coal and Steel Community, was formed in 1951, largely as an experiment, by France, West Germany, the Benelux countries and Italy. The same participants then devised the European Economic Community ('EEC', known in Britain for many years as the 'Common Market'), which was ratified by the Treaty of Rome in March 1957 and subsumed into the European Community or European Union by the Treaty of Maastricht (1992). Suspicious of the federalist nature of some EEC proposals, a group of seven countries—Britain, Denmark, Norway, Sweden, Austria, Switzerland, Portugal—formed the European Free Trade Association ('EFTA') in May 1960.

The membership of these organisations has changed over the years; only four members of EFTA remain, most of the others opting to join the EEC, and the change from EEC to EC has been accompanied by wholesale recruitment of member states.[4] European Union 'EU' identification marks are still voluntary, and though the first moves have been taken towards harmonising markings throughout the many constituent states, commercial authorities in Britain, Germany and elsewhere have voiced particular concerns which seem likely to delay (if not entirely prevent) consensus being reached.

ABBREVIATIONS AND ACRONYMS

Abbreviated marks have also been applied by railway companies from the 1870s onwards, customarily in the form of initials on the tender sheets though other locations could be favoured: cab sheets, buffer beams, the back of the tender body or—particularly in the U.S.A.—on the sides of the sand domes above the boiler. Abbreviations were also to be found on maker's plates and on the surrounds of cast-brass number plates; however, these can only usually be distinguished at close range.

British examples are usually straightforward, and are often very well known: they have included G.C.R. for the Great Central Railway; G.W.R. for the Great Western Railway; H.R. for the Highland Railway; L.B.S.C.R. for the London, Brighton & South Coast Railway; L.M.S. for the London, Midland & Scottish Railway; L.N.E.R. for the London & North Eastern Railway; L.S.W.R. for the London & South Western Railway; M.R. for the Midland Railway; N.E.R. for the North Eastern Railway; and S.R. for the Southern Railway.

In Europe, D.B. signifies the Deutsches Bundesbahn (the German state railway); Ö.B.B. is the Österreichische Bundebahn (the Austrian state railway); and P.L.M. was the Paris–Lyon–Mediterranée railway, incorporated for many years in the Société des Chemins de Fer Français (S.N.C.F.). In North America, B. & O. was the Baltimore & Ohio Railroad; C.N.R. was the Canadian National Railway; C.P.R. was the 'Canadian Pacific Railway'; and P.R.R. was the Pennsylvania Railroad, habitually known as the 'Pennsy'.

German aircraft of the Third Reich era (1933–45) could be identified by the designating codes allocated to the manufacturers, though these were rarely to be seen on the aircraft themselves. Most were simply two-letter contractions of names, almost always the first letters if the designator was a single word—e.g., 'Ar.', Arado; 'Do.', Dornier; 'He.', Heinkel; and 'Ju.', Junkers. Two-word designators were customarily represented by their initials ('Fw.' for Focke-Wulf or 'Bv.' for Blohm & Voss). Anomalies included the use of 'Hs.' by Henschel, 'He.' being allocated to Heinkel, and the identification of Messerschmitt designs by

4. The changes in EFTA have been considerable. Iceland joined in 1971; Finland joined as an associate member in 1961, becoming a full member in 1986; Liechtenstein joined in 1991. However, the UK, Denmark and Norway joined the EEC in 1973, to be followed by Portugal (1986) and then Austria, Sweden and Finland (all in 1995)

Plate 22. Typical U.S. 'Car Heralds', showing how identification with individual railroads is not always obvious. *Vertically in rows.* **First row:** Long Island; Bessemer & Lake Erie; Père Marquette. **Second row:** Belt Railway Co.; Missouri, Kansas & Texas. **Third row:** Manitou & Pike's Peak; New York, Chicago & St Louis; Kansas City Southern. **Fourth row:** New York & Western Ontario; Minneapolis, St Paul & Sault Ste Marie. **Fifth row:** St Louis Southwestern; Louisville & Nashville; Atchison, Topeka & Santa Fé.

'Bf.' instead of the more obvious 'Me.'; aircraft developed by Willi Messerschmitt were actually made by Bayerische Flugzeugwerke AG of Regensburg. Aero engines were designated similarly, displaying 'BM' for Bayerische Motoren-Werke (now better known as 'BMW'), 'DB' for Daimler-Benz or 'Ju.' for Junkers Motorenwerke ('Jumo').

Another class of alphabetical mark, usually confined to wartime, was designed specifically to hide dispersion of war-matériel production from the enemy, preventing disruption caused by carpet-bombing campaigns. Dispersal of this type had been undertaken on a large scale during the First World War (1914–18), but the threat from the air was minimal and disguise was largely unnecessary.

The Second World War was very different, as the fear engendered by the bombing of Guernica in 1937, during the Spanish Civil War, had made governments nervous of attacks from the air. The Germans had begun clandestine rearmament in the early 1930s, before the 1919 Treaty of Versailles had been openly repudiated, and had begun to use numerical groups and coded dates to hide their transgressions.[5] A progression was then made to a simple alphabetic sequence, to hide the manufacture of key components (the marks ran simply from 'a' to 'z'), and then to a much more complex system based first on two-letter groups and then on groups of three. Consequently, many German-made items of the 1940–5 period will be found with marks such as 'jwh' and '42' (for 1942), which, as the codes are known, can easily be interpreted.[6] This particular mark identified an item which had been made in the French government ordnance factory in Châtellerault.

The British system was designed more to ease administrative problems than to promote secrecy, though use of number-groups was undoubtedly a useful cloak-and-dagger tool. The prefixes gave a clue to geography: 'M' for 'Midlands', 'N' for 'North' and 'S' for South', but an identifying number or detail hid the precise location. 'M131' signified Silas Hyde Ltd of Birmingham; 'N5' was used by the Automatic Telephone & Electrical Company of Liverpool; and 'S72' cloaked the identity of MacMillan Foundries of Cassiobury Mills, Watford.

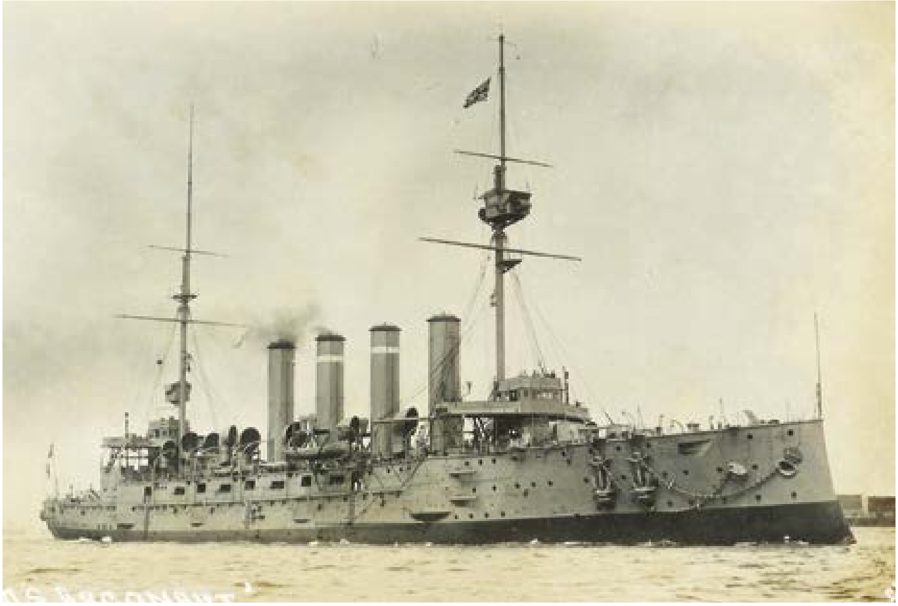


Plate 23. The British first-class protected cruiser HMS *Argonaut*, pictured shortly before the First World War. Note the identification bands painted around the second and third funnels. The ship was completed in 1900 by the Fairfield Ship-Building & Engineering Co. Ltd of Govan, and went for scrap in 1920. She was only the second of the name—the first being a prize taken in 1782—but has since been succeeded by two others.

A few companies rashly advertised their location by adding commercial trademarks—or even their names!—but aids to identification of this type are comparatively rare.

Staggeringly large use of sub-contractors was practised in the U.S.A. during the Second World War, where the wholesale enlargement of the war industries led to the production not only of billions of rounds of ammunition and millions of small-arms, but also to the construction of hundreds of thousands of aircraft, tens of thousands of tanks, and more than 2700 pre-fabricated Liberty Ships. Coded marks were usually confined only to small items such as electrical fuzes or rifle barrels, and much remains to be done before a register of individual participants can be compiled.

NAMES AND NUMBERS

The ability to date the manufacturers' markings (and, indeed, sales literature) by changes in company name or trading style is exceptionally important in the identification of artefacts.

Many individual businesses were extended by taking partners, particularly children, or by becoming a company and then limiting potential liabilities.[7] In addition, individual names have been applied to industrial products ranging from traction engines and railway locomotives to ships and aircraft. Though an understandable tendency to favour commemorative, geographical, historical or mythological names has often ensured that the same name has been used many times, an appreciation of what to seek is still very useful.

Unfortunately, any generalised classification can be compromised by the retention of names that have become traditional, and also by historically or otherwise significant events. Popularity ensures not only the duplication or triplication of a favoured name, but also possibly more than a dozen applications over a hundred years or more.

The name 'Active', for example, has been carried by 25 Royal Navy warships since 1758, 'Adventure' by twenty since 1594, and 'Alert' by 26 since 1793. At the other end of the alphabet, 'Vigilant' has been favoured nineteen times (1745–1942), and, by the time an appropriately named destroyer was launched in 1897,

5. The date-code sequence was apparently to have run A Z M T R B E O N K G S J H (1925–38), but was abandoned before the last few letters could be used.

6. The original code book, *Liste der Fertigungskennzeichen für Waffen, Munition und Gerät* ("List of makers' code marks for weapons, munitions and equipment"), was reprinted in 1977 by Karl Pawlas of Nürnberg. However, the reprint was made from a 1944 edition, lacking not only the codes allotted at the end of the war but also information where, presumably, companies had ceased trading or been amalgamated with others. For a more accessible guide, see John Walter: *German military letter codes 1939–1945* (2005).

7. The trading style 'Ltd' can only date later than implementation of the Limited Liabilities Act of 1861. The substitution of 'plc' ('public limited company') dates from *c*. 1975.

'Wolf' had been used twenty times since the renaming of the Spanish prize *Nostra Señora del Socorro* in 1656.[8] Diversity of this type may hinder dating.

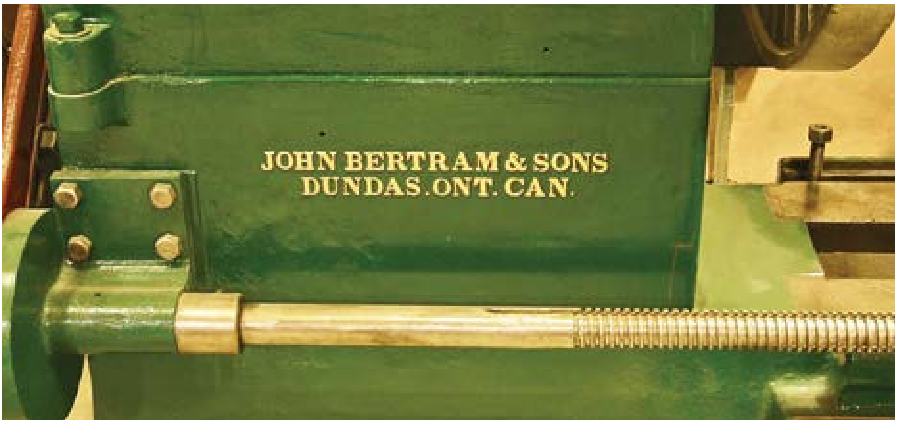
Style may provide an unexpected source of information. Names such as 'Achilles' (at least twelve British railway locomotives, 1839–1968) and 'Albion' (ten, 1845–1966) have always been acceptable, but the inspiration for individual applications may vary: the naming of at least one *Achilles* honoured not the mythological hero directly, but the Royal Navy cruiser of the same name. And though most *Wellingtons* derived their names from Arthur Wellesley, Duke of Wellington, inspiration could also come from the New Zealand city or the Vickers-Armstrongs bomber of the Second World War.

Wars and great social events have often generated short-lived enthusiasm for particular names. Most British towns have districts, built at the end of the nineteenth century, that reflect interest taken by the public in the South African War (1899–1902). The origins of 'Ladysmith', 'Mafeking' 'Natal', 'Pretoria' and even 'Kitchener' are obvious, but other names are less transparent; 'Redvers' was a forename of General Buller, 'Kekewich' was an army officer, and 'Terrible' (in this particular case) honoured one of the two Royal Navy armoured cruisers that had landed guns to help the war effort.

FACTORY NAMES. Engineering businesses often gave their factories names, perpetuating pre-postal traditions by linking names and features to identify locality: "Jacob's Farm", "White House Mill". Consequently, particularly if

8. Capt. T.D. Manning & Cdr C.F. Walker, *British Warship Names* (1959).

Plate 24. This manufacturer's mark is cast into the bed of a sliding gap-bed lathe of *c.* 1900, from the Pictou shipyard in Nova Scotia. *Museum of Making collection.*



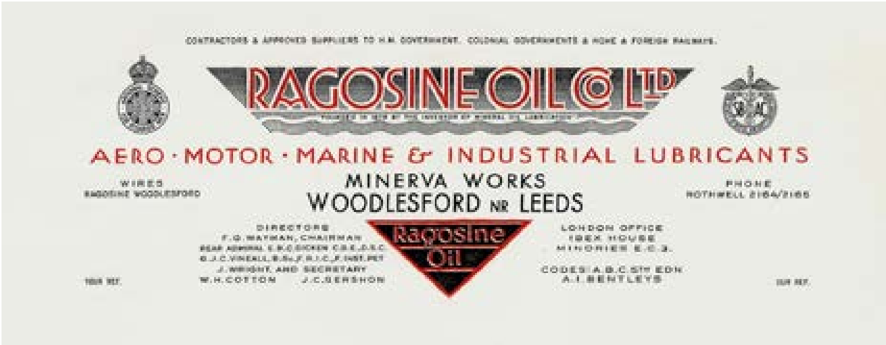


Plate 25: notepaper from the early 1950s. The designs were often much more complicated than today's equivalents, but may confirm trademarks and product details—in addition to factory addresses and the lists of directors that can provide a guide to date.

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the factory-name was effectively a brand name or trademark, knowledge of how, where and when names were used can aid identification. This can be very helpful if the factory name bore no relationship to the trading style of its proprietor, or where, by an amalgamation or by sale, the proprietors had become remote geographically from factories under their control.

The Newcastle-upon-Tyne factory owned by Robert Stephenson & Company was known as 'Forth Bank Works'; 'Scotswood Works' were operated by Sir W.G. Armstrong, Whitworth & Co. Ltd; 'Acton Hill Works' were owned by the New Engine Co. Ltd; 'Salford Ironworks' were owned by Mather & Platt Ltd; and the 'Glasgow Rolling Stock & Plant Works' operated in Motherwell under control of Hurst, Nelson & Co. Ltd. There are literally thousands of names of this type, but no central repository through which they can be easily traced. Sometimes, however, such specialised knowledge can resolve problems created by businesses such as Andrew Barclay, Sons & Company and Barclays & Company of Kilmarnock, which were related by family ties and are thus habitually confused. However, occupation of 'Caledonia Works' and the 'River Bank Engine Works' respectively sometimes identifies which of the Barclay businesses is being sought.

TELEGRAPHIC NAMES. Another untapped source of information, these may be useful more often in connection with ephemera such as bill-heads and catalogues than the artefacts themselves. However, telegraphic code names have been adapted as trademarks, and there are instances where trademarks inspired the adoption of telegraphic code names. For example, the German arms and ammunition maker, Deutsche Waffen- & Munitionsfabriken (often known

Plate 26. the Great Western Railway 4–6–0 no. 2922 *Saint Gabriel*, built in 1907, poses 'on shed'. Note the cast-brass nameplate above the centre driving-wheel splasher, which can serve to identify the locomotive (one of a class of 190) if the comparatively small number plate on the cab sheet is hidden or indistinct. *Author's collection.*

simply as 'DWM') adopted as its company motto the Latin phrase *Si vis pacem para bellum*—'if peace you seek, prepare for war'—which was subsequently adapted to serve as a telegraphic name and a trademark, PARABELLUM being registered in Germany on 21st April 1900 (no. 43353).

Though many telegraphic code names are easily linked with their owners, being essentially contractions of names, others were far more abstract and often much more interesting. Little, Gilbert & Co. Ltd of Horton Works, Bradford, used 'Laborless, Bradford'; Marple & Gillott Ltd of Attercliffe Road, Sheffield, used 'Ferric, Sheffield'; the Unbreakable Pulley & Mill Gearing Co. Ltd of Cannon Street, London EC, once relied on 'Horsepower, London'; and, intriguingly, the use of 'Kahncrete, London' by the Trussed Concrete Steel Co. Ltd of Caxton House, Westminster, may hold a clue to the identity of an owner or a patentee. The telegraphic address 'Klettillo, London', signifying the British headquarters of Maschinenfabrik Augsburg-Nürnberg (now better known as 'MAN') incorporates a reference to August Klett, the founder of one of MAN's antecedents; and the association of 'Unwavering, London' with the Hulburd Engineering Co. Ltd of Leadenhall Street, London EC, allowed an unattributed trademark to be identified.

NAMES AND LETTERS. Steamships and railway locomotives are among the industrial creations to be made in classes of identical units, and so the *number* of letters in a visible name can sometimes be enough to identify a particular unit—even though the name itself cannot be read.

Shipping lines and individual railways often relied on names that fell into particular groups or patterns, and can be readily identified. Steamship names were usually painted onto their hulls, though the use of separate letters is known. These could be castings or simply cut from plate and welded in place. Maritime name-marks include 'Cape' or its equivalents *Cabo* (Spanish), *Cap* (French or German) or *Capo* (Italian). The Lyle Shipping Co. Ltd of Glasgow named its vessels 'Cape…', the Sun Shipping Co. Ltd of London used 'Cape St…', Ybarra y Cia of Seville used 'Cabo San…', and both Chargeurs Réunis SA, Paris, and the Hamburg Sud-Amerikanische Linie used 'Cap…'

The Houlder Line Ltd of London preferred two-word names ending in 'Grange', the West Hartlepool Steam Navigation Co. Ltd relied on '…Hall', and Haldin & Philipps used '…Court'—all classes of name that were shared with railway locomotives. The prefixes 'Cor-', 'Jala-' and 'Um-' were used by Cory Colliers Ltd of London and the Donaldson South American Line of Glasgow ('Cor-'); the Scindia Steam Navigation Co. Ltd of Bombay ('Jala-'); and Bullard, King & Company of London ('Um-'). Others attached suffixes such as '-fels' (Hansa Linie) or '-ia', which was shared by the Cunard White Star Line of Liverpool, the Donaldson Line of Glasgow, and Svenska Lloyd Rederi of Goteborg.

The tankers of Imperial Oil—registered in Toronto, Canada—bore names ending '-lite', and the tramps of Sir R. Ropner & Co. Ltd of West Hartlepool were easily distinguished by '-pool'.

MANUFACTURING OR PRODUCTION NUMBERS. Omission or erasure of the manufacturers' names and indications of origin, whether deliberately or by damaging corrosion, may mean that subsidiary marks are the primary aid to identification.

Makers' plates may also record details of patents (see next section), to assure purchasers of merchantable quality, and this can often ease not only the task of dating but also of deciding nationality. The plates can list not just when, where and by whom the item had been made, but also give dates of exhibition awards and designations. They may also give the dimensions of engine cylinders or the rating of an electric motor; the build or re-build dates; and a variety of other numerically-based details. The key to success, therefore, lies in acquiring the interpretative skill that allows patent references to be distinguished from serial numbers, or dates of origin to be separated from dates of reconstruction.

The makers of items ranging from planimeters and theodolites to traction-engines and even steamships habitually numbered their products cumulatively, and, on occasion, knowledge of the ways in which the sequences run can allow a date of manufacture to be retrieved or suggest the date of manufacture in the absence of any other details. ‘Works numbers’ can often be used to support dating on the basis of number/year graphs, as long as pitfalls are considered—not all manufacturers began at ‘1’ (starting at ‘1000’ gave the impression that sales were better than they were), some skipped number-blocks for essentially similar reasons, and others numbered their differing products in small individual series instead of a single large one.

The Sentinel Waggon Works Ltd is known to have numbered its products sequentially, and the correlation between number and date is easy to establish. The plate reproduced on the next page shows that the steam wagon must have been made after 1921, owing to the last of the patent marks, and the actual date can be deduced from the serial number. The Super Sentinel was introduced in April 1923, surviving wagon no. 6979 was made in June 1927, and surviving tractor no. 7527 *Little Hercules* followed in August 1928; no. 7334, therefore, must have been completed in the Spring of 1928. This example, however, presents few interpretative problems; Problems are more likely to occur if identical products are sub-contracted to several manufacturers, or if individual manufacturers number each product in its own sequence.

The use of prefix and suffix letters, or the inclusion of dates (which may even be randomly coded), can also complicate identification. Japanese military rifles form just one of many artefact-groups that can be dated by pattern, but this gives only a rough guide. Initial inspection suggests their numbers to be sequential, but qualified by katakana or individual-character prefixes which divide production into blocks. The sequence of the prefixes is defined by a most unlikely source—a traditional poem, *Irōha*, which contains all 46 katakana ideographs in the most commonly-accepted order of progression.

Many pre-1945 German military firearms were numbered in blocks of ten thousand, with additional suffix-letters where appropriate. The first ten thousand bore unadorned numbers, the next block was given an ‘a’ suffix, ‘b’ followed, and so the process continued to ‘z’. The letter ‘i’ was never used—it was exchangeable in German with ‘j’—and so the series could accommodate 260,000 items. When 10000z had been reached (never with the pistols but occasionally with infantry rifles), a reversion to ‘01aa’ was made and work began again; this series would then theoretically have advanced to 10000zz if the opportunity had ever arisen, and could have started again at ‘01aaa’.

Numbers of this magnitude were prevented partly by ensuring that each individual contractor numbered its products separately, and also by re-setting the system at the beginning of each year. Consequently, hundreds of Parabellum or 'Luger' pistols are listed only as number '1234', failing to recognise not only by whom they had been made but also the significance of serial-number suffix letters! An acceptably accurate catalogue entry should read 'German Army 1908-pattern Parabellum ('Luger') pistol, no. 1234a, made in 1915 by DWM (the Deutsche Waffen- & Munitionsfabriken factory in Berlin-Charlottenburg)'.

PATENTS & DESIGNS

The precise origins of 'Letters Patent' are still often contested. In Britain, they originally allowed a Monarch to confer the privileges on favourites that were 'patent': open to public scrutiny, so that the honours or services due to the beneficiary would be provided on request.[1] Gradually, however, the system evolved more into a method of honouring merchants who introduced new manufactories, techniques or inventions by granting them a period of unchallengeable exploitation.

The first patent of this type to be granted (by Henry VI in 1449) allowed a stained-glass maker, a Fleming immigrant named John of Utynam, a twenty-year monopoly on a manufacturing process unknown in England. Protection was then extended to benefit inventors, though grants were slow and erratic. Only about sixty monopolies had been the subject of Letters Patent prior to the death in 1603 of Elizabeth I, and the inventor of the water closet, Sir John Harrington, had been rebuffed on the grounds that his invention 'offended propriety'.

By 1610, the granting process was being regularly abused; some requests were mistakenly rejected on the grounds that the 'trade was already being pursued' and the acceptance of others owed more to favouritism or to patronage than real merit. Public outcry and judicial criticism prevailed, however, and the system of grants was radically overhauled.[2]

The new system was operated by the judiciary for more than two hundred years without governmental interference, though a change made *c.* 1713, in the reign of Queen Anne, established that a petitioner had 'by an instrument in writing [to] describe and ascertain the nature of the invention and the manner in which it is to be performed'. The first application to be accompanied by a written specification was made in 1718 by James Puckle, to protect a primitive form of machine-gun, but the grants of protection were still often contested.

1. Letters Patent were apparently first used in Britain by Richard II, *c.* 1386, to grant peerages.
2. Section 6 of the Statute of Monopolies of 1624 (21 James I, c. 3), declared monopolies illegal excepting those 'for the term of fourteen years or under hereafter to be made of the sole working or making of any manner of new manufactures within this realm to the true and first inventor'.

A crucial patent granted to Richard Arkwright in 1775 to protect his 'water frame' was voided after less than a decade on the grounds that the specification had been inadequate, and the wrangling over James Watt's steam engines eventually established that patents could be sought not only to protect ideas and principles,[3] but also for improvements to existing designs.

Many changes have been made over the years to national and international patent law, and the original English intention of petitioning the king by way of Lords Chancellor had soon given way to applications made directly to officials appointed by the Crown to receive, assess and grant protection. But the growth of industry in the early nineteenth century brought problems of its own. Grants of patents depended on the advice given to the Crown by lawyers with little knowledge of science or engineering, and there were clashes between inventors who felt they had been treated harshly and entrepreneurs who had been given rights to ideas claimed by others.

Difficulties even arose from the absence of an acceptable vocabulary. The 'steam engine' patent granted in 1698 to Thomas Savery, for example, prevented the exploitation of the Newcomen atmospheric engine until an agreement had been reached with its proprietor; and the separate-condenser patent granted to James Watt in 1769, then prolonged until 1800, set the development of motive power back by at least ten years.[4]

There were many other cases where grants inhibited progress, even when the patent ran only for its full term. For example, U.S. Patent 9430X, granted to Samuel Colt on 25th February 1836 and reissued on 24th October 1848 (no. 124), prevented any revolver being made with a mechanically-rotated cylinder until the mid 1850s; and the patent granted in the 1850s to Rollin White, better known as the designer of the White Steam Car, then allowed the little-known partnership of Horace Smith and Daniel Wesson to prevent the manufacture of any revolver with chambers bored through its cylinder.

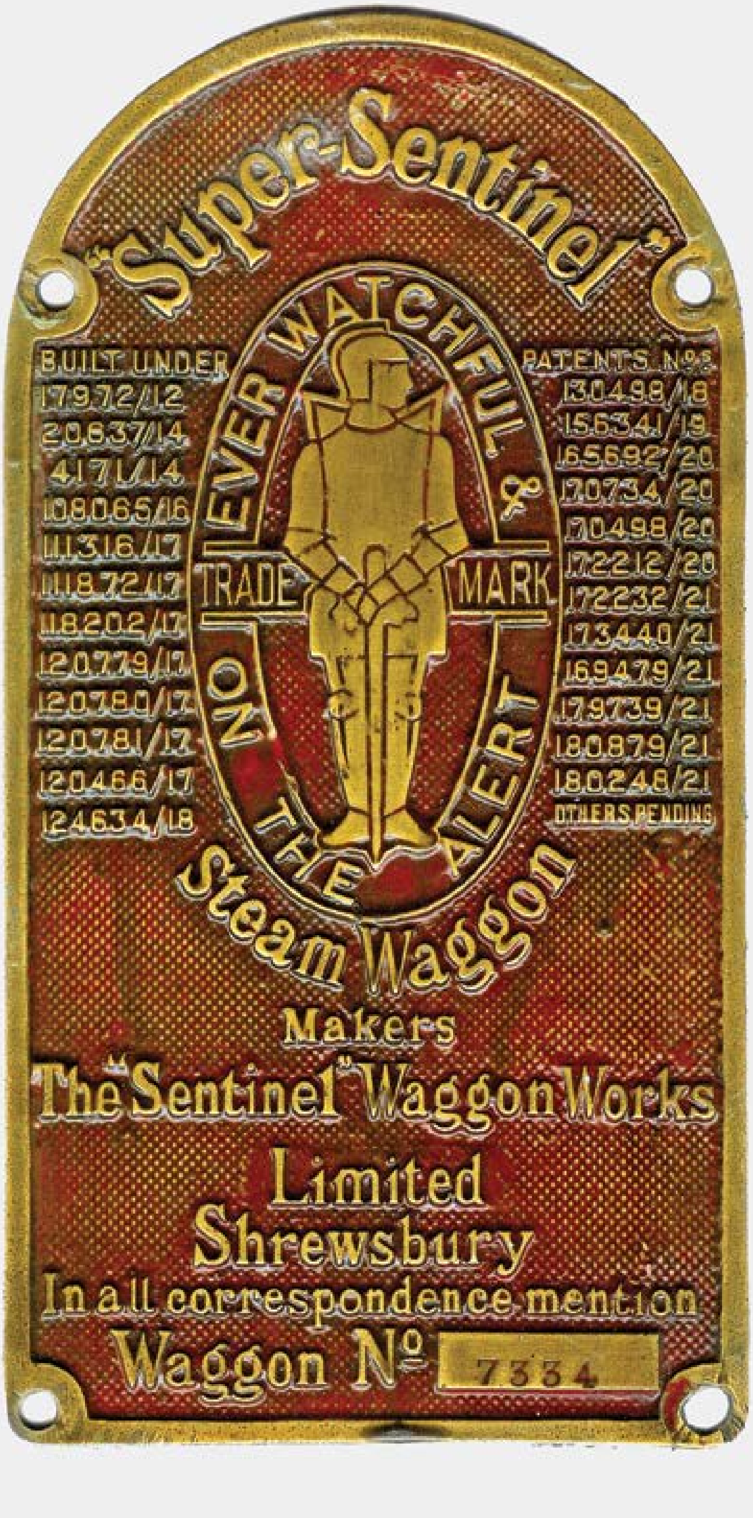
A major change was made to the British patent system shortly after the Great Exhibition had been opened in London in 1851. Prior to the last day of September 1852, English and Scottish patents were numbered in separate series.[5] With effect from 1st October 1852, however, the implementation of the Patent Law Amendment Act[6] combined the disparate series; numbers

3. Provided that they were 'clothed in practical application'.

4. James Watt guarded his success jealously, successfully defending his patent against infringers such as the Hornblowers and Matthew Murray. The zeal with which litigation was pursued, and Watt's own high reputation, allowed his terror of high-pressure steam to retard development until his death in 1819.

5. The first patent to be numbered was granted in England in 1617 to Rathburn and Brydges, protecting a method of 'Engraving & Printing Maps & Plans &c'.

6. See 15 & 16 Victoria c. 83.



"Super-Sentinel"
BUILT UNDER
PATENTS Nos
17972/12
20837/14
4171/14
108065/16
111316/17
111872/17
118202/17
120779/17
120780/17
120781/17
120466/17
124634/18
130498/18
156341/19
165692/20
170734/20
170498/20
172212/20
172232/21
173440/21
169479/21
179739/21
180879/21
180248/21
OTHERS PENDING
EVER WATCHFUL &
ON THE ALERT
TRADE MARK
Steam Waggon
Makers
The "Sentinel" Waggon Works
Limited
Shrewsbury
In all correspondence mention
Waggon No 7334

Plate 27, previous page. Fitted to a Sentinel Steam Waggon dating from 1928, this offers a range of detail: the name and location of the manufacturer, confirmation of the trade mark and brand name, and the numbers of no fewer than 24 British Patents—ranging from no. 17972 of 1912, granted on 31st July 1913 to Stephen Evans Alley and George Woodvine of Sentinel Works, Polmadie, Glasgow, to protect 'Improvements in Steam Boilers', to no. 180248, granted on 25th May 1922 to Stephen Alley to protect 'A Mechanical Stoker for Steam-waggon and like Boilers'. *Courtesy of the Intellectual Property Office, London.*

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were reduced to '1' and a simple progression occurred until, on 1st January 1853, the series re-started at '1'.

A new Patent Office was created in a Master of Chancery's office in Southampton Buildings, London WC, where, much extended, it remains to this day. A trademark registry was created in 1875, applying marks from 1st January 1877 onward; and the Patents, Designs and Trade Marks Act of 1883 not only transferred responsibility from the 'Commissioner of Patents' to a Comptroller General of Patents appointed by the Board of Trade, but also appointed the first Examiners. An Act of Parliament passed in 1902 ensured that investigation, albeit limited, was made into claims of novelty before patents were granted; by 1907, all British patents had been abridged and assessed in 146 classes occupying more than a thousand volumes. These provide a wonderful source of information, but are comparately rarely seen in their entirety.

The 1852-type grant system continued until 30th December 1915; from 1st January 1916, a new series began at '100001' to run on, supposedly sequentially, without regard to calendar years. The Patent Act 1977 then made an important change, as applications made after 1st July 1978 were numbered from 2000000 upward. However, processing claims made on or prior to 30th June 1978, often slowed by investigation (and litigation), ensured that the old numbering system survived into the present century. Numbers that had stood at about 1525000 on 1st July 1978 were approaching 1610000 by 1st September 2000.

A mark PATENT 12345 on an artefact of British origin, therefore, can have several interpretations:

¶ Registry in England (or, theoretically Scotland) prior to 30th September 1852, the last remnant of a cumulative non-specific system begun in the eighteenth century.

¶ Registry in any of the years between 1853 and 1915 in which more than 12,345 patents had been granted. In this case, but not infallibly, the marks will be found as PATENT 12345/67—the 12,345th of 1867—and the year date should be included (e.g., '12345/67' or '12345/1867') in cataloguing information. Few if any pre-1915 individual years exceeded thirty thousand grants.

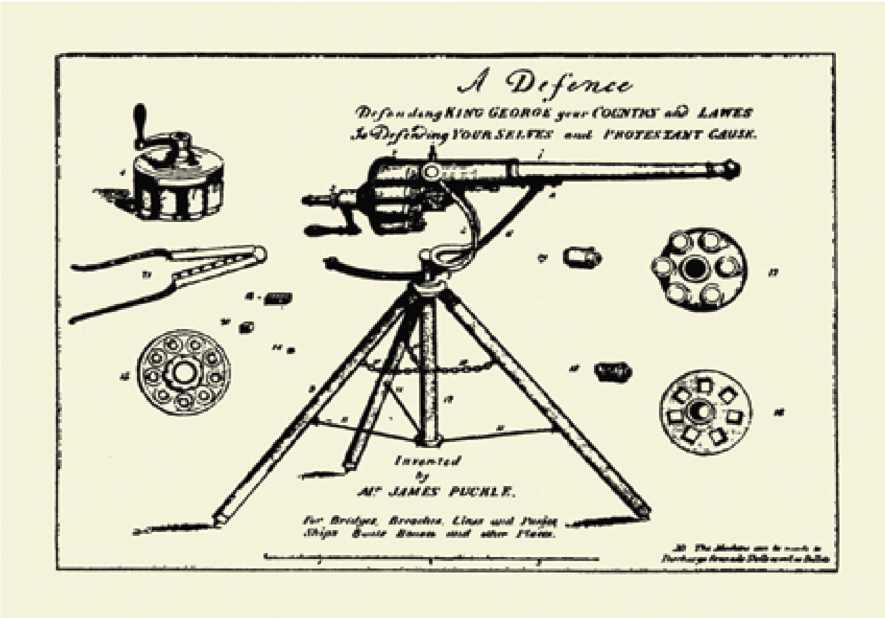

Plate 28. The Puckle Gun, an embryonic machine-gun, was patented in England in 1719.

¶ An agreement by which a particular patent (which may or may not be accompanied by its annual identifier) has been licensed to a manufacturer, common in cases where the inventor lacked suitable finance or production facilities. Thus the mark PATENT 12345 would be the 12,345th item to have been made in accordance with the licensing agreement, and, therefore, would not refer directly to the protecting legislation.

Patent no. 12345 cannot have been granted after 1st January 1916, as the new cumulative system began at 100001: grant no. 123456 dates from 1919. Patent growth was initially very slow, as only 2812 specifications were accepted in 1916 when ten times this number could have been expected. This was probably due to the First World War, which slowed inventive zeal in all areas excepting weaponry, and to a wholesale reduction in the 'communicated' (overseas) claims.

PATENTS ABROAD

The British system was well-organised, but this was not always true of other countries. Spain, for example, had a more flexible 'patent' system which, often misleadingly, could incorporate the registry of trademarks. Practically all

European countries with the exception of Austria and Austria-Hungary, which issued Privilegium numbered in annual-cycle sequences, relied on simple cumulative numbering series from which the earliest date of an item may be deduced with comparatively little difficulty. Knowledge of progression of patents in consecutively numbered sequences is an extremely useful tool, as it can often allow a 'not before' date to be fixed.

Information may be obtained from patent offices, but it is sometimes easier to make a date/number graph for each of the major patent authorities: Britain (post 1916), the U.S.A. and Germany. The French and Belgians often neglected to include patent numbers, relying simply on BREVET, BREVETÉ and DEPOSÉ, and too few Spanish items will be found to merit inclusion.

The U.S. patent system owed its inception to an Act, signed on 1st April 1790, which recognised the rights of men to profit from their inventions. A board comprising the Secretary of State, the Secretary of War and the Attorney General—or their nominees—was empowered to issue patents to endure no more than fourteen years on presentation of specifications, drawings and models.[7] In 1793, however, the Patent Board was abolished in favour of a fee-based registration system based not on novelty or utility, but instead on the raising of revenue. Finally, on Independence Day, 1836, a new Patent Act repaired much of the damage that had been done by the ineffectual grant system, and a system of investigating claims against 'prior art' appeared. On 15th December 1836, unfortunately, the Patent Office lodged in Blodgett's Hotel, Washington DC, was destroyed by fire together with more than seven thousand irreplaceable patent models, nine thousand drawings, and the entire application/grant records.

The continuous nature of U.S. patents, even though they began again at '1' after the implementation of the new Patent Act on 13th July 1836,[8] ensured that numbers had reached 6981 by 1st January 1850; 640167 by 1st January 1900; 2492944 by 1st January 1950; and 6009555 by 1st January 2000. One particularly helpful feature of marks applied in accordance with U.S. Patents (though they rarely include the actual number) is the legal requirement to state the day, month and year of grant. This is so unlike regulations governing the exploitation of protection in other countries that it can provide an immediate clue to nationality.

The U.S. Patent Office has also sparingly re-issued patents, numbering them separately from 1838 onward. Numbers representing this sequence will

7. If appropriate to the claims, models were expected to be submitted until the Patent Act of 1870 made them essential only if the Commissioner of Patents requested them. This system was abolished in 1880.
8. Numbers had reached 9957 under the provisions of the Patent Act of 1790.

Plate 29. This Elliott-Richards engine indicator, made about 1875/6, is marked ‘Richards Patent No. 10411’: the 10411th instrument made under the terms of the original licence.

occasionally be found, and, unless accompanied by proper identification, can be perplexing. Marks such as REISSUE or simply ‘RE$^{\text{D}}$’ can be helpful. Reissue numbers stood at merely 158 on 1st January 1850; at 11798 on 1st January 1900; at 23186 on 1st January 1950; and at 36479 on the first day of 2000.

The German system, which was implemented in 1877, six years after the foundation of the German Empire or *Deutsches Reich*, also runs sequentially. Patents granted by the German Federal Republic (1945–91) follow on from those granted during the Kaiserzeit (1871–1918), the Weimar Republic (1919–33) and the Third Reich (1933–45). The sequence has been continued since the reunification of Germany. However, a satisfactory individual year-date/patent number correlation has yet to be compiled. A few typical examples give an idea of the numerical progression: no. 1192 (7th August 1877), 28109 (4th November 1883), 65225 (16th February 1892), 105620 (20th December 1898), 256606 (22nd November 1911), 578765 (7th November 1930), 824160 (4th July 1950) and 1553964 (July 1966).

Even if the date/number charts or graphs are not available, individual artefacts may yield helpful links between patents and registered designs. For example, a British 'Viceroy'-brand mechanical razor, made by Rolls Razor Ltd of Cricklewood, London, lists appropriate protection as British Patents 501965, 502084, 513153 and 522426, dating from 1939–40. But it also lists British Registered Design no. 828796, U.S. Patents 2104929, 2290689 and 2311552 (1938–1943), in addition to U.S. Design no. 118240 (1939). The razor clearly post-dates 1943. Finding a British-made 'King Dick' wrench marked RD. NO. 765509, therefore, would indicate on the basis of the design-registry number that it dates no earlier than 1931.

The duration of patents, customarily enshrined in law, can also be useful. Pre-1852 English patents were granted, with significant exceptions, to run fourteen years from the application of the seal of the Lord Chancellor's office; the 1852 Act, though retaining the fourteen-year maximum, backdated protection to the date of application to ensure that infringement could not occur between the first submission and the final grant. Additional provisions included fee-supported renewal of patents after three and then seven years, and the submission of a Provisional Specification with the patent application.

Items made in the few months between initial submissions and the final grant will display marks such as 'P. P.', 'P. PT.', 'P. PAT.' or 'PROV. PAT.' For example, a tube-cutter made (or perhaps simply sold) by Buck & Hickman of London in the days immediately before the First World War is marked PRO.-PAT. 20142-13.

PATENTS: MISLEADING INFORMATION

The patents listed on industrial items often prove to have been granted to someone other than the manufacturer. This became increasingly common in the era of mass-production, where fewer inventors had the opportunity to produce and then market their ideas.

Many licensed them to well-established manufacturers, obscuring the origins of particular items, and others were employed by large and well-established businesses which viewed the work of employees as their own. An idea of this loss of identity is provided by the steam-engine valve gear first

Plate 30, preceding page. Marks on the external-spring Crosby indicator acknowledge patents ranging from 2nd July 1879 to 18th November 1902. Unfortunately, the numbers are not included in marks applied in the U.S.A.; consequently, it is necessary to search the Crosby name on international patent databases to correlate dates and numbers.

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used in 1842,[9] the work of Robert Stephenson's employees William Howe and William Williams. Stephenson habitually acknowledged this fact, but common usage (and Stephenson's early death in 1859) soon blurred the distinction until "Stephenson's Valve Gear" resulted.

Another instance concerns Waffenfabrik Mauser & Co., a world-renowned supplier of military rifles by 1914, which secured the lasting reputation of its surviving 'founding father', Paul Mauser, by filing all patents in his name. It is doubtful if Mauser personally undertook design work after about 1890, but involvement of others, with one well-documented exception, is now impossible to prove.[10]

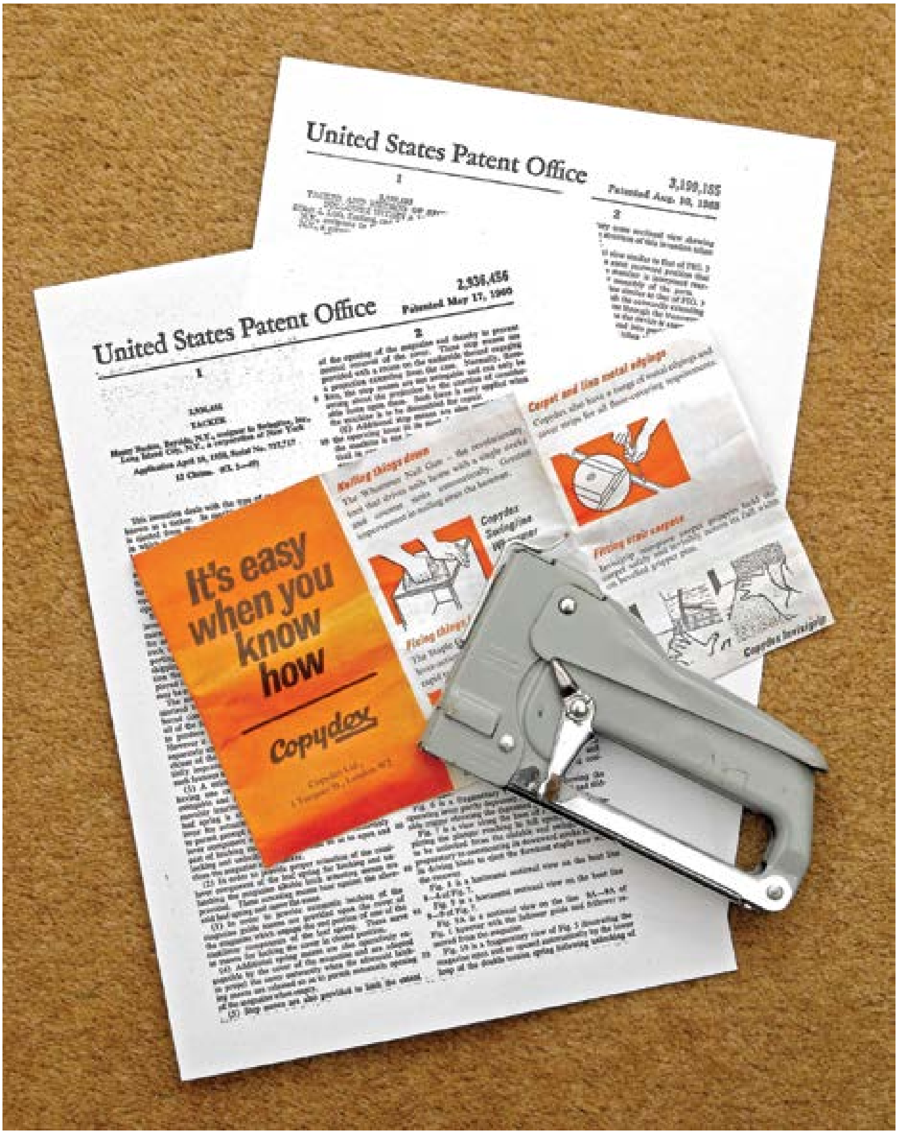
Another problem can be provided by 'Communicated' patents, which often bear the name of a British patent agent working on behalf of an inventor domiciled overseas. Prior to 1859, the identity of the inventor was seldom revealed; it then became a statutory requirement. Yet many spelling mistakes were still made in British records—particularly foreign names—and there have been lapses of geography.[11] Other problems may arise from the transfer of patented designs by licence, which often allowed differing manufacturers to make the same items at the same time. It was common to find notes such as 'the proprietor of British Patent 12345/06, for improvements in the manufacturer of the widget, seeks interest from patents wishing to benefit from his invention…' in periodicals such as *The Engineer* or *Engineering*.

A major flaw in the use of patent information to date items is provided by the retention of marks, often for historical reasons, long after the patents themselves have elapsed. The Crosby external-spring indicator illustrated in Plate 24 was made *c*. 1910. In addition to the name of the Crosby Steam Gage & Valve Company and the shield-like trademark, the markings on the body also allude to six U.S. Patents: two granted in 1879, two in 1882, one in 1895 and one in 1902. Granted to G.W. Crosby, U.S. Patent 219149 of 2nd September 1879 protected the design of the first indicator, an unusual instrument that

9. Known originally as 'Williams & Howe Gear', the perfected mechanism was fitted for the first time to North Midland Railway 2–4–0 locomotive no. 71, 'rolled out' of the Newcastle upon Tyne factory on 15th October 1842. The patent was granted in the name of Robert Stephenson & Company.

10. The Mauser 'broomhandle' pistol, introduced in 1896, was originated *c*. 1894 by the three Feederle brothers. Fidel Feederle managed the principal Mauser in Oberndorf am Neckar factory at this time.

11. In one case, for example, Zella St Blasii, in the Thuringian forest (Thüringerwald) district of Saxony, then part of the German Empire, was placed in Austria-Hungary.


United States Patent Office
3,199,155
Patented Aug. 10, 1965
United States Patent Office
2,936,456
Patented May 17, 1960
It's easy when you know how
Copydex


LOAD STAPLES
POINTS UP
Swingline INC.
LONG ISLAND CITY, N.Y. 11101
MADE IN U.S.A.
U.S. PATS. 2,936,456, 3,199,155
EXTRACTOR

Plates 31 and 32, preceding page. The inclusion of a Copydex leaflet with this U.S.-made Swingline stapler confirmed the date of sale to be 1981. However, the acknowledgement of two U.S. Patents indicate dates of 1960 and 1965. The later date is, therefore, the earliest the tool could have been made. The markings on the sole plate confirm the actual manufacturer's name; Copydex merely sold the staplers in the UK. *John Walter collection. Patent papers by courtesy of the U.S. Government Patent Office, Washington DC.*

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encountered limited sucess. A modification credited to Gilman W. Brown was granted protection on 5th September 1882 (U.S. Patent 263843), but was immediately replaced by a better design protected by U.S. Patent 256295 of 11th April 1882; this was the original form of the well-known Crosby internal-spring design. Patent 538515, granted on 30th February 1895 to Albert F. Hall, protected the strengthened form of the amplifying mechanism identified by a straight rear link—the 1882 form had been curved—and U.S. Patent 713611 was granted to Theodore Davidson on 18th November 1902 to protect the basic construction of the external-spring indicator. Gilman Brown, Albert Hall and Theodore Davidson were all listed in the patent specifications as assignors to the Crosby Steam Gage & Valve Company of Boston, Massachusetts, and it is clear that the 'Crosby' indicator only owed a part of its parentage to Gordon Crosby himself.

REGISTRY MARKS

Registering a basic design conferred less protection than a patent, but weaker criteria ensured that it was easier to obtain and hence appreciably cheaper. The first British marks were applied in 1839 under the provisions of the Registry of Designs Act,[12] which required the name and address of the claimant to be displayed on items in addition to the date of registration.

However, this system lasted only until 1842, when a coded marking system was introduced; this in turn lasted until the advent of the Patents, Designs and Trade Marks Act of 1883 introduced a cumulative numbering system. The system used in 1842–83 consisted of a diamond-like mark containing 'RD' bounded by convex fences to form a separate compartment in each apex, with an encircled class mark—in roman numerals—surmounting the diamond. Thirteen class marks were used, 'III' signifying glass and 'IV' containing ceramics.

Prior to 1868, the compartments contained (clockwise from the top) a year-date code, the day of the month of registry, a 'parcel number' (a batch-

12. See 2 & 3 Victoria, cap. 17. This superseded an 1814 amendment to the Sculpture Copyright Act of 1797, which had allowed designs to be protected if they bore 'Published by', the modeller's name and address, and the date of registration.

Plate 33, next page. The first page of a typical British Patent specification of the 1930s, giving considerable detail in addition to descriptions of the items to be protected: for example, the dates of application, the name, address and profession of the patentee and any assignments of rights. *By courtesy of the UK Intellectual Property Office, London.*

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reference referring to the day of registration), and the coded month of registry. The identification sequence of post-1868 marks became the day of the month of registry at the top, beneath the class identifier, followed by the year, the month and the parcel number.

The month-codes are believed to have been 'C' (sometimes read or possibly even applied as 'O') for January; 'G' for February; 'W' for March; 'H' for April; 'E' for May; 'M' for June; 'I' for July; 'R' for August; 'D' for September; 'B' for October; 'K' for November; and 'A' for December.[13] The year-codes began in 1842 at 'X', then ran H C A I F U S V P D Y J E L K B M Z R O G N W Q T, to recommence in 1868 at 'X'. An identical sequence continued until 'K' was reached in 1883,[14] but the system was then abandoned in favour of numerical progression. Marks granted after 1883 can include REGISTERED DESIGN, REGD. DES., REG^D, or even R.D., and may (but rarely) be accompanied by a number from which a date may be deduced. The marks applied since 1955 have usually been distinguished with ®.

Similar systems were used elsewhere. The official registry in the U.S.A. began to issue protection for 'Designs' in 1842, at number 1, and had reached no. 258 by 1st January 1850. By 1st January 1900, the numerical series had advanced to 32055; it had reached 156686 by the first day of 1950; and stood at 418273 on 1st January 2000. The German patent office began the issue of 'DRGM' or 'D.R.G.M.' (*Deutsches Reichs Gebrauchs Muster*, 'German Empire Utility Design') in 1891, numbering them in a single series until the end of the Second World War. The mark was then changed to 'DBGM' in 1952, substituting *Bund* ('Confederation') for *Reich* ('Empire') and is still being used.

QUALITY ASSURANCE MARKINGS

This category contains, among other things, marks applied to raw material and finished goods by assayers, gold- and silversmiths, pewterers, cutlers, metal-casters, proof houses and many other agencies. Most of them simply confirm that prescribed standards of workmanship, purity or strength have been reached. Marks were registered by many medieval guildsmen, and the basic method was perpetuated until the livelihood of their descendants was

13. According to Geoffrey Godden, *New Handbook of British Pottery & Porcelain Marks*, 'K' was used for August and September in 1860, and 'R' was used from 1st August 1857 until 19th September.
14. The letter 'W' was applied for the first week of March 1878, but the year-code then reverted to 'D'.

RESERVE COPY

PATENT SPECIFICATION

Application Date: Jan. 7, 1938. No. 579/38.

513,153

Complete Specification Left: Dec. 9, 1938.

Complete Specification Accepted: Oct. 5, 1939.

PROVISIONAL SPECIFICATION

Improvements in or relating to Hair Cutting or Clipping Machines

We, ROLLS RAZOR LIMITED, a British Company, of 255—289, Cricklewood Broadway, London, N.W.2, and EDGAR HAROLD LAW, a subject of the King of Great Britain, of the aforesaid Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to hair cutting or clipping machines and has particular reference to what are now known as dry shavers.

The chief object of the present invention is to provide an improved construction of mechanically operated dry shaver.

According to one feature of the invention, the dry shaver comprises gearing for actuating the movable cutter member, that can be operated by means of an operating arm or lever extending from the shaver casing, which is pivotally mounted at the upper part of the device, i.e. adjacent the head or cutting end. Normally the operating lever is so disposed that it can be gripped when the device is held in the hand and thereby moved or pressed inwardly about its pivotal axis against the action of a spring to set the gearing in motion for operating the movable cutter, which is mounted within and co-operates with a fixed or stationary cutter. The upper end of the operating lever is preferably connected to an operating quadrant which is located at the lower part of the casing.

According to a further feature of the invention, the gearing and mechanism is self-contained within a frame and the parts are so mounted that the casing can be opened for removal or inspection of the mechanism without any parts becoming displaced or dislodged from their proper positions.

Further, according to the invention, various improvements in the details of the gearing and the arrangement of the parts are provided as will be hereinafter specified.

In one embodiment of the improved dry shaver, the casing may comprise two parts which are suitably held together, to contain within them the aforesaid gearing from which extends the operating handle or lever through a suitable slot in one side of the casing at the upper part thereof. The said lever is pivotally mounted in the upper part of the aforesaid frame, which latter is constituted by two side members held together by pillars and containing between them the aforesaid gearing. On the exterior of one of the side members is a connecting link which extends from an arm on the spindle or shaft of the operating lever to another arm at the lower part of the frame and within the frame, this lever being adapted to operate the quadrant which imparts the movement to the aforesaid gearing. The aforesaid frame member against which the exterior connecting link bears, is formed with arcuate slots to permit of the necessary movement of the aforesaid arms, and preferably the arm at the lower part is shorter than the arm at the upper part, the whole arrangement affording an increased quadrant movement in relation to the long hand lever and also affording increased acceleration so that with one inward movement of the hand lever the gearing will operate for some considerable length of time to impart a prolonged rapid reciprocatory movement to the inner cutter or shearing member. The quadrant is so disposed within the frame that it can engage with one of the pillars connecting the two frame members, so that when dismantling the shaver the quadrant moving under the influence of its spring, merely engages or bears against the said pillar and does not fly out of position when the mechanism is lifted out of the casing. The quadrant is toothed to co-operate with a pinion associated with ratchet and pawl mechanism on a gear wheel which meshes with another small pinion on a shaft of another gear wheel in mesh with a pinion on a flywheel member having an eccentric that engages with a pivoted lever, the outer or free end of which engages the reciprocatory inner cutter member in order to impart reciprocation to the latter when the gearing is operated. The aforesaid ratchet and pawl mechanism is so designed as to afford a positive action and smooth running. The pawls are shaped with enlarged heads which are grooved on their

[*Price* 1/-]

Price 5s. 0d.

Price 4s 6d.

Plate 34, next page. A four-page leaflet advertising the Hornsby-Stockport gas engine, published in June 1922. This example confirms the name of a major distributor, as well as the precise design of the engines in this particular period. *Author's collection.*

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threatened by nineteenth-century industrialisation. Gunsmiths, silversmiths, iron-founders and many others have left identifiable marks to help researchers. However, though some areas have been subjected to minute scrutiny (and many sources of additional information are listed in the Bibliography), others are still largely untouched.

The best known are the hallmarks applied to precious metals, which can reveal the date and place of assay, and the identity of the manufacturer. Most British marks consist of four elements: a national mark, the mark of the assay office, a letter representing the year-date, and a maker's mark. Many books provide a guide to identification (particularly valuable owing to the use of differing letter styles), and only a guide will be given here.

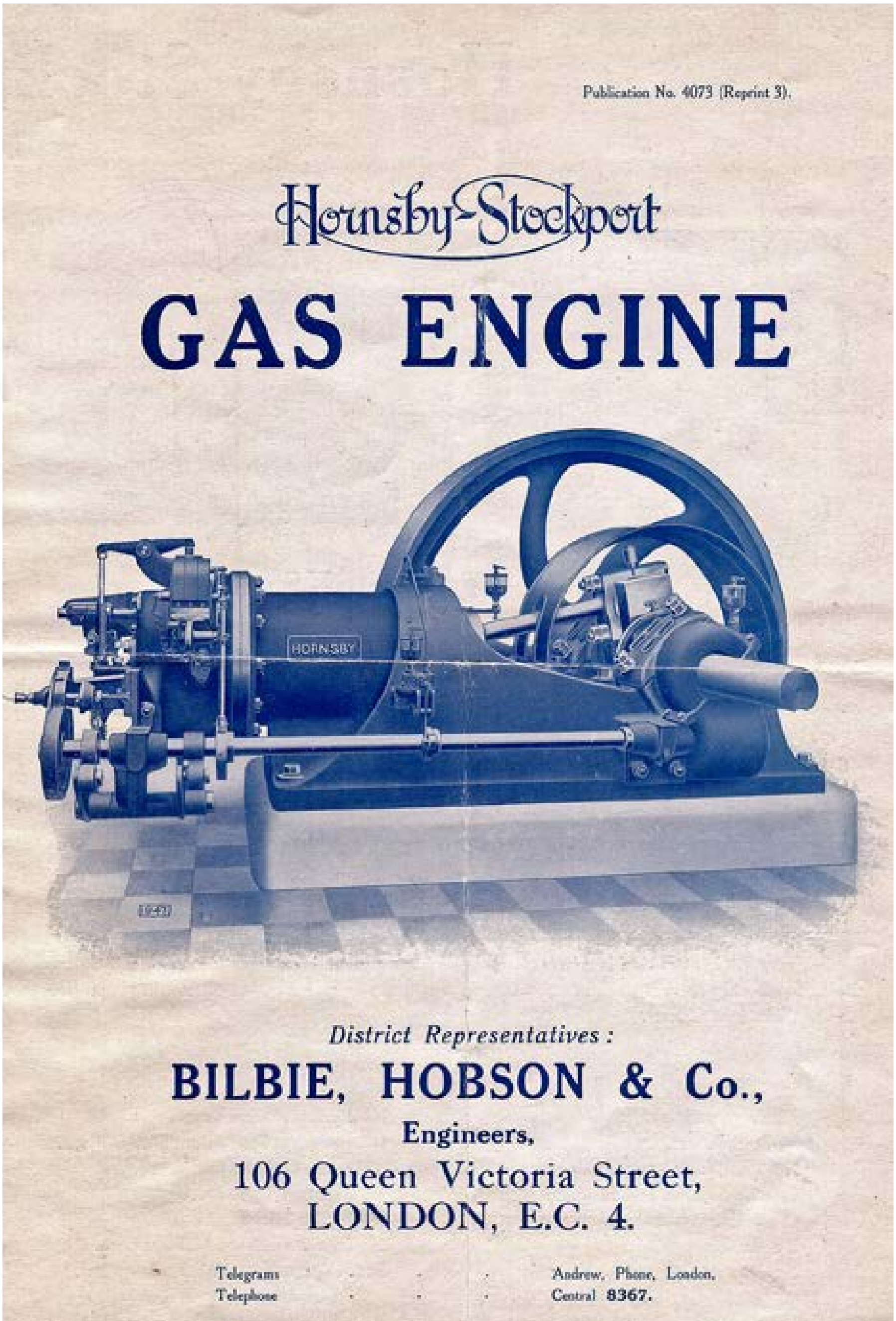
A study of hallmarks may seem anachronistic, and of little real use to the industrial archaeologist and historian owing to its connotations with 'craft' instead of 'industry' (terms with definitions which are very blurred!). However, the facility with which nineteenth-century manufacturers produced goods such as clocks, watches and jewellery means that even gold has been used surprisingly widely in the last two hundred years.

Hallmarks—and, indeed, many proof marks—are complex blends of heraldry, letters, numbers and pictorial representations. This makes them difficult to consider under a single heading, though the primary tasks of dating the piece and identifying the maker are usually undertaken on the basis of the date letter.

British assay-office marks include the lion's head affronté signifying London (originally the mark of the Worshipful Company of Goldsmiths), which first appeared on gold ware at the beginning of the fourteenth century. The lion's head was surmounted by a crown until 1822.

Chester assay office used a sword between three garbs (sheaves of corn) until this gave way to three lions dimidiated with the garbs, a mark that survived until the facilities were closed in 1962.[15] Active until 1856, York assay office originally used a lion's head affronté dimidiated with a fleur de lys, but this gave way first to a seeded rose and secondly, in 1701, to the original city Arms of five lions passant on a cross.

15. The second-pattern or dimidiated Arms of Chester were confirmed in 1580, the sword, complete with scabbard and belt, being removed to the crest. The original simple Arms were re-granted to Cheshire County Council in 1938.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Hornsby-Stockport
GAS ENGINE
HORNSBY
District Representatives:
BILBIE, HOBSON & Co.,
Engineers,
106 Queen Victoria Street,
LONDON, E.C. 4.
Telegrams - - - Andrew, Phone, London.
Telephone - - - Central 8367.

Glasgow perpetuated its Arms, matriculated in 1866 (though derived from a seal of 1684), until assaying finished in 1964. The design included a tree, a bird, a fish and a ring. Norwich briefly used a castle above a lion passant (the city Arms recorded in a Visitation of 1562) prior to c. 1620, then changed first to a seeded rose, and then to a rose 'leafed and slipped'—with a short stem.

In Scotland, Arbroath had a portcullis, Banff had the Virgin and Child, Dundee had a pot of lilies, Elgin had a bishop-and-crozier, Montrose had a rose, and Perth had the Holy Lamb bearing the Banner of St Andrew (all from the shields of Arms); Inverness, idiosyncratically, had a dromedary, a supporter of the Arms; and St Andrews had a saltire or St Andrew's Cross.[16] Greenock had a 'Green Oak', a punning mark unrelated to the Arms. Among pictorial symbols were the anchor used by Birmingham and the crown used by Sheffield from 1773 onward, neither of which derived from their Arms.

The proliferation of assay offices prior to the eighteenth century, when they stretched in Britain from Truro to Inverness, ensured a commonality of marks and, therefore, created problems of identification. For example, three triple-towered castles have featured in marks applied by Aberdeen and Newcastle, matriculated in 1674 and 'recorded and confirmed' in 1575 respectively. Single triple-towered castles appear in the marks of Edinburgh from 1759 onward; Exeter, in 1701–1882, replacing a crowned punning X; and possibly also Ayr.[17]

The 1904 Hallmarking (Imported Plate) Act not only refined the marking of caratage on goldware but also introduced new British assay-office marks destined solely for Plate emanating outside Britain. These included a faced sunburst for London, a triangle for Birmingham, an acorn and oakleaves for Chester, a shamrock for Dublin, a sheath of eight arrows in saltire (points downward) for Sheffield, and a simple St Andrew's Cross for Edinburgh.

Not all of these proved to be satisfactory, and so, in 1906, London's mark became a horseshoe on a cross on a circle; Dublin adopted a water bourget; and Sheffield began to use the Greek letter omega (Ω) above a bar. The shape of the cartouche indicated the material, a square with chamfered corners for silver, an oval for gold, and a cross between a pentagon, and a square for platinum.

After the implementation of the 1973 Hallmarking Act at the beginning of 1975, only four assay offices remained in the United Kingdom: London,

16. Most of these derived from seventeenth-century Arms, though the grants to Arbroath (1900), Inverness (1900) and St Andrews (1912) were much later. However, virtually all had earlier origins: the Arms of Perth and Dundee were in use by 1378 and 1416 respectively, and the others derived from seals pre-dating 1439.

17. Edinburgh's Arms were matriculated in 1722, but were in use by the end of the fifteenth century; Exeter's, with its representation of Rougemont Castle, was granted in 1564; Ayr's, based in a thirteenth-century seal, was matriculated in 1673. Marks of this type are often so small that, particularly when worn, they can appear as three letters 'X'

retaining the lion's head affronté; Edinburgh, with the castle; Birmingham, using an anchor (vertically on silver but horizontally on gold or platinum); and Sheffield, marking all precious metals with a seeded York Rose.[18]

Assay marks were customarily a small lion passant in a cartouche that was approximately rectangular, though the corners were chamfered and the lower edge could be decoratively scalloped. A mark of this type was introduced by the Worshipful Company of Goldsmiths in 1478, and then adopted in 1544 to signify silver of Sterling quality.

A short-term change was then made on the introduction of Britannia Silver (0·958 pure) in 1696. The standard had been raised from Sterling (0·925) to combat the widespread conversion of silver coinage to Plate that went otherwise undetected. The new or post-1697 marks, a lion's head erased and Britannia, were used exclusively until the re-introduction of Sterling standard by an Act of Parliament 1719. However, 'Britannia Standard' remained optional and limited use of special marks persisted for many years.

Though the lion passant was adopted for all English assay offices by the 1719 Act, a thistle served Edinburgh from the demise of the 'Deacon' or assay-master cyphers in 1759 until the implementation of the 1973 Hallmarking Act, and a lion rampant was used by the Glasgow office from its foundation in 1819 until closure in 1964. Dublin has used a crowned harp since the seventeenth century, the figure of Hibernia being added in 1731. Goldware made after 1784 also bore a fleur-de-lys (20ct) or a unicorn (18ct) in addition to the standard marks, though the harp was habitually omitted from jewellery and significations of a purity of 15ct or less.

The style of the date-letter and the shape of its cartouche are significant, but can be difficult to determine if the marking is worn or badly struck. Yet the options can be reduced to a handful if the interpretative key is known. After 1916, the order of the marks, which had occasionally varied from office to office, was stabilised: the sponsor's or "maker's" mark and the assay mark came first, followed by the assay-office mark and the date letter. The assay mark for silver was either Britannia or the lion passant (lion rampant for Edinburgh only), depending on the purity; gold was signified by a crown, and platinum by an orb.

The use of abbreviated manufacturer's marks first appeared on English goldware in 1363, and the use of letters to camouflage the date has also been a long-term feature of British hallmarks—though the sequences may be difficult to identify. Marks applied by the London assay office are usually the easiest to interpret. Beginning in 1478, they ran in twenty-year alphabetic

18. The crown had been the Sheffield silver mark, which meant that the 'York Rose' had appeared on all caratage of gold from 1904 onward, accompanied by the crown on 18ct and 22ct items only.

progressions ('A'–'I', 'K'–'U') until the introduction of Britannia Standard in 1696. Consequently, one sequence ends with two years of 'V'—which was actually 'U' in its traditional form—before the next commences. The dates of the sequences can be assessed first by the design of the lettering and secondarily by the shape of the enveloping cartouche.

Outside London, dating was often less certain. The length of individual cycles varied according to assay office, sometimes extending to 25 years (usually 'A'–'Z' excluding 'J'), and individual series may even be random instead of sequential. The cycle begun in Sheffield in 1799 typifies this problem: E N H M F G B A S P K L C D R W O T X I V Q Y Z U. Elsewhere, if production was erratic, some letters in sequence were never used; Newcastle-upon-Tyne, for example, does not seem to have assayed goods in 1709–11, 1713 and 1715–16, and changed the style of the lettering (as well as the shape of the cartouche) part-way through the series that began in 1759. Date letters of the four remaining British assay offices were altered to run from 1st January under the terms of the 1973 Hallmarking Act, commencing in 1975.

Sheffield, or 'Old Sheffield' Plate (see page 30) was made in quantity from the 1750s until the 1860s. Its popularity then gave way to electro-plated ware, which was often identified by EP, EPNS or EPBM (for 'electro-plated', 'electro-plated nickel silver' and 'electro-plated Britannia metal' respectively). Many misleading marks were used on Sheffield Plate in an attempt to delude buyers that they were buying silverware, until action was taken to restrict them. The same was also once true of electro-plated goods, which could display symbols such as a bell, a hand, cross arrows (from the Arms of Sheffield), a pineapple, or keys in saltire; however, use of a crown in any form was prohibited in 1896.

Purity of metal has been marked numerically in Britain since 1854, when the 9-carat, 12-carat and 15-carat standards were introduced. The purity of gold had originally been set at 19⅕ carats *c*. 1300, the first maker's marks appeared in 1363, and the standard was revised to 18-carat in 1477. A coded date letter was added in 1478, a separate lion-passant assay mark was introduced in 1544, and a rise in purity to 22-carat occurred in 1575. Finally, a change in 1798 saw the approval of two standards of purity, 18-carat and 22-carat, the former being signified by a crown replacing the lion passant and the latter by a crown in addition to the lion passant. Another change in 1854 saw the abolition of the separate marks on 22-carat and 18-carat gold, and the introduction of three lesser purities: 15-, 12- and 9-carat. These were marked as '18' in a square cartouche, with chamfered corners, until the 12-carat and 15-carat grades were replaced in 1932 by a single 14-carat standard. At this time, the purities of the two poorest standards were

Plate 35. Hallmarks are customarily associated with 'craft items', such as this silver-gilt tray made during the reign of George IV (1820–30), but will also be found on items—clocks and watches, for example—that were made in quantity. *By courtesy of Christie's, London.*

additionally signified by decimal equivalents—'0·375' and '0·585' for 9- and 14-carat gold respectively.

Exceptions were made in 1904, when marks specifically intended for 'Foreign Plate' appeared. These took an exceptionally unusual form; the caratage value, in a cartouche shaped according to purity, was set at right angles to an oblong cartouche containing the purity expressed as a decimal. The surrounds of the 22-carat ('0·916'), 20-carat ('0·837', Dublin only, 1904–32) and 18-carat ('0·756') were rectangular; the 15-carat ('0·626') surround was oval; and 12-carat ('0·5') and 9-carat ('0·375') marks lay within diamonds. The 15- and 12-carat categories were then replaced by a single 14-carat standard in 1932, the new mark (or '0·585') lying within an oval cartouche. The 1973 Hallmarking Act affirmed the use of millesimal purity instead of caratage: '916' (22-carat), '750' (18-carat), '585' (14-carat) and '375' (9-carat).

Proof marks have been applied to firearms of all types, civil and military, for years. The principal proof houses in Britain, in London and Birmingham, first enacted proof in accordance with a law passed in 1813. Since amended several times to account for changes in procedure, the introduction of new forms of propellant and the importation of firearms from abroad, the system of crowned abbreviations gives clues to date, as well as some of the details of the proving process. Typical of commercial marks is a crowned BNP, 'Birmingham Nitro Proof', but military weapons were marked very differently and individual marks can be much harder to identify.

A form of guarantee or 'proof mark', often of dubious standing, may be found in the form of WARRANTED CAST STEEL or a similar qualification. Few of these have any significance in law—indeed, many are misleading—but they sometimes give a clue to date or origin.

TRADEMARKS AND BRAND NAMES

These provide another source of data, as they can appear on a wide range of interrelated items: not only on the artefacts themselves, but also on supporting literature and advertising material. Some are easy to identify, particularly when they are either universally known or effectively the same as the name of the user; others can be identified by association with the company name, perhaps elsewhere on the name plate or cast into a component. But there are many instances when the appropriate records are difficult to access—which is particularly true of marks granted before the Second World War if no other information is to hand.

The identification of trademarks is often more difficult than brand names, where (with a few exceptions) words are easy to define. The interpretation of pictorial marks and monograms may be much more subjective. It may not be easy to determine what the originator of a mark had in mind, especially if the illustration shows something that enjoyed only a short period in vogue, or if a group of cursive letters is intertwined to the point where clarity is lost.

An illustration of the first problem is given by the names applied to a group of inexpensive Spanish pistols made prior to 1914: The 'Titanic' was named to mark the commissioning of RMS *Titanic* of the White Star Line, the largest passenger liner of its day (not the tragic sinking only a few months later); 'Stosel' or 'Stossel' honoured General Anatoly Mikhailovich Stössel, the heroic Russian defender of Port Arthur during the war with Japan (1904–5); 'Terrible' was named after the British first-class protected cruiser that had become famous during the South African War (1899–1902); and 'Peral', often identified as a misspelling of 'Pearl', commemorated a naval engineer, Isaac Peral y Caballero, who had designed Spain's first successful submarine.

The widespread introduction of brand names encouraged manufacturers to hide behind them. A good example of this may be seen in German goods

Plate 36. The dial of this pressure-test gauge by the Crosby Steam Gage & Valve Company of Boston clearly shows the shield-like trademark. *Canadian Museum of Making collection.*

exported to English-speaking markets which usually favoured the products of Sheffield or Birmingham. Robert Hartkopf of Solingen, for example, traded from the 'Hudson Cutlery Works' and C.F. Ern masqueraded as the 'Crown and Sword Razor Works'. Solingen smiths rarely copied specific marks associated with their rivals in Sheffield, such as George Wolstenholm's IXL ('I excel'), although Nathan Kastor did register the trademark XLNT ('excellent'). This was largely due to the registry of many original British marks in Germany.

Yet the predilection for English-sounding brand names continued until the First World War began in 1914: FLYING SCOTCHMAN was registered in 1902 by Böntgen & Sabin of Solingen; LORD KITCHENER by Robert Melcher (1904); LORD ROBERTS by Henry B. Simms of Hamburg (1901); and KNIGHT COMMANDER OF THE BATH by C. Friedr. Ern (1904). North American sales were aided by the brand name UNCLE SAM, registered in 1907 by Robert Klaas of Solingen; and by BUFFALO BILL, registered in 1905/6 and again in 1923 by Robert Middeldorf. John S. Holler & Company of New York, clearly with family ties in Germany, registered THE TOWER BRAND on a flag-topped tower in 1899).

The destination of many knives and bladed tools may be evident in the brand names and trademarks that appear on them, as it was by no means

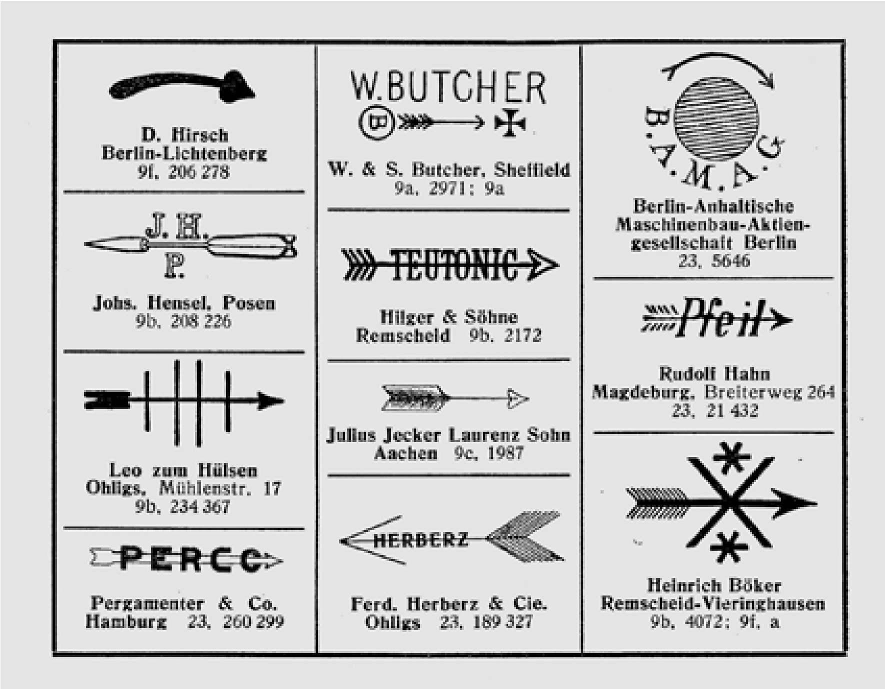


Plate 37. Taken from a register of trademarks and brand names granted to makers of cutlery and metalware, published in Germany in 1924, these entries not only illustrate the registered mark, but also gives its number and the class of goods to which it was applied. The weakness of coverage is simply that no dates are given, and the index of the six-volume set is needed to check if the word-marks were used by more than one agency. *By courtesy of Henning Ritter, Hubertus-Stahlwarenfabrik, Solingen.*

unusual for individual cutlers or distributors to export to specific markets. Consequently, Spanish-language brand names indicate sales in Spain, or, more commonly, in central and southern America. Berg & Company of Solingen registered several registered EL PEINE ('the comb'), LA VELA ('the candle'), LAS ROCAS ('The rocks') and EL LOBO ('The wolf'). Marks in Cyrillic usually indicate sales in Russia: ТОЛСТОИ or 'Tolstoy' was registered in 1900 by Köller & Co. of Solingen, and СИНГЕРЪ, 'Singer', was registered by Weissweiler & Co. of Köln (1904). Others could be destined for the French market, such as TOUJOURS EN AVANT ('Always ahead') granted in 1901 to Carl Spitzer of Solingen. Other marks were in Greek, and a few may even be found in Dutch or Hungarian. Chinese characters were used by Georg Richter (1895), Corn. Cremer & Co. (1895) and

Fertsch & Laeisz (1899), all of Hamburg; a Japanese *mon* by German-owned merchants Carl Rohde & Co. of Yokohama (1896); and a ying/yang mark by Taumeyer & Company of Shanghai (1896).

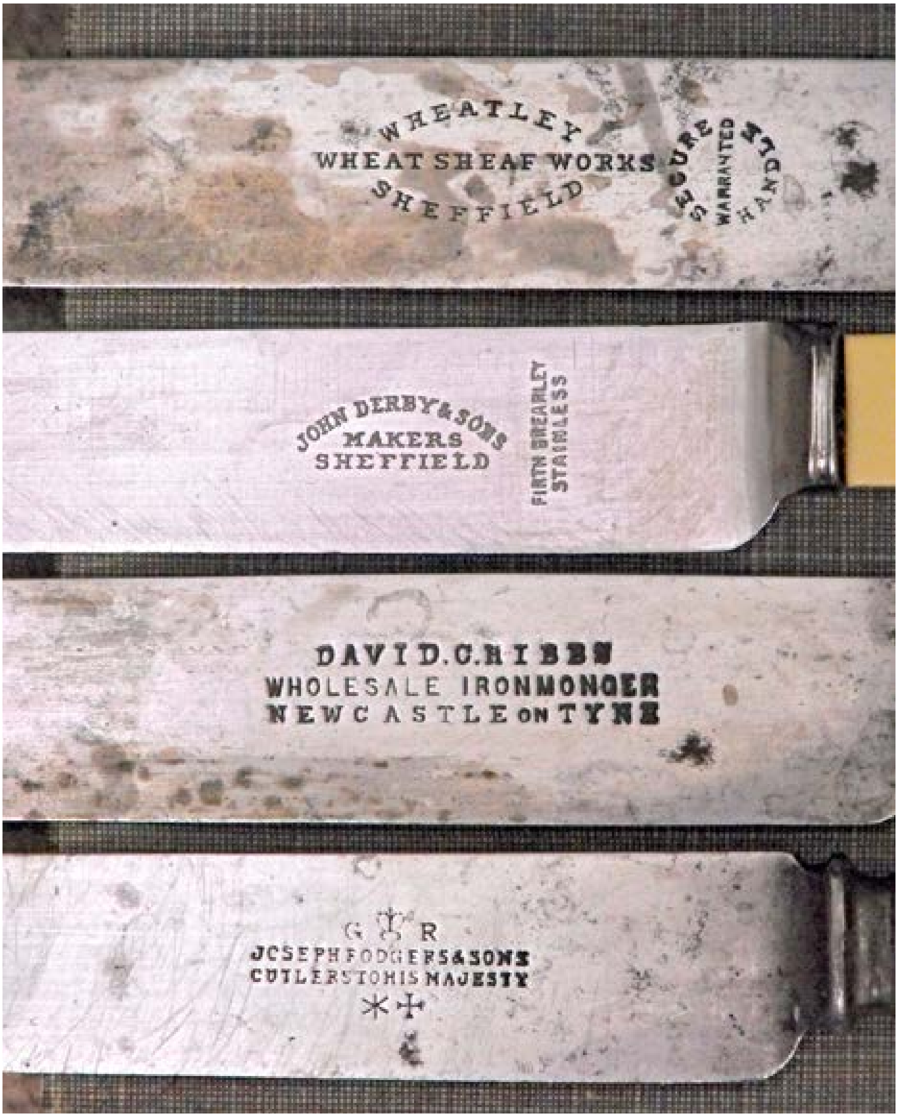
Marks such as GERMANY or MADE IN FRANCE usually show that the item was made during the period of restrictive legislation that began in the last quarter of the nineteenth century. For example, the British Merchandise Marks Act of 1887 forced distributors of goods originating outside the British Isles to mark them clearly—and, it was hoped, discourage imports by associating them with inferior standards of 'foreign' manufacture in an era when the British prided themselves greatly (but often mistakenly) on the high standards of their craftsmanship.

It has been argued that concepts of 'free trade', and a reluctance to be told what to buy, undermined British attempts to influence the importation of goods 'made abroad'; much more effectual was the bill approved by the U.S. Congress on 1st October 1890, which forced imports entering the U.S.A. from 1st January 1891 to be marked with the country of origin in English. Now universally known as the 'McKinley Tariff Act' after its principal proposer, Congressman William McKinley (subsequently President of the U.S.A.), this act increased duty on imports by an average of nearly fifty per cent.

McKinley sought not only to improve sales of American-made goods but also to explore foreign markets, hoping to negotiate reciprocal trade agreements (using the Tariff Act as a bargaining tool) and assure American manufacturers of plentiful supplies of cheap raw material. Though the immediate results were catastrophic, particularly in agriculture, the McKinley Act had a long-standing effect on markings applied to manufactured goods. The U.S. Revenue Act of 23rd November 1921 amended the rules to ensure that the prefix 'MADE IN…' was added to the country of origin from 1st January 1922, and these requirements are still in place.

Attempts can be made to search trademark journals and registers, particularly through national patent offices, but the results can be patchy unless visits can be made to the offices themselves or to central libraries. Published information is often sketchy; the ease of identification of trademarks is greatest with large-scale items such as railway locomotives, motor vehicles or aeroplanes, and most problematical with the many small mass-manufacture items that bear nothing but the marks themselves—knives, cigar cutters, razor blades, locks, buttons or small storage tins.

Small portions of the immense historical-industrial output have been studied in extreme detail, yet there are still huge gaps. For example, the needs of the collector of pottery and porcelain are far better served than those of the bladed-tool collector. And although many impressive lists of manufacturers—German toolmakers, English shipbuilders, North American stationary steam-engine makers—may be found in literature or on websites, only rarely do they attempt to match these names with the registry details of brand names and trademarks. This is a problem that needs to be addressed before real progress can be made.



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