Collecting Drawing Instruments

2nd Edition

David M Riches

Contents

Preface

This book is written primarily for the ordinary collector; one who is not a millionaire and who has to balance the spend on his collection against a budget. For that reason I have decided to concentrate on instruments that date from the late eighteenth century onwards, that the ordinary collector can reasonably hope to find and purchase.

I have used my own collection as a basis. When the first edition was published the most I had spent on any item was £300. Since then I have spent more on a couple of large sets but most of the sets and individual instruments have only cost a small fraction of that amount. I started collecting back in 1995 when I inherited some interesting items. I had already decided that I would like to collect the tools of my profession, namely mechanical engineer. I had also obtained a copy of Michael Scott-Scott's 'Drawing Instruments', Shire Album 180, which proved to be a useful introduction to the subject. However I soon realised that the field of drawing instrument collecting is a far wider one than that portrayed by Scott-Scott.

In this book I have attempted to show this wider aspect and I have described each of the main patterns of drawing instrument produced in the 1780 to 1980 period and the differences in style between each of the major manufacturing countries.

I have deliberately avoided giving a detailed history of the development of technical drawing and drawing instruments. This has already been amply covered by the late Maya Hambly in 'Drawing Instruments 1580 to 1980' (Sotheby's, 1988). However I have given some historical information on each of the major makers/sellers. It should be noted that the name printed on a case or stamped on an instrument is not necessarily that of the maker.

In this second edition I have added further information that has come to light since the first was published and taken the opportunity to change some of the pictures in the Gallery.

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Acknowledgements

I would like to thank all those who have helped me with this book. Patrick Mill, Chairman of the Scientific Instrument Society, and Michael Stewart kindly read through the manuscript, meticulously pointed out my typos and errors of punctuation, and made some useful recommendations regarding the introduction. Ron Bristow also read through the manuscript and helped with the information on Elliott Brothers and its predecessor firms. Peter Hopp suggested the publisher and found yet more typos.

In preparing this second edition Peter Hopp and Rod Lovett suggested and facilitated its publication as an electronic book on the UK Slide Rule Circle website for which I am extremely grateful. Also Martin White helped with new and corrected information on W H Harling.

I would also like to thank my wife, Anne, for her patience whilst I spent long hours taking photographs and writing this book, and again for the second edition.

Introduction

Mathematical instruments have been in use since the beginning of civilisation. They were in use at the time of the building of Babylon and were well known to the Egyptians. The earliest surviving examples date from Roman times.

During the Renaissance they were developed in form as objects of both function and beauty. Instruments of this date, however, rarely appear on the market today and are generally only to be seen in the major museums. By the middle of the Georgian period they were in commonplace use and it is from this time forward that they can be found and purchased for a reasonable sum. The best instruments continued to be hand-made to very high standards until the early years of the twentieth century and to be both functional and pleasing to the eye.

Most collectors will start by obtaining sets of drawing instruments. A typical set might contain a large compass with a selection of attachments (points) for drawing circles in ink and pencil, dividers for measuring or marking off in conjunction with a scale, various smaller compasses, and some pens for drawing lines. The smaller compasses might be of two types: pen and pencil bow compasses for drawing medium size circles, and spring bows for small circles. One spring bow will usually be a divider for making small measurements or stepping off equal distances along a line.

The case might also house a protractor for measuring or marking out angles, a parallel rule for drawing parallel lines and a sector, which is actually a calculating instrument, particularly useful for calculations of proportion. Set squares, for drawing lines at angles to the horizontal, and French (irregular) curves might also be included.

As the collection develops there are many other types of instrument that can be added. Beam compasses were used for drawing large circles, whilst drop bow (rotating) compasses were used for extremely small ones. There were also compasses specially designed for carrying in the pocket.

Large protractors with moving arms and Vernier scales were used for very accurately plotting and measuring angles. The Vernier scale is a short supplementary scale, placed alongside the main scale. Its pitch is slightly different so that by matching lines a more accurate reading can be obtained. These were used for plotting theodolite readings when surveying by triangulation.

Drawings could be copied by tracing or pricking so tracers and prickers were included in larger sets. The proportional divider (proportional compass) could also be used for copying and for enlarging or reducing. The pantograph and eidograph are more complex and expensive instruments that were also used for this purpose.

In the two hundred years covered by this book drawing instruments developed slowly at first, but the pace of change accelerated with growing industrialisation. Throughout the Georgian period the principal metal used for compasses was brass, with steel used for the points, pen nibs and other parts subject to wear. Silver was also used but only on instruments for the wealthy.

From about 1830 German silver, also known as electrum, an alloy of copper, nickel and zinc, was increasingly used for the better quality instruments. It had the advantage over brass of being more resistant to corrosion and more durable, but was also more expensive By the end of the nineteenth century brass was only used for cheap sets intended for use by students. However, in the second half of the 20th century brass made something of a comeback with the introduction of chromium plating.

In the Georgian period the handles of pens were generally made of brass. In Britain and France this was superceded by ivory or bone, again about 1830, and these materials continued to be used until the 1940s. However aluminium, ivorine (plastic), and vulcanite (hard vulcanised rubber) were also used from the end of the nineteenth century. Brass handles continued to be used in Italy and the Netherlands throughout the nineteenth century. Each country had its own distinctive style of pen handle, of which I will say more later.

Throughout the nineteenth century most instruments continued to be hand made. This was a skilled, labour intensive process and it was therefore natural that thoughts should turn to making them by machine. The traditional patterns of instrument made in Europe were not easily adapted to machine production and in Germany two new patterns were developed and patented in the fourth quarter of the nineteenth century. These were the round system, produced by Clemens Riefler, and the flat system, produced by E O Richter. I will describe both of these in detail later. The flat system eventually became the more popular of the two and came to dominate drawing instrument manufacture in the mid-twentieth century.

This is not the end of the story however as there was yet another significant development in the 1930s. This was the invention of the master bow compass, a development of the spring bow. By increasing its size from three to six inches, providing it with interchangeable pen, pencil and divider points, and an extension bar this one instrument was capable of fulfilling the functions of a full set of earlier instruments.

In the 1930s tubular nib pens were introduced with a large ink reservoir and sets of nibs for specific line widths. After World War II a standard form of handle for these pens was developed in Germany which incorporated a screw thread by which the pen could be fitted to a specially adapted master bow compass. Rotring pens and instruments are probably the best known example of this system.

In parallel with the development of compasses and pens, protractors and squares were also changing in response to stimuli such as improving manufacturing techniques and new materials. Although all of these developments seemed an improvement at the time, one new material in particular, celluloid (chemically cellulose nitrate) has not stood the test of time and in its transparent form eventually crumbles and decomposes. The fumes from this process will corrode any metal in the vicinity. I will discuss this problem further in the chapter on looking after one's collection.

After World War II, a study of German drawing instrument production in the British, French and American occupied zones was conducted by the British Intelligence Objectives Sub-Committee and a report was published by H. M. Stationary Office. Before the War Germany had developed a very strong export market in addition to their home sales. German instruments had a reputation for high quality and yet were sold at very competitive prices and it was recognised that Germany supplied the majority of the world's requirements..

The study took place in March and April 1946 and all the significant firms were visited. The team concentrated on the manufacture of the higher quality instruments, to see what could be learnt.

The conclusions are interesting. Many of the factories had survived intact due to their location predominately in villages in Southern Germany. Although producing on a lower scale than before the conflict, most would be capable of production at pre-war levels if the manpower and materials were available. Quality was still high, partly due to the machinery used, and partly due to the high skill level of the workforce. The finishing and polishing was done by hand by highly skilled personnel. Wage levels were generally low, leading to prices significantly lower than for UK equivalents. They also concluded that the German workers were more productive.

We now know of course that they would again become world leaders in the manufacture of high quality drawing instruments in the second half of the 20th century, as indeed Haff still are.

One piece of knowledge that most beginners lack, and at the same time want, is the ability to date their acquisitions. This is a tricky subject; many of the common patterns of instrument were made for periods of fifty years or more, in some cases nearer one hundred years, without significant change. I will attempt to provide some guidance on this throughout the book, but often dating a set will need to be based on the observation of several features and even then will only be approximate in most cases.

This is not the only puzzle that will be encountered. Many sets are unsigned. Where were they made and who made them? There are sets in my collection where I am still unable to answer either of these questions. However, as I have already mentioned, each country had its own distinctive styles and features and I will show how these can be of assistance in answering these questions.

Well, what about the actual collecting process? There are a number of questions that need to be asked and some decisions to be made:

What is my budget?
How much space do I have?
Do I wish to display my collection?
What is the period I wish to collect?
Will I collect worldwide or specific countries?
Will I specialise on one maker?
Will I just collect certain types of instrument?

There are also a number of different ways to search for and purchase your instruments. The important thing is to do some research and carefully consider your objectives before jumping in and making an expensive purchase which you may later regret.

Of course you need to know how to carry out that all important research. Well there are no prizes for guessing that my first recommendation is that you read this book. I also have a web site www.mathsinstruments.me.uk which shows much more of my collection than is illustrated here. I have already mentioned two other books that are a must read and I have listed these and more in the bibliography. Obtain some old drawing instrument catalogues. American ones are easier to find and cheaper than English ones, which can be expensive. However there are increasing numbers of reprints and also some have been scanned and can be downloaded from the Internet. Some libraries and museums will also provide photocopies for a fee. I will expand on this in the chapter on building a collection.

Fortunately at this present time, unlike in many fields of scientific instrument collecting, fakes and reproductions are unusual and I will provide guidance on the few that one may come across. However many sets for sale are not complete and may contain items that are not original, either because a previous owner has replaced lost and broken items so that the set has continued to be of use, or because a seller has attempted to make it appear complete when it isn't. I will give some guidance on how to spot the items that don't belong. In some cases it may not be too difficult to find the correct replacements but much more often than not this will be extremely difficult if not impossible. I've learnt that purchasing incomplete sets is something that needs to be very carefully considered.

In describing drawing instruments it is necessary to use terminology with which the reader may not be familiar. I have tried to use a consistent terminology, which is based on that used by William Ford Stanley in his book on drawing instruments, which was published in seven editions between 1866 and 1926. There are a few instances when I have had to deviate from this and I have used appropriate manufacturers' catalogues or other contemporary literature as a reference. Where there is more than one commonly used term I have, in the first instance, mentioned the synonyms. I have also included a glossary.

1. The Full Set

In the second half of the nineteenth century the layout of sets of English drawing instruments became quite standardised with each of the major manufacturers producing sets with similar layout and contents. Central to these was the set known as the 'Full Set'. This contained all the compasses and pens that a draughtsman would need for ordinary work. In other European countries similar sized sets were made although the contents might differ, which I will detail in a later chapter. Full sets were made in large numbers and hence will feature in most collections.. As they can be obtained quite reasonably they form a convenient point for starting a collection and hence I shall start by describing their contents.

Fig. 2 ***Morocco case for a W F Stanley full set of electrum instruments, ca. 1900***

Fig. 1 ***W F Stanley full set of electrum instruments in a Morocco case***

Figure 1 shows a typical full set of instruments by W F Stanley of Great Turnstile, Holborn, London. Firstly it contains a six inch compass half set (compass with divider, pencil and ink points, lengthening bar and knife key). Above the compass is a divider. Next up on the left are three spring bows, one each of divider, pencil and ink. On the right, above the compass ink and pencil points, are a pair of bow compasses, one ink and one pencil. Above the compass lengthening bar are two drawing pens and above them is a pricker. Finally, barely visible in a slot at the top are a compass key and a knife key. Figure 2 shows the Morocco case. This is lined in the lid with blue silk and the pockets for the instruments are formed from wood covered with blue velvet. The lid has a compartment behind a flap that could contain a protractor and other items, of which more anon.

The same sets would also have been available in wooden cases, which could be mahogany, oak, walnut or rosewood, the latter two usually being veneer on a mahogany carcase. Figure 3 shows another W F Stanley full set in a solid oak case. The electrum instruments in this case are of a better quality than those in the Morocco one and would have been more expensive.

Fig. 3 ***W F Stanley oak-cased set of electrum instruments***

The most obvious sign of its higher quality is the use of nut and bolt needle points on the compass and bows. Stanley also calls these 'Type B' needle points. This is a very late English pattern set, mid-twentieth century, and there are three items not seen in earlier sets, a case for leads and spare needles, a lead pusher, and a folding compass key, the latter instead of a knife key.

The case is again lined with blue silk and velvet. The full set in wooden cases is housed in a tray under which are compartments for other instruments. These sets were frequently sold with an ivory rectangular protractor and ivory scales in these compartments, which could also contain a sector, a six inch parallel rule, and other items. If original, these items should be marked with the name of the maker of the set and will then considerably enhance the value.

Both the sets illustrated contain the most usual size of instruments. However sets were also made with a 4½ inch compass half set, in which case the sizes of the other instruments and the case were also smaller.

I should also mention that not all full sets contain a pricker.

I will now describe the individual instruments in more detail.

Fig 4. ***W F Stanley oak case***

The Compass Half Set

Figure 5 is an illustration of a half set with ordinary needle points from the 1912 W F Stanley catalogue. There were three types of point commonly available on English drawing instruments. The plain point was the cheapest and that is fitted to the compass shown in Figure 1. The compass in Figure 3 has nut and bolt needle points, originally patented by W F Stanley. There was also a fourth type of needle point, the spring loaded 'Type A', which Stanley supplied with the most expensive compasses, but this is rarely found.

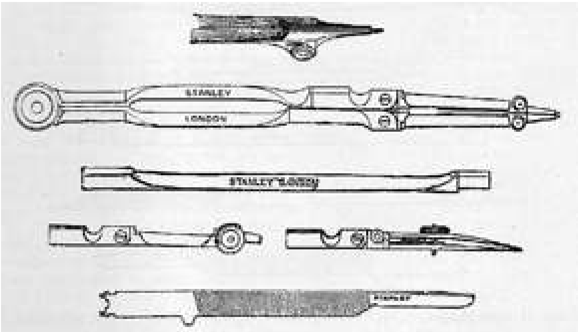


Fig. 5 ***Half set with ordinary needle points.***
W F Stanley 1912 catalogue

The points of quality English pattern compasses were fitted to the compass leg with a slip joint. One half of the joint is the socket, a round hole, slit up one side for the whole of its length such that it springs and grips the shank of the matching part, a round pin with an inset steel web (feather). The socket can either be on the compass, or better, on the points. Figure 6 shows two points, one with a socket and the other with a shank, obviously from different sets.

Fig. 6 ***Needle points showing socket and shank of slip joints***

Figure 6 also shows two types of needle points. The upper one is an example of the rare Stanley Type A spring needle point showing the socket of the later, better form of the slip joint. The lower one is a nut and bolt needle point illustrating the shank of the original arrangement of the slip joint.

Slip joints are a characteristic of hand made English instruments and not normally found on compasses of Continental manufacture. They required careful workmanship but those on my William Elliott set still work perfectly after more than 160 years.

Screw shank joints were also used on English instruments, especially in the Georgian period, but in the Victorian period these had been relegated to cheaper brass instruments intended for student use. I will describe these later.

Another characteristic of hand made English compasses and dividers is the sector head. This was a development of the earlier, long-joint head used in Georgian times. Figure 7 shows the sector head of a Stanley compass.

Fig. 7 ***Sector head on a Stanley compass***

It can be seen that there are two steel plates in the joint which separate the electrum plates to minimise wear and provide a friction surface that will hold the compasses open in any position without excessive clamping force from the central screw.. The joint is lubricated with beeswax.

Fig. 8 ***Two varieties of pencil point***

Compasses could be single jointed, as in Figure 1, or double jointed, as in Figure 3. The joints in the compass legs and points also contained two steel plates, which can be seen in Figure 8. This shows two forms of the pencil point, both of which have a clamping screw to close the split socket around the pencil or pencil lead. The upper one is the earlier form, sized to take the size of drawing pencil then commonly in use, whilst the lower one takes a lead only.

The compass ink point was usually of the lifting nib type, of similar form to the pen which I will be describing shortly.

The knife key is shown in Figure 5. It combines a knife for sharpening pencils, a file for finishing the point on the lead, a screwdriver blade protruding from the bottom edge and a compass key to fit the sector head.

The Divider

Dividers could be either plain, as shown in Figure 1, or hair spring, as shown in Figure 3. One of the points of the hair spring divider is extended back along the leg in the form of a thin steel spring, recessed into the leg and attached by a screw near the head end. Near where the spring broadens out to form the point there is a milled head screw, which pushes the point towards the fixed point as a means of fine adjustment. Figure 9 shows another form of hair spring divider, partially open so that the spring point can be seen.

Fig. 9 ***Hair spring divider with captive adjusting screw, earlier type with adjusting screw in the middle of the leg rather than near the point.***

Spring Bows

It was usual for spring bows to be in a set of three, whether part of a larger set such as the full set, or a set of spring bows alone in a Morocco case. As with compasses the points could be either plain, ordinary needle, or nut and bolt needle. Those in Figure 1 have plain points whilst those in Figure 3 have nut and bolt needle points. Both of these sets have milled handles. However the earliest forms of spring bows had hexagonal handles and this style of handle remained an alternative available from some makers until the beginning of the 20th century. Figure 10 shows a set of A G Thornton spring bows dating from the Edwardian period which also have central adjusting wheels. The divider spring bow has plain points whilst the others have improved nut and bolt needle points, a combination more usually found in Continental sets.

Fig. 10 ***A G Thornton spring bows***

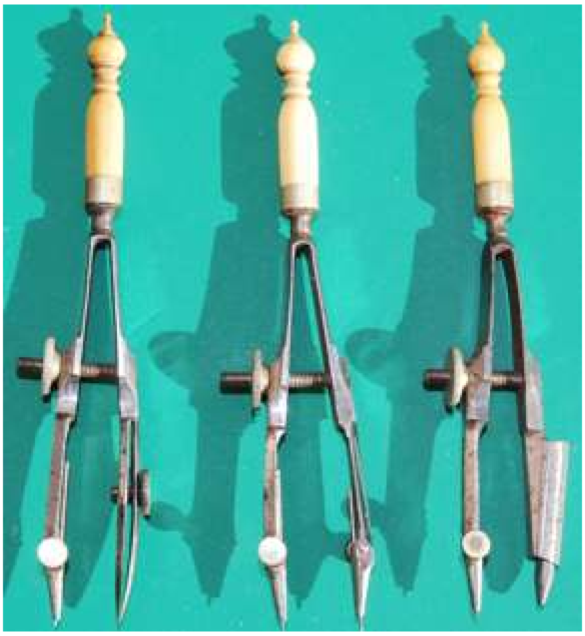


Fig. 11 ***Set of spring bows by J M & H Cronmire with ivory handles***

Rarer are spring bows with ivory handles such as the ones from a J M & H Cronmire set shown in Figure 11. These have ordinary needle points and a spring steel holder for the pencil lead. They date from 1865 - 1869 and are from a large Cronmire set.

Bow Compasses

The full set always contained a pair of pencil and ink bow compasses and these can be seen in Figures 1 and 3. There was considerable variation. There were two distinct styles and the legs could be un jointed, single jointed or double jointed. They could also have any of the types of needle point or plain points. Lengths varied from three to four inches.

Fig. 12 ***William Elliott brass bow compasses***

Figure 12 shows some brass bow compasses of the earlier style with turned handles, made by William Elliott between 1835 and 1849. They are double jointed and have ordinary needle points. The pen has a lifting nib. A single jointed pencil bow is illustrated in Figure 13.

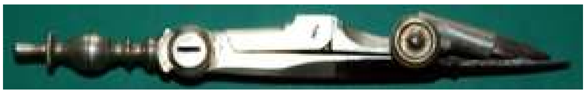


Fig. 13 ***Single jointed electrum pencil bow***

Fig. 14 ***Electrum bows by Elliott Brothers which have no leg joints***

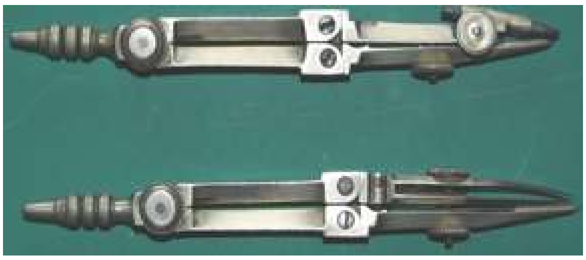


Fig. 15 ***Halden double jointed bow compasses***

Figure 14 shows the most basic form of electrum bow compass. These have no leg joints and have plain points. The later style of bow compass is illustrated by the Halden pair in Figure 15. These are double jointed and have nut and bolt needle points. W F Stanley claimed that these were better than the earlier style because the milled handles were shorter and hence the legs longer (for the same overall length), thus enabling larger circles to be drawn. Also the shape of the legs was altered to provide a recess so that they could be opened single-handed. The earlier style continued to be made in parallel but were priced cheaper. Simplified brass versions of the earlier style, with a single steel leaf in the joints, were included in student sets.

Screw-Off Points

Since the first edition of this book was published several examples of sets in which the compasses and bows have another type of point have been added to my collection. Figure 16 shows a compass from a Thornton set and figure 17 shows a spring bow from the same set. A G Thonton, W H Harling and J Halden all sold sets with this type of point. The spring bows in each case have the same, distinctive, three-ring handles suggesting that they were actually all made by the same manufacturer; but which? In Thornton's 1895 catalogue these points are described as "Thiornton's Improved Points" suggesting Thornton may have been the originator. However Harling also called them "Harling's Improved Needle Points in his 1883 catalogue. A Harling set may be seen in the Famous Makers and Retailers chapter.

Fig. 16 ***Thornton compass with screw-off points***

Fig. 17 ***Spring bow with screw-off points***

Drawing Pens

It was usual for two pens to be included in a full set. Most often these would be of two kinds, one with a lifting nib and one for drawing fines lines, but sets are also found with two lifting nib pens, sometimes both the same size and sometimes one six inch and one five inch. Fine line pens were generally five inches long. The handle of English made pens was generally ivory with a characteristically turned finial and a brass or electrum ferrule at the nib end. The fine line nib would be all steel whilst the blades of the lifting nib pen would be half electrum and half steel with a soldered tenon joint between the two halves of each blade. A small spring acted on the upper blade of the lifting nib pen to hold it against the adjusting screw Stanley also sold an improved lifting nib pen in which the lower blade was thicker and hence stiffer and the upper blade was steel and hence the spring was not required. By the time production was coming to an end the pens could also be had with stainless steel blades.

Figure 18 shows five ivory handled drawing pens. The top two are six inch, lifting nib pens, the second having the improved type of nib and a square section on the handle for improved grip.

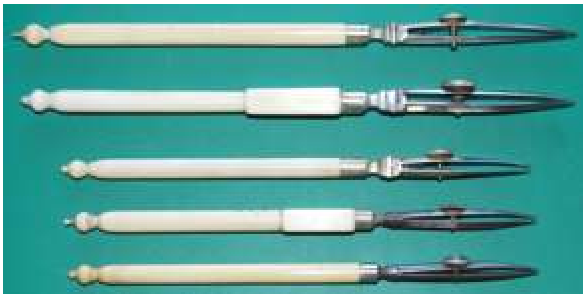


Fig. 18 ***Selection of ivory handled drawing pens***

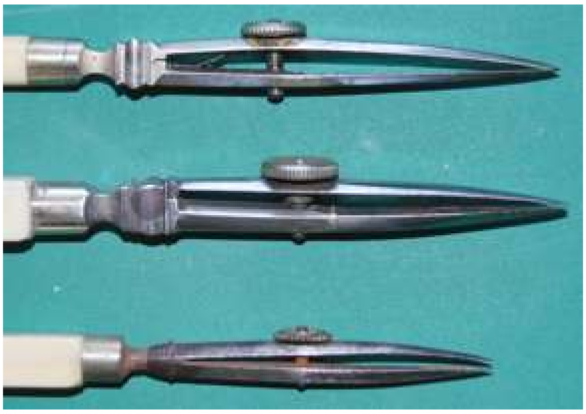


Fig. 19 ***Detail of pen nibs***

The third is a five inch lifting nib pen. The last two are fine line pens.

Figure 19 shows the nibs in more detail. The first shows the ordinary type of lifting nib. The spring can be seen at the root of the nib. The second shows the improved type of lifting nib and the third shows a fine line nib.

The Pricker

Two types of pricker are illustrated in Figure 20.

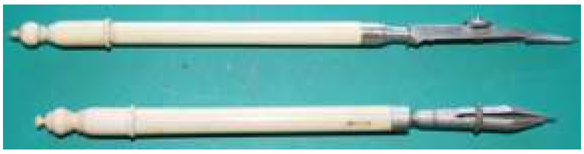
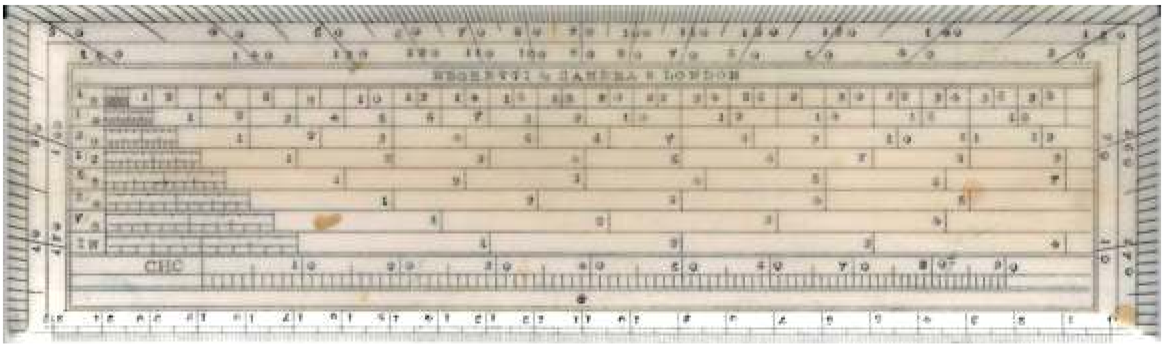


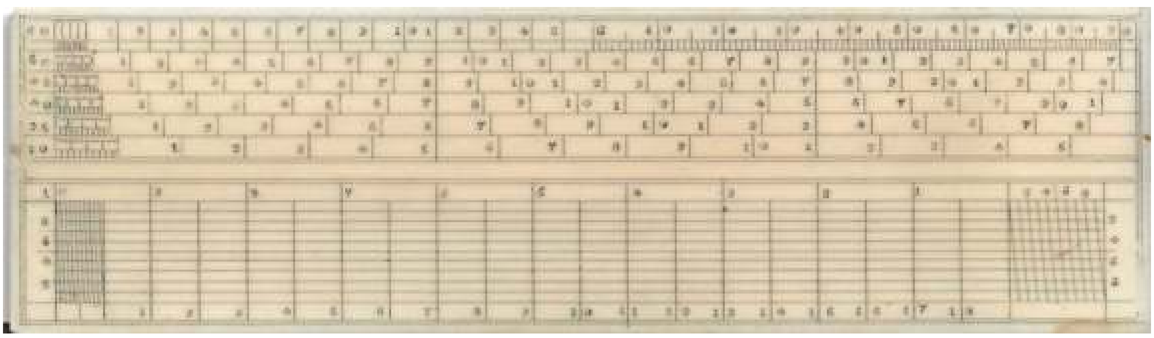
Fig. 20 ***Prickers***

Both have ivory handles with a screw off cap to a compartment in the handle for spare needles. The first has a nut and bolt needle point, similar to that used on compasses. The second has a split collet which is closed around the needle by a sliding ring. Typically they are five inches long although six inch ones were also made. In sets of compasses with screw-off points, the pricker would also have a screw-off point (not illustrated).

The Rectangular Protractor

There were some other instruments that were frequently supplied in the full set case although they were not part of the full set. These included scales,





Figs. 21 & 22 ***Negretti & Zambra six inch, ivory, rectangular protractor upper and lower surfaces.***

parallel rules, sectors and the rectangular protractor. Of these the most commonly found instrument is the latter one. Usually these were made of ivory although boxwood was also used as a cheaper alternative. The Negretti & Zambra one shown in Figures 21 and 22 is of the highest quality. Lower quality ones had fewer scales and the diagonal scales would have been coarser.

containing ivory items can still be sold/purchased if complying with the 10% rule.

The Sector

The principal use for the sector was not drawing but was calculation. To explain every aspect of its use would require a chapter to itself so I will limit

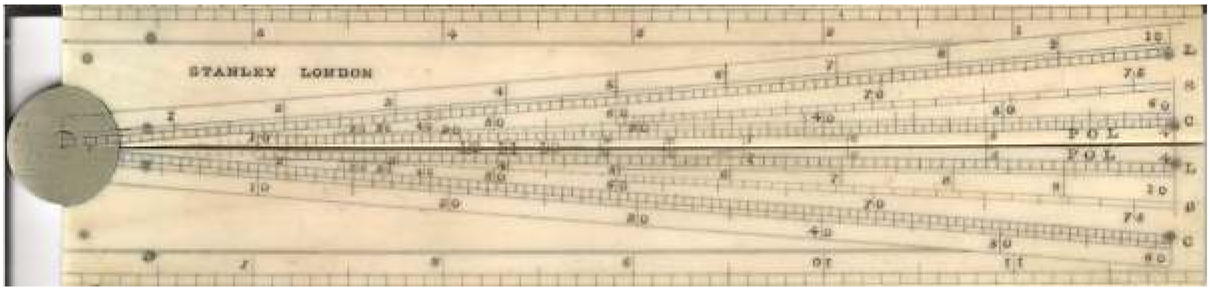


Fig. 23 ***W F Stanley ivory sector, upper face***

Fig. 24 ***W F Stanley ivory sector, bottom face***

Looking at the upper face it has degree scales around three sides running from 0 to 180 and 180 to 0 degrees. In the centre is a group of eight plain scales ranging from 1/8 to full size in 1/8 steps. Below these is a chord scale and on the bottom edge there is a scale of 40 to the inch. On the reverse are two sets of scales. The upper set are plain scales for 30, 35, 40, 45, 50 and 60 divisions to the inch and a short chord scale. The lower set are diagonal scales, the finer of these theoretically allowing a measurement to be made or set off with a precision of 1/400th of an inch. All these scales were intended for use with dividers.

This pattern of rectangular protractor is the most commonly found. However there were several other patterns, often made for specific uses, and these will be discussed later.

When the first edition was written there was a problem with ivory protractors and other ivory instruments missing from sets as they were separately collected and it was expensive to replace them. Since then the law has changed and it is illegal to sell or purchase any items partially or wholly ivory regardless of whether they are pre-1947 unless the ivory content is less than 10% of the whole. Sets

the discussion here to a description of the scales and proportional calculation.

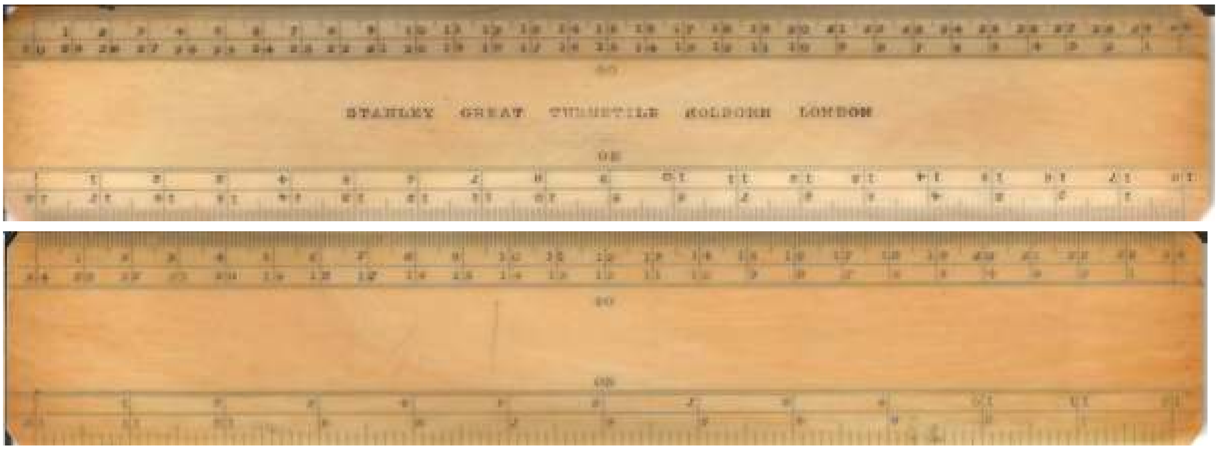
Firstly, not visible in the figures, there is a scale of decimal feet along the outer edges.

On the upper face (Figure 23) there is a scale of inches enabling the sector to be used as a foot rule when opened fully. The angled scales, radiating from the axis of the electrum hinge, reading from top to bottom are labelled ‘L, S, C, POL, POL, L, S, C’.

On the bottom face (Figure 24) the scales along and parallel to the edge are intended to be used with the sector fully open. They are labelled ‘T, S, N’ reading from the inside outwards. The angled scales are ‘S, T, T, S, T, T’ reading from top to bottom.

L is the line of lines. Suppose I wished to divide a line into three equal parts. I would set my dividers

to the length of the line and then open the sector such that the dividers exactly spanned the distance between the 9 (a suitable multiple of 3) points on each of the L scales. I would then take the dividers and open them so that they exactly spanned the distance between the 3 (1/3 of 9) points. That



Figs. 26 & 27 ***Stanley six inch, ivory, chain scale, upper and lower faces.***

would be 1/3 the length of the original line. I could have used the 3 and 1 points if the original line was a very short one but it is advantageous in this case to start closer to the open end. All of the radial scales are used in this manner except POL.

On the upper face, **S** is the **line of Secants**, **C** is the **line of Chords**, and **POL** is the **line of Polygons**. The line of polygons is chiefly used to divide the circumference of a circle into a number of equal parts from 4 to 12. A description of how to do this and other calculations with the sector is given in the 1775 edition of A Treatise of Mathematical Instruments by John Robertson, which is available as a reprint (see Bibliography).

The sectoral (radial) lines on the lower face are for **Tangents** (two radii) and **Sines**. The scales parallel to the edge are for **Log Tangents**, **Log Sines**, and **Log Numbers.**

Fig. 25 ***Stanley ivory six inch parallel rule***

The Parallel Rule

Parallel rules were commonly included in sets of all qualities. Most six inch parallel rules were probably made of ebony with brass links, but some, like the one in Figure 23, were made of ivory with electrum links. Most ebony ones are not signed and are therefore impossible to date with any accuracy since they were made to the same design from the late eighteenth century until the middle of the twentieth.

Scales

Scales were also sometimes included in full set cases, like the W F Stanley example shown here. This is a chain scale with 50 and 30 to the inch scales on the upper face and 20 and 40 to the inch scales on the lower face. It is from a three tier, ten inch case dating from about 1880 but similar ones were also put in full set cases. Architect's scales were also sometimes included.

2. The Georgian Period

Some of the most attractive sets and instruments were made during this period. Although considerably more expensive to purchase than Victorian and later sets, and more difficult to find in original condition, sets in pocket cases should not be beyond the reach of the ordinary collector. Individual instruments can still be found for very modest sums.

The pictures on this page and overleaf show a quality set of brass and ivory instruments by Jacob & Halse, which date from ca. 1809/10. They are housed in a green dyed and polished shagreen case with silver mounts, also known as an etui. It is a typical set of late 18th and early 19th centuries.

The brass instruments comprise: a compass with divider, pencil and ink points; divider, an ink bow; and a drawing pen. The compass has a long joint head and the points are fitted with an early form of slip joint. The socket is triangular in section with a slit on the apex. The points have a matching triangular spigot with the top vertex flattened. The compass head has two steel plates whilst the joints in the ink and pencil points have one steel plate and this is normal for English instruments of this period.

Note carefully the styles of these instruments. I have often seen these sets for sale with either the compass or divider replaced by a cheap French instrument about 100 years newer and claimed to be complete.

Fig. 28 ***Jacob & Halse set in shagreen case***

Fig. 29 ***Brass instruments from the Jacob & Halse set, ca. 1809/10***

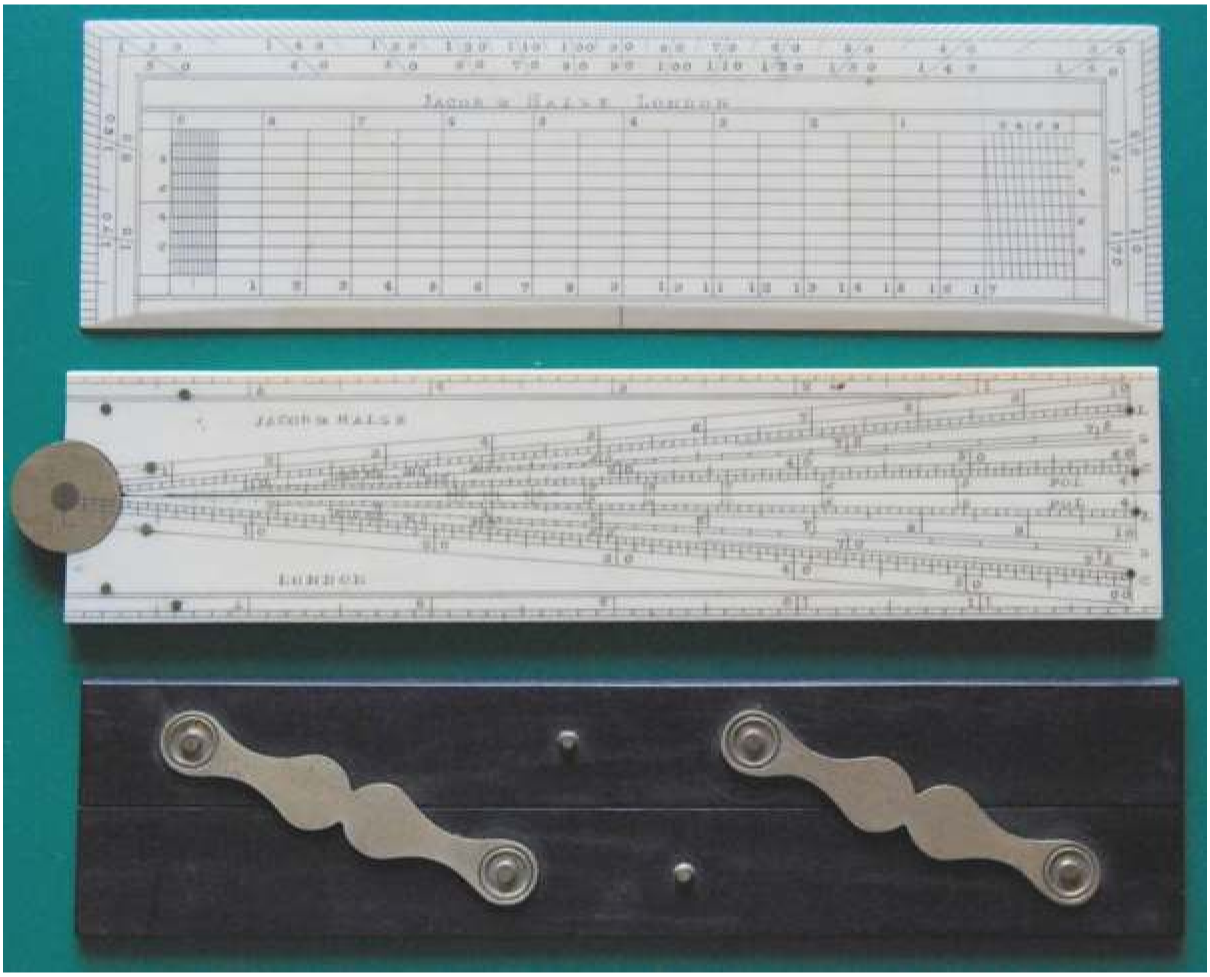


Fig. 30 ***Protractor, sector and parallel rule from the Jacob & Halse set***

The pen has a turned brass handle from which the upper half unscrews to reveal a protracting pin. It has a lifting nib with a hand cut wing screw for adjustment. All three pen nibs in this set are lifting ones with hand cut wing screws.

The six inch ivory protractor has different scales to that shown in the previous chapter. On the front face, besides the degree scales around the outer edges, it has a set of diagonal scales. On the reverse there are a set of plain scales and a set of scales intended for navigation labelled CHO (chord scale), LAT (latitude), SIN (sine), INC MER (inclination of the meridian), TAN (tangent), HOU (hour), RU (line of rhumbs), LON (longitude).

The sector has the same scales as that already described, but the hinge is brass as electrum was not available in Georgian times.

Fig. 31 ***Jacob & Halse pen***

Fig. 32 ***Set in a black, shark skin case***

Figure 32 shows a black shark skin case (etui) of drawing instruments dating from ca. 1800. This set would have been significantly cheaper when new than the Jacob & Halse set. Its instruments are shown on this page.

The brass instruments comprise: a compass with divider, pencil, ink and dotting pen points; divider; drawing pen; and pencil holder/ink feed. The compass and divider long joints have a screw through the centre without the capping plates. The points are attached with a screw shank, the triangular section socket has a hand cut, wing clamping screw that bears on a recess filed in the top of the mating spigot. The ink point and the drawing pen have block nibs in which the blades are soldered directly into a brass block and cannot be opened for cleaning. The pen handle unscrews from the nib block but there is no protracting pin.

Fig. 33 ***Protractor, plain scale and sector***

Fig. 34 ***Brass instruments from the shark skin case***

The protractor is brass, hand stamped and bevel edged. Again the collector should beware of later replacements, which will be thinner and flat. The sector, which has the usual scales, and the plain scale are boxwood.

The upper face of the plain scale has scales of 15, 20, 25, 30, 35 and 40 to the inch, and a chord scale. The lower face has diagonal scales, a six inch by tenths scale and a decimal foot by hundredths scale.

Shark skin was much used for cases in this period. It is very hard and durable and the genuine material can be recognised because when rubbed in one direction it is quite rough, whilst it is smooth in the opposite direction.

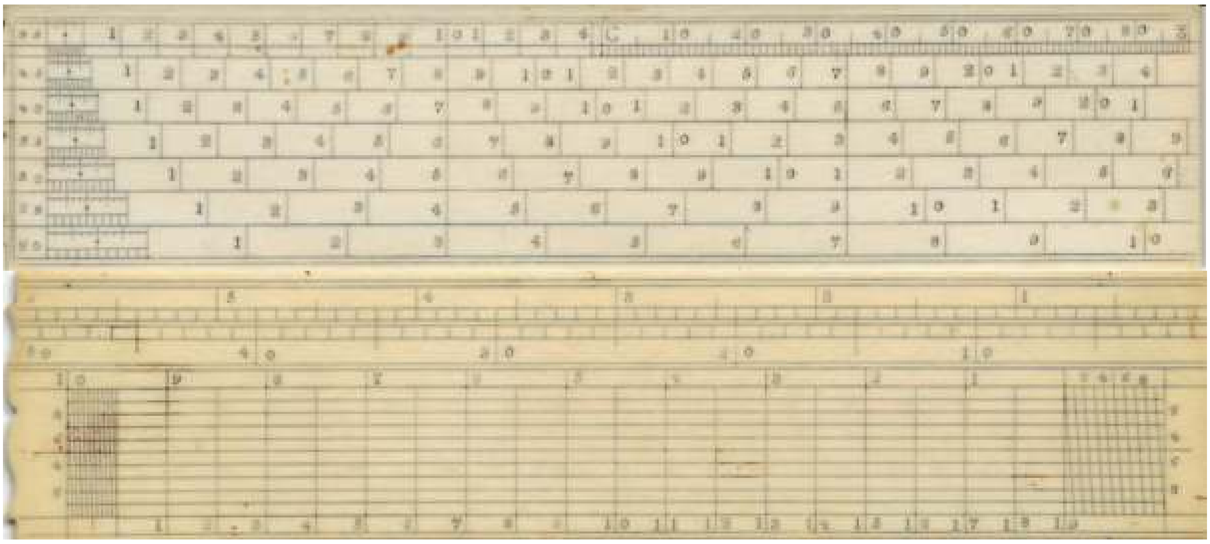
Figure 35 is a detail of the English long joint, so called because of the length of the two steel plates.

Fig. 35 ***Compass long joint***

Georgian Scales

For most of the Georgian period edge scales were not much used and dimensions were set off or measured using dividers in conjunction with body scales. These were engraved on plain scales and rectangular protractors. Figures 36 and 37 show an ivory plain scale.

This six inch scale has similar scales to the box-wood one in the shark skin case, except that the plain scales on the upper face are 20, 25, 30, 35, 40, 45 and 55 to the inch.



Figs. 36 & 37 ***Ivory plain scale***

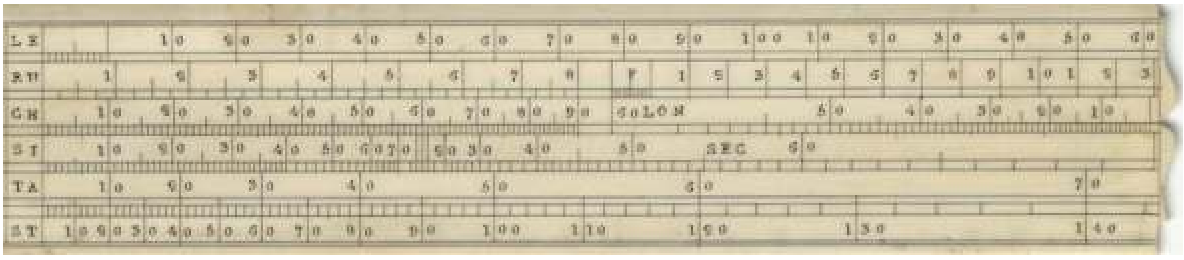
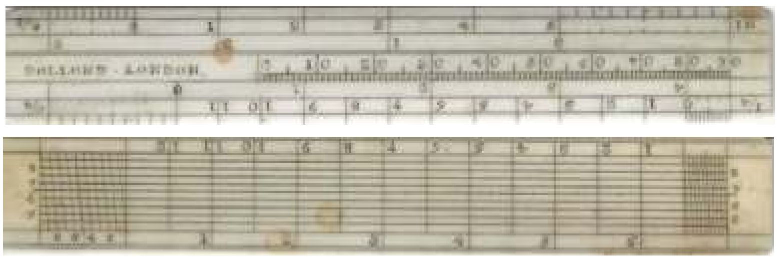


Fig. 38 ***Ivory plain scale, alternative type***

Like ivory rectangular protractors (for example that in the Jacob & Halse set) the plain scale could have navigational scales in place of the scales shown in figure 36. These alternative scales are shown in figure 38. The scales are: LE (line of equal parts), RU (line of rumbs), CH (chords), SI (sines), TA (tangents), ST (sines & tangents of small angles), P (equal parts), LON (longitude), and SEC (secants).The scales on the other face are the same as in figure 37.

The ivory scale by Dollond of London (probably Peter Dollond) is typical of those placed in small size etuis of drawing instruments in the late 18th century. It is just 4½ inches long. On the upper face there are edge scales. The upper one is divided for inches by tenths and half scale inches by tenths. The lower edge is divided similarly for quarter and three-quarter scales. There is a chord scale in the centre. On the under side there are diagonal scales.



Figs. 39 & 40 ***Dollond ivory scale***

This Cary scale, is an early example of a scale divided solely on the bevelled edge so that dimensions could be marked off or measured directly from the scale. It is a scale of 40 to the inch divided the same on both edges. A feature of early scales of this type is the zero line, which is not at the end but, in this case, two large divisions in from the left end. It is divided to 50 large divisions to the right so the total length of the scales is 13 inches.

Fig. 41 ***Ivory chain scale by Cary, London, probably ca,1820***

3. Further Instruments

Besides the instruments associated with the full set there was a wide range of other instruments available, some of which might be purchased by the individual, and others by the firm for shared use. It was even possible to hire some of the more expensive instruments such as the eidograph.

The Protractor

This was one of the most varied instruments. I have already described the common form of the rectangular protractor and shown a brass semi-circular protractor.

Fig. 42 ***Folding arm protractor by John Cail of Newcastle-upon-Tyne, probably 2nd quarter 19th century***

Undoubtedly the king of protractors was the folding arm type. The one by John Cail is quite an early example. The circle is six inches in diameter and the degree scale is engraved on an inset ring of silver. There are two Verniers, reading to one minute of arc, under the folding arms, and these are also divided on silver. The two arms fold inwards for storage in a mahogany case. The arms are rotated about the circle by a pinion under the milled wheel, which meshes with the rack around the outside of the instrument. There are pins under the instrument to stop it sliding on the paper.

When the Verniers have been set to the desired angle and the instrument has been set up along the line using the index marks on the inside of the circle and the cross hairs in the centre, the arms, which are normally held off the paper by steel springs, are pushed down so that the protracting pins on the extremities mark the paper. In this way angles could be set off extremely accurately and these protractors were especially useful for plotting theodolite readings. There are adjusting screws on each end of the shafts about which the folding arms rotate to adjust them and eliminate any sideways movement. To check that they were accurately centred the whole arm assembly could be rotated through 180 degrees and the pins again pushed into the paper.

In the second half of the nineteenth century the design was modified and the rack and pinion drive was replaced by a clamp and tangent screw for fine adjustment.

A small magnifier was supplied with this instrument for reading and setting the Verniers.

John Cail was working from 1825 to 1865.

These protractors are quite rare and hence will be near the top end of the budget for many collectors but the single arm Vernier protractor is considerably more common and hence more reasonably priced.

Single arm Vernier protractors may be either circular or semi-circular and the most common size is again six inch diameter. Normally the Vernier reads to one minute but some only read to three minutes.

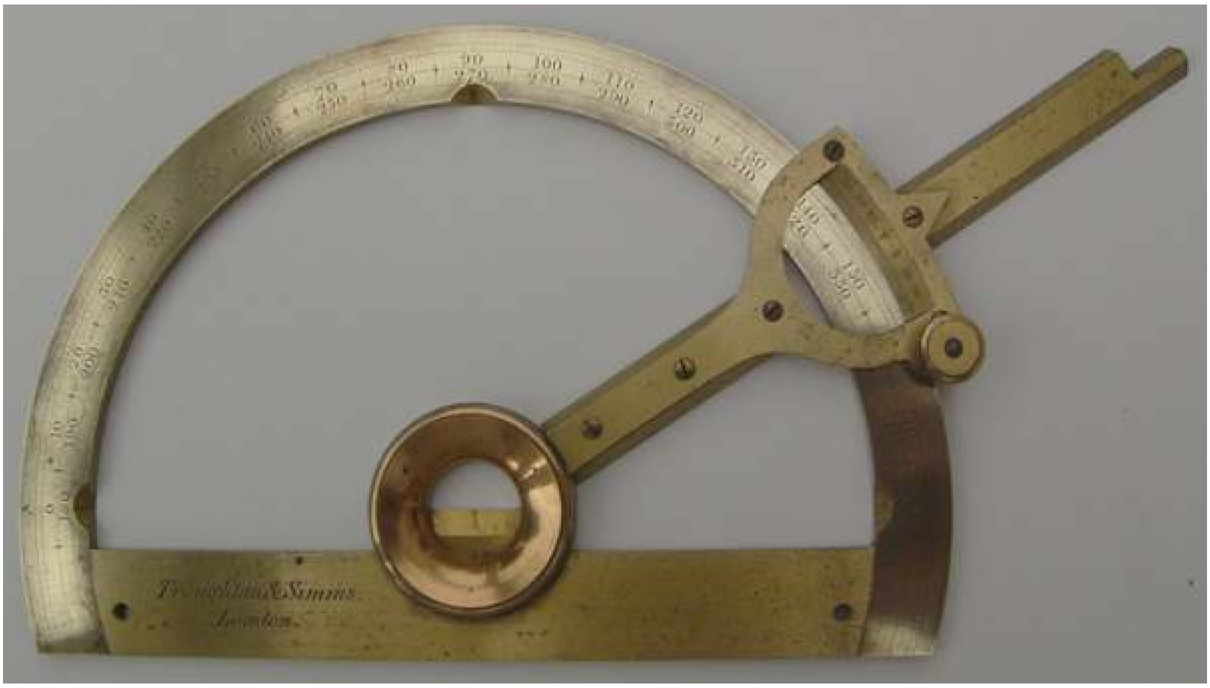


Fig. 43 ***Troughton & Simms, London single arm brass Vernier protractor***

The Troughton & Simms protractor above is a fine example of this type. It is heavily constructed of brass and has a mahogany case. Included in the case are two pins which screw into the two holes, which can be seen in the bottom limb, to hold the protractor firmly in place on the paper once the index marks at 0, 90 and 180 degrees and in the centre have been aligned on the drawing. The rotating arm has a clamp screw to secure it once the Vernier has been set.

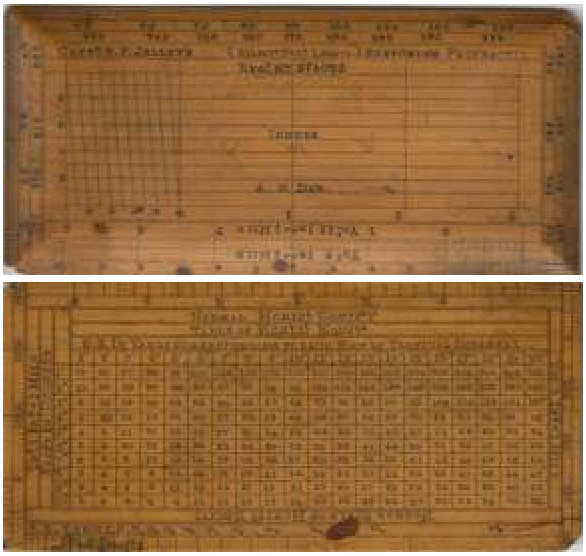
A circular example in electrum by W F Stanley, dating from ca. 1900 is shown in Figure 44.

Fig. 44 ***Stanley electrum Vernier protractor***

Brown & Sharpe, Providence, RI, USA were granted a patent for the 'Draftsman's Protractor' on December 2nd 1890. The example shown is steel although a nickel silver version was also catalogued. The Vernier is graduated to 5 minutes. A tongue on the periphery of the rotating parts runs in a groove in the fixed part. The instrument can be laid down on either side.

Fig. 45 ***Brown & Sharpe draftsman's protractor***

Fig. 46 ***Robson, Newcastle-upon-Tyne, protractor***



Figs. 47 & 48 ***Elliott Bros., Capt. R F Jelley's Sketching Protractor***

The Robson protractor is a typical circular one, made of brass, 7.4 inches diameter, dating from the late nineteenth century. They were made in sizes from six inches (the most common) upwards to one foot and frequently had mahogany cases. Semi-circular protractors were also made in brass and electrum in sizes from three inches to one foot.

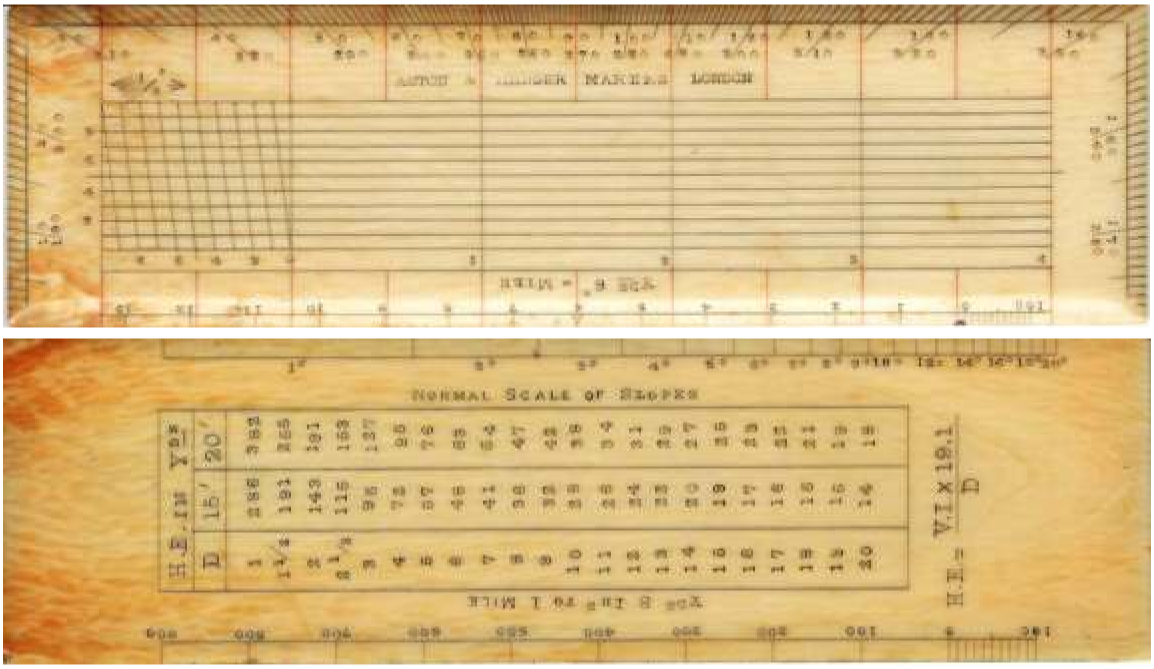
In the twentieth century brass and electrum were replaced by celluloid and, later, other plastics.

Besides their use in the drawing office, rectangular protractors were much used by the military and several designs were produced, both for purchase by officers and army issue.

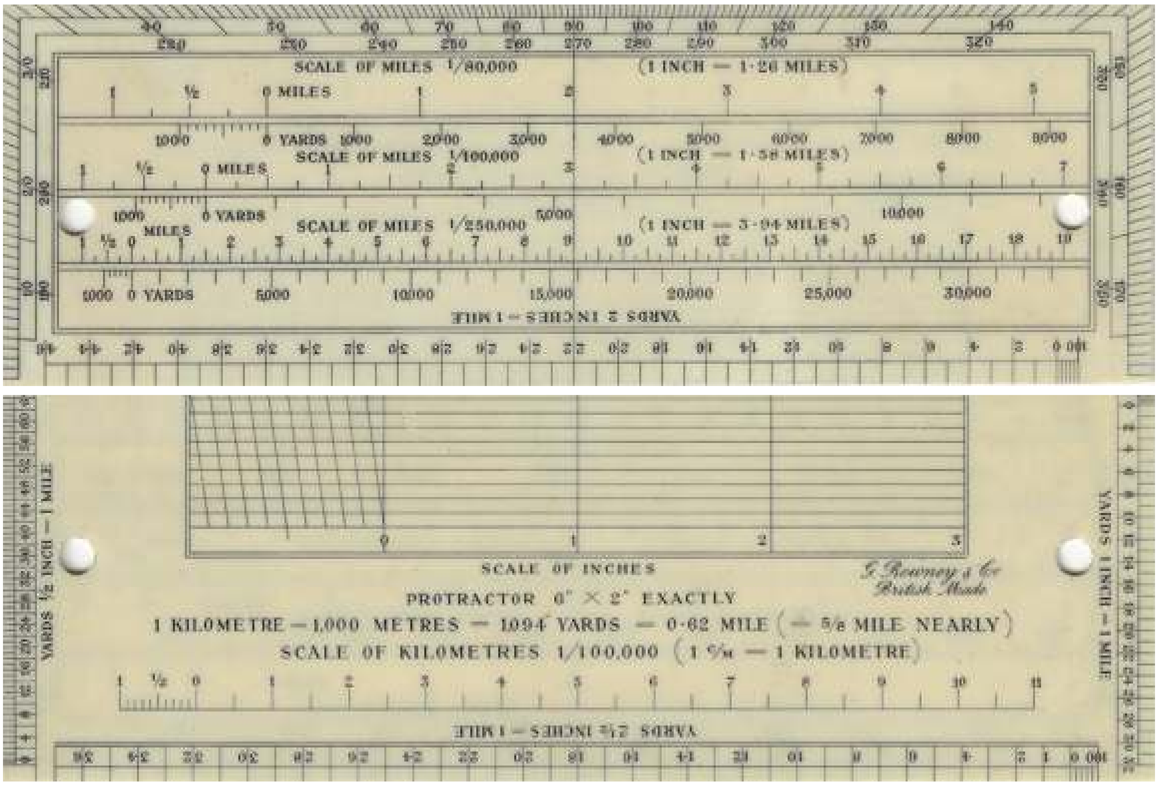
Capt. R F Jelley's Sketching Protractor was one of the former. It was made by Elliott Brothers, who also made sketching cases. The design was registered in 1901, no. 374020.

The front face has the usual degree scales, diagonal scales, and map scales for 6 and 12 inches to the mile. The reverse has 1 and 8 inch to the mile scales, a table of horizontal equivalents for different slopes, and a normal scale of horizontal equivalents.

The Aston & Mander ivory protractor has degrees around three edges, a scale of 6 inches to the mile and diagonal scales on the front face. On the reverse are a scale for 8 inches to the mile and again a table of horizontal equivalents. Horizontal equivalent equals the vertical interval times 19.1 divided by the angle of the slope in degrees. There is also a normal scale of slopes.



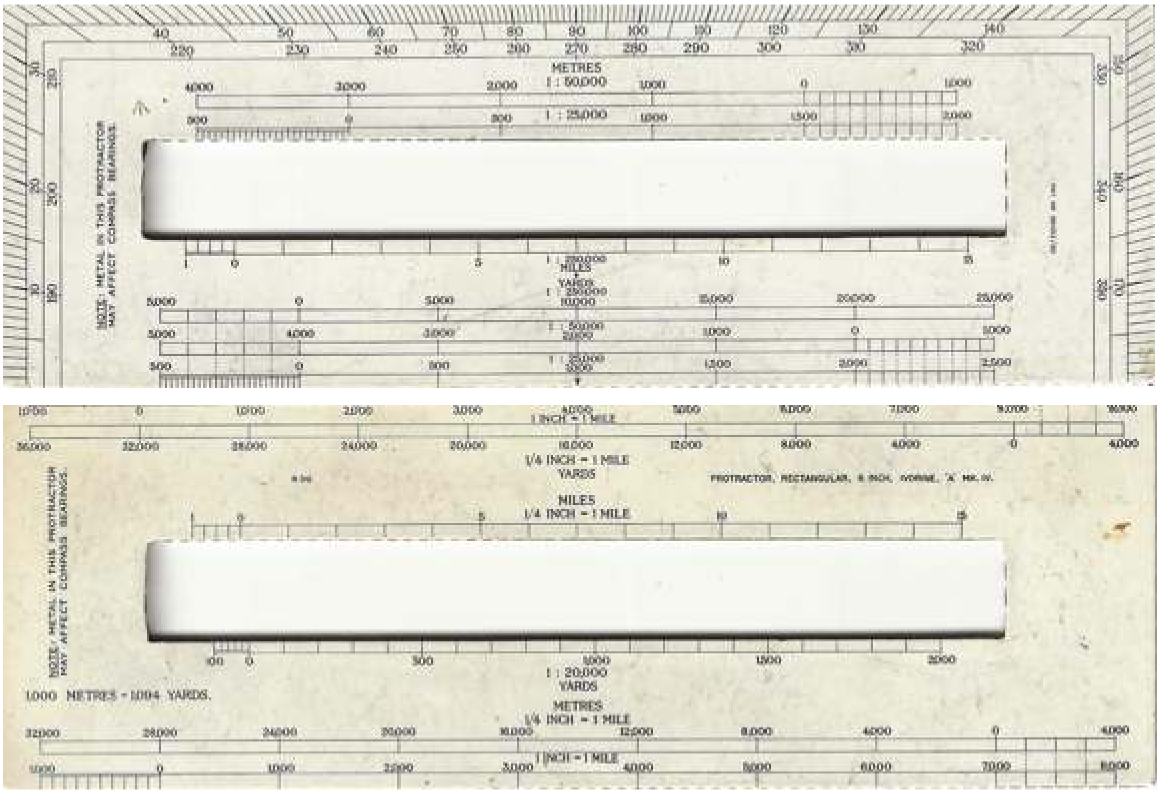
Figs. 49 & 50 ***Aston & Mander ivory six inch rectangular protractor***



Figs. 51 & 52 ***Protractor 6" x 2" Exactly by G Rowney & Co.***

The protractor 6" x 2" exactly is an example of an army map reading protractor. This particular example is celluloid and was made for sale but the original design was made for the military, and many were made in boxwood and also in brass for army use in the first world war. It was known as the A II.

The protractor rectangular 6 inch ivorine 'A' Mk IV was a later design, patent application 361012/30. The ivorine (celluloid) was reinforced with a metal mesh. The design continued to be produced in PVC without reinforcement into the 1970s, by Blundell Harling.



Figs. 53 & 54 ***Protractor Rectangular 6 inch Ivorine 'A' Mk IV***

The Square

Everyone will be familiar with the celluloid or transparent 45 degree and 30/60 degree set squares in school geometry sets and large versions of these were made for professional use. Prior to their being made in these materials they were made in wood and also vulcanite, which is hard vulcanised rubber.

The most common wood used for ordinary squares was pear wood. Although this was pretty stable it could warp over time and framed set squares, like the one in Figure 55 were better. The best, like this Stanley one were made of mahogany and edged with ebony. Each corner joint, besides being glued, has a thin slip of wood inside and the sides are pinned through this with brass pins.

Using the 45 degree and 30/60 degree set squares in combination against a T-square any multiple of 15 degrees could be achieved. If other angles were required then there were special squares such as those for slopes and batters, and ones for lettering. However there were also devices for drawing lines at any angle.

The clinograph was a kind of early adjustable set square, usually made of mahogany with a copper or brass hinge. Examples can also be found in pear wood and also celluloid. They are usually seven to ten inches long.

The isograph is basically a stiffly jointed boxwood rule, six or twelve inches long when folded. The hinge is graduated in degrees. They seem to be quite rare.

These were largely superseded by the introduction of the celluloid adjustable set square ca. 1920. In the 1950s celluloid was itself superseded by the much more stable transparent acrylic.

Fig. 55 ***W F Stanley 8" 45 degree framed square***

Fig. 56 ***Harrison's patent clinograph by Harling***

Fig. 57 ***W F Stanley 6" isograph***

Fig. 58 ***A G Thornton 'Kinwest' eight inch celluloid adjustable set square***

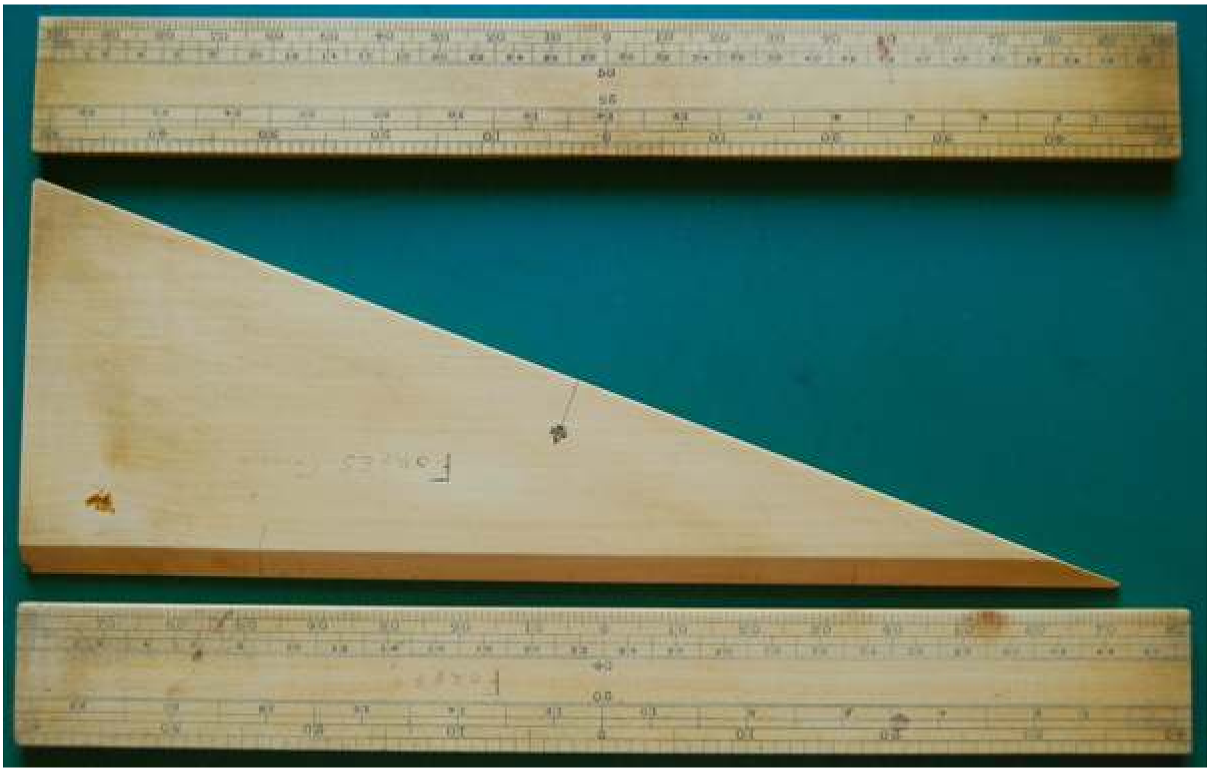


Fig. 59 ***Set of Marquois scales and triangle***

Fig. 60 ***Maginnis's Dead Beat Sectioner and mahogany box***

Figure 59 shows a set of Marquois scales and triangle. These were sold in sets in slide top cases, which this set has, and also were included in 'Woolwich' and 'Sandhurst' cases of instruments for the military. Used for sketching in the field they could perform the functions of square, straight edge and parallel rule. The two scales are very robust, being ¼ inch thick boxwood.

The **hypotenuse** (longest side) of the triangle is three times the length of the shortest and the other side has a bevelled edge.

Each of the rules has two pairs of scales divided on top and bottom faces. Each pair represents one of 20, 25, 30, 35, 40, 45, 50 and 60 divisions to the inch. The inner scale is the **natural scale** and, being open divided, the actual divisions can only be seen at one end, the remaining divisions being in units of ten. The outer scale is the **artificial scale**; its divisions are spaced at three times that of the natural scale, which is the ratio of the sides of the triangle.

Because of this three times magnification, accuracy was claimed to be improved in drawing parallel lines and making measurements using a scale and triangle in combination. In his book 'Drawing Instruments' (see bibliography), W F Stanley gives a more detailed explanation with examples of their use.

Figure 60 shows a Maginnis's Dead Beat Sectioner. This is one of the earliest devices for accurately spacing parallel lines, which are used in mechanical drawing for indicating sections through an object. There have been many other devices invented since, especially in the USA, and they would make an interesting collection in their own right. However, despite appearing in the catalogues of all the major firms they are not easy to find.

The Maginnis's Dead Beat Sectioner consists of a vulcanite triangle and an ebony rule. The ebony rule has mounted on it an electrum taper which sits between two electrum pins in the long face of the triangle. This taper can be moved in and out, and locked by a screw, to vary the distance between the parallel lines. There is a scale on the taper running from 0 to 40. This does not, however, appear to relate to any actual measurement of the distance between adjacent lines; at the maximum setting of 40 the distance between the lines is a little over 1/8 inch.

The Alpe "Super Velox 300" section liner (Figure 61) is a much later example, made in Italy. The 30 cm ruler can be set to angles of 0, 15, 30 and 45 degrees and the line spacing can be adjusted between 0.5 and 4 mm. The arm and ruler are advanced by pressing the button on the left hand side of the mechanism cover. It is made of wood, metal and plastic, and probably dates from the 1960s. It has a friction mechanism. More forms of section liner can be seen in my paper "Section Liners - A drawing instrument that most didn't need" (see Bibliography)

Fig. 61 ***Alpe Super Velox section liner***

Scales

Scales were usually available in three standard sections, which W F Stanley illustrated in his book. These were **oval**, divided on both sides, **flat**, usually divided on the upper side only, and **triangular**, divided on all three sides. They were sold singly and in sets.

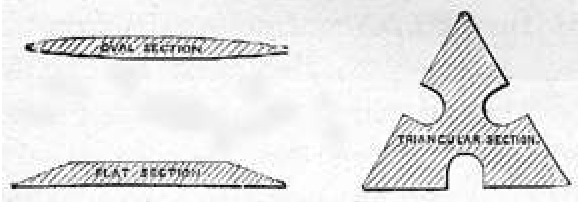


Fig. 62 ***Standard scale sections*** *(W F Stanley, 1900)*

Fig. 63 ***Set of chain scales and offsets sold by the Army & Navy Cooperative Stores***

Fig. 64 ***Set of six W F Stanley celluloid edged boxwood surveyor's scales***

Figures 63 and 64 show two boxed sets of scales for use by surveyors. The Army & Navy Stores set comprises six chain scales and six offsets. These were intended for plotting the results of a land survey When conducting a survey, for instance along the edge of a field with a wavy boundary, the chain would be laid along a straight line (its angle and position determined) and at intervals the distance at right angles to the field boundary would be measured. These distances are known are known as **offsets** and the little scales, also called offsets would be used to plot them. These were usually exactly two inches long and divided from end to end. Each one matches the chain scale it is intended to be used with. Each scale is divided on one edge for chains to the inch with the equivalent scale length in feet on the other edge. A chain consisted of 100 links and was 66 feet long. The scales are for 10, 20, 30, 40, 50 and 60 to the inch. E.g. the 10 scale is divided so that one inch represents one chain.

The Stanley scales are patent boxwood and celluloid ones, which were easier to read.. The set comprises the following surveyor's scales: 10 & 20 to the inch; 20 & 100 to the inch; 33 & 44 to the inch; 30 & 60 to the inch; ½ inch = 1 foot & inch = 1 foot; 1½ inch = 1 foot & 3 inch = 1 foot.

Both these sets contain flat section scales.

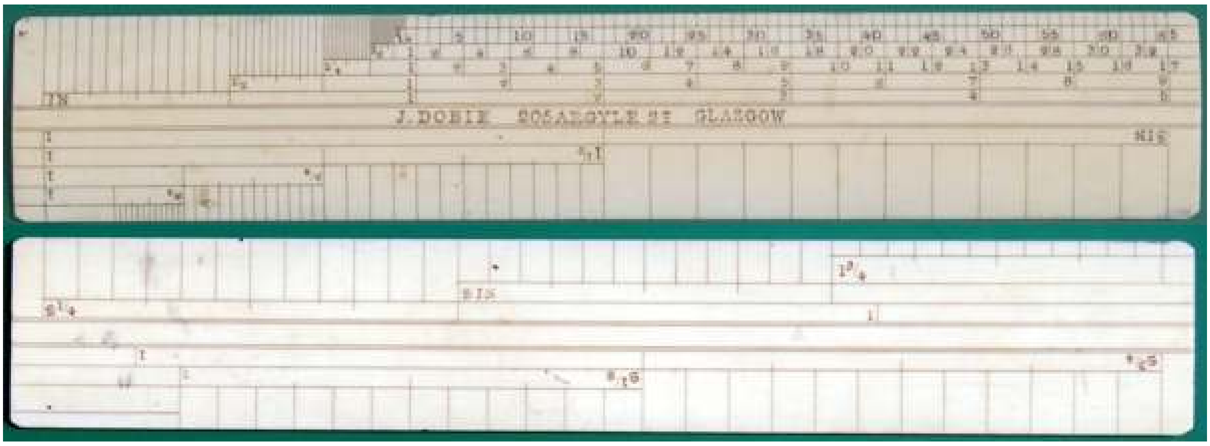


Fig. 65 ***Six inch ivory builder's scale by J Dobie, Glasgow***

Fig. 66 ***Boxwood and celluloid six inch Armstrong scale***

The builder's scale (Fig. 65) was an early type of universal scale, like the architect's scale which had a slightly larger number of scales on it. On this one by J Dobie of 205 Argyle St, Glasgow there are 14 scales. Although it is a flat scale, it has scales on both upper and lower surfaces. The nine on the upper are: inch; 1/2; 1/4; 1/8; 1/16; 3 inch; 1 1/2; 3/4; 3/8. Underneath are: 2 3/4; 2 1/2; 2 1/4; 2 inch; 1 3/4. Some twelve inch builder's scales have two further scales on them, making a total of 16, and architect's scales typically have 17 scales.

By the early twentieth century builder's and architect's scales had become obsolescent following the introduction of the Armstrong scale (Figure 66). This is an oval scale with four scales on each surface, two on each edge. The standard scales are: inch; 1/2; 1/4; 1/8 on the upper surface and: 1 1/2; 2; 3/4; 3/8 on the lower. These scales were frequently given to customers by builder's merchants and other firms as promotional items, with the firm's name on them. These should not be confused with maker's names.

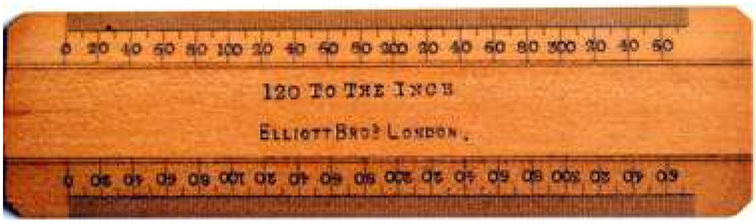


Fig. 67 ***Elliott Bros. 120 to the inch engine indicator scale***

To confuse the drawing instrument collector, engine indicator scales appear from time to time. The little flat scales, about four inches long are actually for measuring the vertical axis of engine indicator diagrams for calculating the mean effective pressure (MEP). 120 to the inch means 120 psi {pounds per square inch) pressure to the inch and is intended for use when the indicator is fitted with the 120 psi pressure resisting spring. The engine indicated horsepower can be calculated from the MEP.

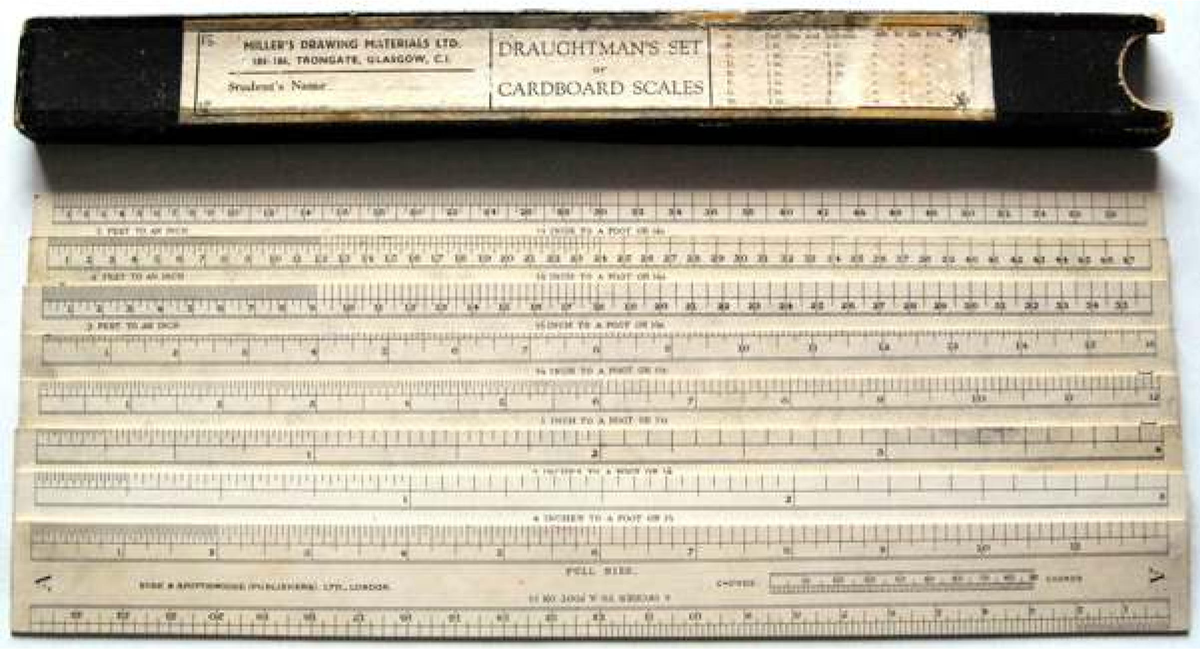


Fig. 68 ***Set of eight draughtsman's varnished card scales made by Eyre & Spottiswoode (publishers) Ltd for Miller's Drawing Materials Ltd, Glasgow***

Boxwood scales were quite expensive to buy and so sets of varnished card scales were made for use by students. Typically a set of eight card scales cost less than half the price of a single twelve inch boxwood one.

The most commonly found sets of card scales are those produced for draughtsmen by Eyre & Spottiswoode. The set of eight 12 inch long scales, lettered from A to H, were printed on one face only. The set comprised: A - full size and half size scale to the foot; B - 4 inch and 2 inch scale to the foot; C - 3 inch and 1½ inch; D - 1 inch and ½ inch; E - ¾ inch and 3/8 inch; F - 1/3 inch and 1/6 inch; G - ¼ inch and 1/8 inch; H - 1/5 inch and 1/10 inch. Identical scales are also found with other names on them, such as Reeves and Technical Sales.

Eyre & Spottiswoode also produced a set of nine surveyor's scales for 10 to 60 chains to the inch, 1/2500, 1/500, and six inches to the mile, each being graduated for links on one edge and feet on the other.

Lockie's Improved Drawing Scales, manufactured and published by Mackenzie & Storrie, 35 Shore, Leith were also sold in sets of eight, numbered 1 to 8, and were similar to the Eyre & Spottiswoode draughtsman's scales but the printing has a more open appearance.

Low's Improved drawing scales were printed on both sides of the card and were nine inches long. They were produced in sets of three or four by Longmans Green & Co, Paternoster Row, London. They are quite rare.

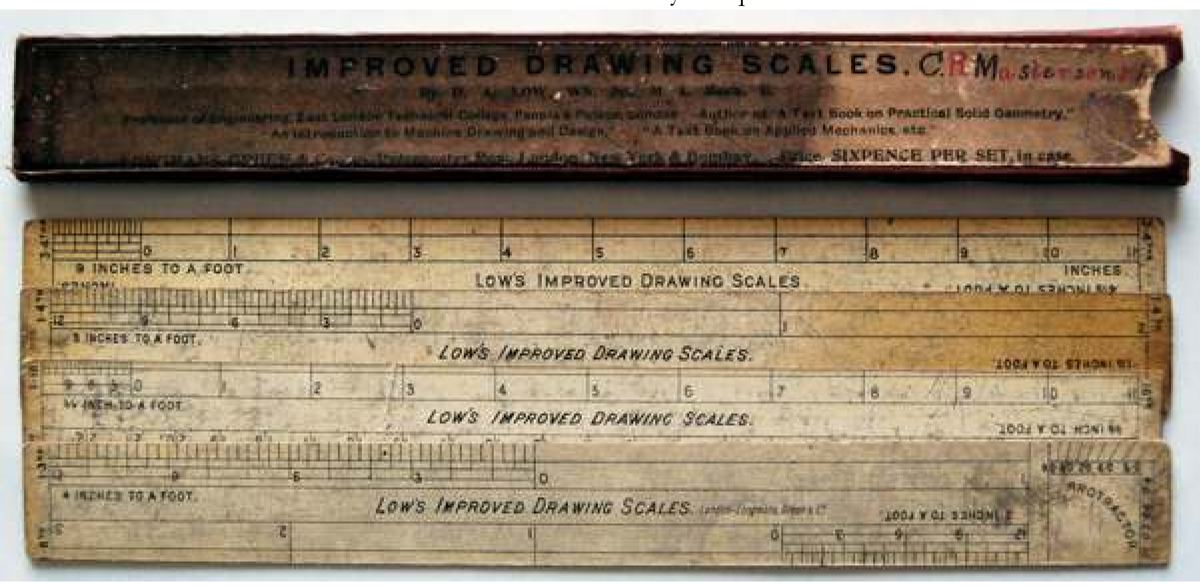


Fig. 69 ***Set of four varnished card Low's Improved Drawing Scales published by Longmans Green & Co***

Parallel Rules

There were two basic forms of parallel rules, the bar type and the rolling type and they were made in a variety of sizes from six inches to two feet and sometimes larger. Either type was sometimes combined with a rectangular protractor but these are now rare, as are bar ones with scissors links or a third bar and two sets of links.

Ebony was the commonest material for plain bar type parallel rules but boxwood and ivory were also used. In recent times acrylic has replaced wood.

Fig. 70 ***Six inch parallel rules, the upper in ebony and brass, the lower by Stanley in ivory and electrum***

Fig. 71 ***Eighteen inch 'Capt. Field's Improved' parallel rule in boxwood & brass made in 1938 by Dargue Bros. for the Air Ministry***

Fig. 72 ***W H Harling boxwood & brass 15 inch rolling 'Capt. Field's Improved' parallel rule***

Fig. 73 ***Ebony, ivory and electrum nine inch parallel rule by C W Dixey, 'Inst. Maker to Her Majesty'***

The Captain Field's improved parallel rule, marked with degrees around three sides and compass points was intended for chart work and many of the bar type were made for the Air Ministry for aircraft navigation.

The W H Harling one also has a ruler scale on the bottom edge.

Rolling parallel rules with ivory edges with scales on them were made in six, nine and twelve inch sizes and were sometimes included in magazine cases of drawing instruments.

The parallel rule in Figure 74 dates from the 1940s and was made for navigational use. The base material appears to be vulcanite (or just possibly Bakelite) and the cover I think is phenolic resin.

Fig. 74 ***Two foot rolling parallel rule with vulcanite plate and reinforced phenolic axle cover.***

Curves

The most common type of curve template from the period is the French curve. Originally made of wood, usually pear, as vulcanite and celluloid became available they were also made of these new materials. Celluloid had the advantage of being transparent. However it was later discovered to deteriorate badly with age and was replaced by newer plastics such as polystyrene and acrylic after the second world war.

Fig. 75 ***Vulcanite French curves by AJS Ltd.***

Fig. 76 ***Pear wood French curves***

Fig. 77 ***'Simplon' transparent plastic French curves***

Railway curves are far less common but it should be possible to find them. Incomplete sets are often very cheap. They came in boxed sets of two types, namely radius curves and degree curves. However both types are constant radius curves with the same radius on both curved edges. Wood, varnished card and celluloid were the materials used.

Less common still are ship's curves and yacht curves, which were irregular, more like French curves but much larger. I have seen these on eBay from time to time.

Fig. 78 ***Pear wood railway curves from a set of 50 by W F Stanley***

Fig. 79 ***Split steel pens, ca. 1830***

Drawing Pens

The variety in drawing pens, also known as ruling pens, was mainly concerned with special functions, such as producing dotted lines. However, in the early nineteenth century, split steel pens (Figures 79 & 80) were an alternative to the pens with turned brass handles or, later, ivory handles. The upper pen is the more usual type. To open for cleaning the brass cap and adjusting screw must both be unscrewed, allowing the pen to open like a pair of scissors. On the lower pen the brass cap is permanently fixed and only the adjusting screw needs to be removed.

Fig. 80 ***Split steel pens opened for cleaning***

Fig. 81 ***Border, dotted line and road pens***

The border pen was used for drawing thick lines. The blades are individually adjustable and separated with a feed for the ink.

The dotted line pen has a small wheel inset at the tip. It has a lifting upper blade for cleaning and for changing the wheels, further ones with different patterns being stored in the compartment at the end of the ivory handle. There is an ink feed incorporated in the lower blade.

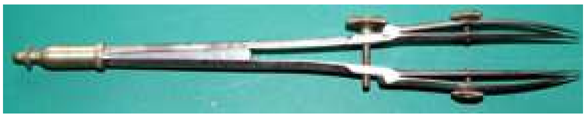


Fig. 82 ***Split steel road pen, ca. 1850***

The road pen could be adjusted for drawing parallel lines at the desired distance apart. There was also a road pencil. The split steel road pen is an earlier type. This one has an electrum cap so is a late example of its type.

Fig. 83 ***Detail pens by W H Harling & W F Stanley***

The detail pen, sometimes called the Swedish pen, was intended for drawing long, straight lines and had a larger ink capacity than normal drawing pens. The Harling one has an ebony handle and the Stanley one has an ivory one. Continental ones (Figure 84) often had aluminium handles; the cross joint enabled them to be opened for cleaning and they sometimes had an adjusting screw graduated for line thickness.

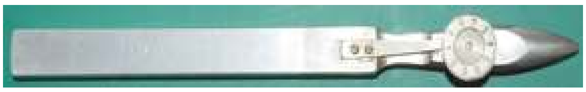


Fig. 84 ***Cross joint detail pen (Continental)***

Fig. 85 ***Curved line pens (German)***

The ordinary drawing pen was not very convenient for drawing curved lines. W F Stanley did produce a pen with a cranked handle for this purpose but it does not seem to have been a success and the German type of curved line pen was much more popular. They were imported and sold by English makers from the end of the nineteenth century. They have a hollow (usually aluminium) handle with a rod running down the centre to the nib. The screw knob at the top can be loosened allowing the nib to pivot to follow the curve. The road pen shown in Figure 85 is also a curved line pen, both nibs being curved in the same manner to follow a curve.

Both W H Harling and Cary made cases of drawing instruments for the military. The Woolwich sets, in japanned steel cases, came in two sizes. The upper pen in Figures 86 and 87 is from the larger case, made by Harling, and is a split steel pen encased in an ivory handle. The lower pen, from the smaller case made by Cary, has a long electrum ferrule inside which is the protracting pin. Although these sets date from the late nineteenth and early twentieth centuries these pens carry over features from an earlier period. Elliott Brothers also made many sets for the military and also for the East India Coy.

The 'Farkas' pen was patented by A G Thornton and introduced in 1939. It was claimed that the opening gave a clearer view. With enamelled aluminium handle it cost 4/3d and was 3d more with a white Erinoid handle.

Figure 86 shows three pens by W H Harling dating from the 1950s with plastic handles. The road pen has an offset handle for better visibility. The lifting nib pen has their special three lobed handle for better grip and a stainless steel nib. The bottom one is a litho pen for drawing on lithographic stones.

Drawing pens were not suitable for lettering. The draughtsman would use a type of writing pen for this task and the preferred type was known as the crow quill. The nib was smaller than that of the ordinary pen, with a tubular base to ft the holder. The Pelikan 'Graphos' fountain pen could be fitted with nibs for either line drawing or lettering. The set shown in Figure 91 has twelve line drawing nibs for different line thicknesses.

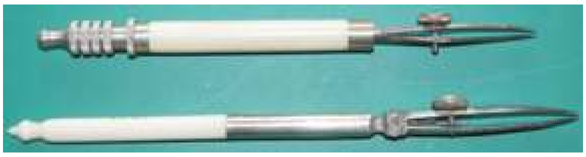


Fig. 86 ***Pens from Harling & Cary Woolwich cases***

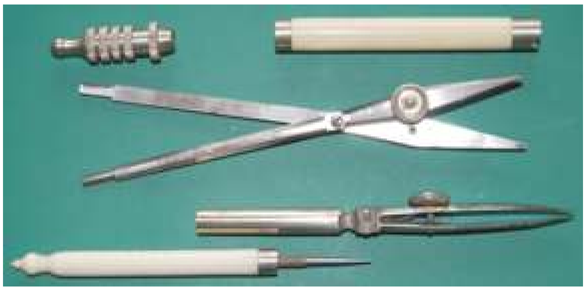


Fig. 87 ***Woolwich case pens showing features***

Fig. 88 ***A G Thornton patent 'Farkas' drawing pen***

Fig. 89 ***Pens by W H Harling***

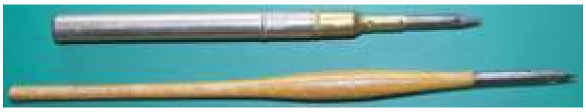


Fig. 90 ***Crow quill pens***

Fig. 91 ***Pelikan Graphos pen set, made in Germany***

Pocket Compasses and Dividers

Small is beautiful. Although not particularly rare, pocket compasses are much sought after by collectors and fetch disproportionately high prices. The nicest and most sought after is the pillar compass.

Figs. 92 - 94 ***Brass pillar compass and shaped Morocco case, English, mid 19th century***

The pillar compass is really three compasses in one. Fully assembled it is a 4½ inch compass, which can be configured either as a pencil compass, or as an ink compass, or as a divider. Disassembled it divides into a 2 inch pencil compass and a 2 inch ink compass. They were also sold with two extension legs which could be assembled with all the other parts to form a six inch compass. The one illustrated probably dates from about 1850 but they were made throughout the late Georgian and Victorian periods, and into the 20th century.

Not as versatile, but very convenient for carrying in the pocket were Napier compasses. These folded to a very compact size and could similarly be configures as dividers or pencil or ink compasses. Figure 95 shows one in its Morocco case and another can be seen opened in the middle of Figure 96

Fig. 95 ***Hughes & Son Napier compass***

. To the left of it is a Swiss pattern folding compass, which differs in the direction of fold of the points. Both of these instruments are electrum and proba-

Fig. 96 ***Folding compasses and dividers***

bly date from around 1900. The last item is a folding divider, made by J J Threadwell and dating from about 1980.

Figures 97 and 98 show another type of pocket compass by Johann Faber, dating from the early twentieth century. The compass has pencil, ink and divider points which are a push fit into the legs and are reversible. There is a sheath to protect the user from the sharp points when it is placed in the pocket. The pen is missing its adjusting screw which is removed when the sheath is fitted, and screwed into the point of the sheath.

Figs. 97 & 98 ***Johann Faber pocket compass***

More Compasses

The Cary turn-about bow compass was often included in their small Woolwich tins. The telescopic turn-about compass was an alternative to the compass half set. Both legs can be extended by pulling out the points.

Fig. 99 ***Cary turn-about bow compass***

Fig. 100 ***Electrum telescopic turn-about compass***

Beam Compasses

Beam compasses came in two basic sorts, complete compasses with a beam, and boxes of fittings for the owner to fit on a wooden lath.

Figs. 101 & 102 ***W F Stanley, Great Turnstile, London, tubular telescopic beam compass, ca. 1900***

The W F Stanley beam compass is telescopic with three sections that can be pulled out to give a maximum length of thirty-eight inches. However Stanley, himself, actually commented that they were very unstable at that length and not to be recommended. It has a micrometer adjustment at the left hand end for fine adjustment.. It is made of electrum and housed in a blue silk and silk velvet lined Morocco case. A shorter one with two pull out sections was also made. They are now fairly rare and difficult to find.

The British military seem to have favoured twenty-six inch long beam compasses and the Aston & Mander one pictured below, made in 1917, is one of these. The lath is mahogany with an inlaid box-wood scale. At the left hand end is the fixed trammel with an index mark for lining up with one on the lath. The movable trammel is a roller one. The milled roller is held against the lath by a steel spring. There is a Vernier in the aperture for precise positioning.

Fig. 103 ***Aston & Mander 'Compasses Beam 26"' made for the British government in 1917***

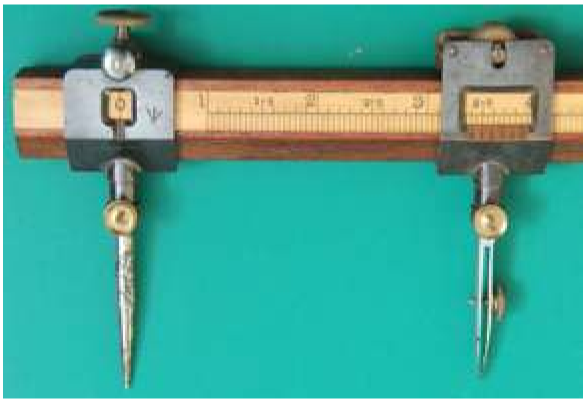


Fig. 104 ***Aston & Mander 'Compasses Beam 26"'***

Fig. 105 ***Stanley patent 'La Trobe' beam compass fittings with 'flexible strap' for release***

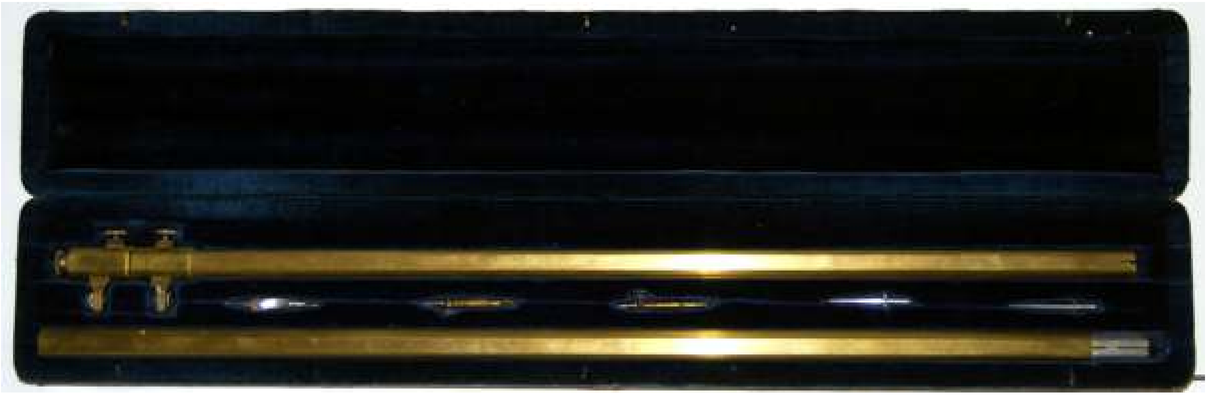


Fig. 106 ***Gebrüder Wichmann brass beam compass, early twentieth century***

Figures 106 and 107 show a fine, brass beam compass by Gebrüder Wichmann of Berlin, No. 1070. The two section, seven sided beam is 43.5 inches long. It probably dates from about 1910. There is a screw for fine setting of the left hand trammel at the end of the beam.

The VC7983 Compasses Beam 26 in TP (Thornton Pattern) B.8025 is another example of a beam compass used by the British military. It is made of brass and steel and, as the illustration from Thornton's catalogue shows, can be used with an ordinary pencil or with ink, pencil and needle points placed in the adapter supplied (bottom right in the box). They were also made in electrum and steel.

Fig. 108 ***V.C.7983 Compasses Beam 26 in. T.P.***

Fig. 107 ***Detail of Wichmann beam compass***

Fig. 109 ***Thornton Universal Roller Beam Compass, Gill's Patent No. 155970/19***
(A G Thornton 1930 catalogue)

Fig. 110 ***English made Swiss pattern beam compass***

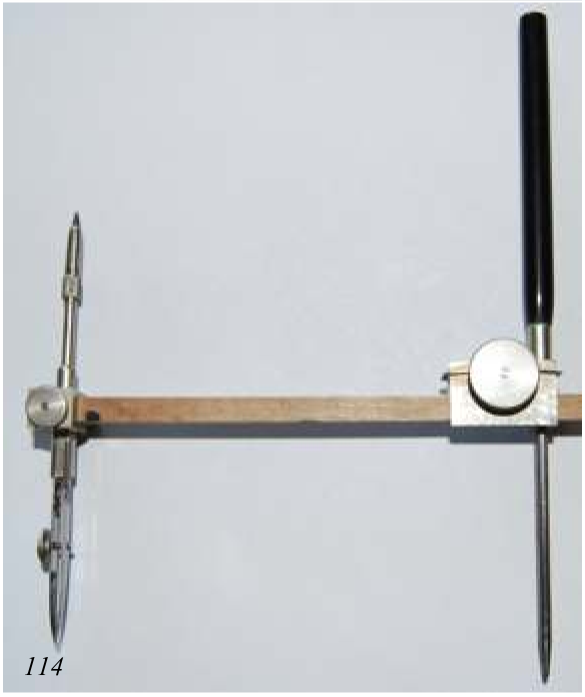
Why these beam compass fittings, probably made by J J Threadwell, are known as Swiss pattern is lost in the mists of time, but most of the English makers produced sets of them and they were usually included in ten inch and larger cases. They were intended to be clamped to a wooden lath, which the makers could also supply if required.. For fine adjustment one trammel was fitted with a micrometer screw.

Fig. 111 ***Beam compass fittings by Riefler, Germany***

German beam compass fittings, such as these by Riefler of Nesselwang & München, frequently used a screw and spring loaded lever for fine adjustment instead of the micrometer screw.

112

113



114

Figs. 112 to 114 ***Beam compass by unknown maker***

The maker of this beam compass is unknown but it is probably German. It is made of German silver and steel with a ten inch long, quarter inch square wooden beam. The fixed fitting takes the double ended ink/pencil point. The needle, with its long handle for rotating the compass fits in the roller fitting. It can also be fitted with the mechanical dotted line pen.

The Norton & Gregory beam compass fittings (Figure 115) comprise a fixed trammel and a roller trammel. There is the usual selection of plain, needle, pencil and ink points.

Fig. 115 ***Norton & Gregory beam compass fittings***

Fig. 116 ***Riefler, Nesselwang & München, R1 beam compass***

Riefler made a range of these tubular beam compasses from German silver and they were justifiably popular. The R1 was one of the shorter ones with a total beam length of 26 inches. Fine adjustment was by micrometer screw at the end of the beam. The longer R2 had screw and lever fine adjustment, similar to that on the beam compass fittings shown in Figure 111.

Fig. 117 ***'New Portable Beam Compass', unsigned but probably made by W H Harling, 1930s***

Fig. 118 ***Harling roller beam compass fittings***

Fig. 119 ***Harling roller beam compass detail***

W H Harling made roller beam compass fittings in two sizes. The smaller size was supplied in sets with a Duralumin beam and known as the 'Portable Beam Compass'. They were made for other drawing instrument suppliers as well, such as A West & Partners and Casella who used Harling's engraving in their catalogues with Harling's name crudely blanked out. The set illustrated has a five section beam giving a total length of 48 inches.

Harling supplied their beam compasses either in leather cases or in card boxes, in which the larger size fittings are illustrated. These were intended for fitting to a wooden lath, as shown in Figure 119, which they could also supply in various lengths.

The Lee Guinness beam compass is another example of the roller type with a Duralumin beam, in this case totalling 51 inches long.

Fig. 120 ***Lee Guinness beam compass***

Fig. 121 ***Six inch electrum proportional dividers and fitted case by Newton & Co., 3 Fleet Street, London***

Proportional Dividers

These are sometimes also called proportional compasses but that can cause confusion with the sector, which is known by names that translate as compass of proportion in Italy and other European countries.

The six inch size was the most common in Britain, made of brass or electrum. The best were fully divided, i.e. with scales on both faces, usually for circles, lines, plans and solids like the Newton & Co one below.

Fig. 123 ***Halden proportional dividers***

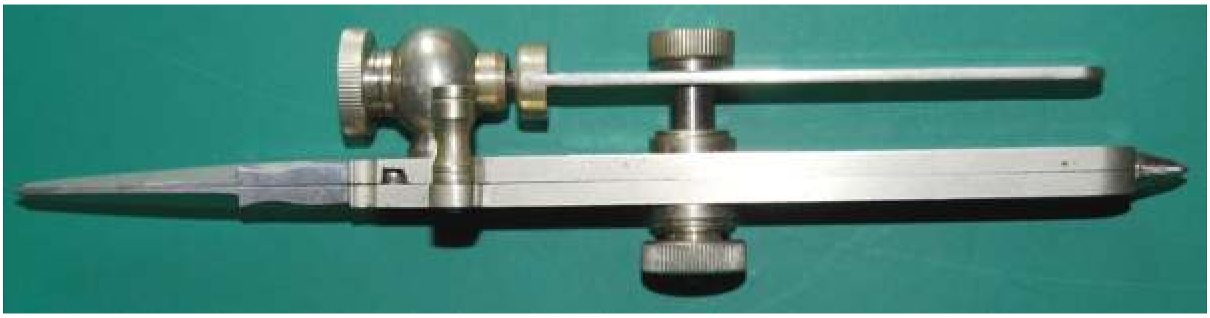


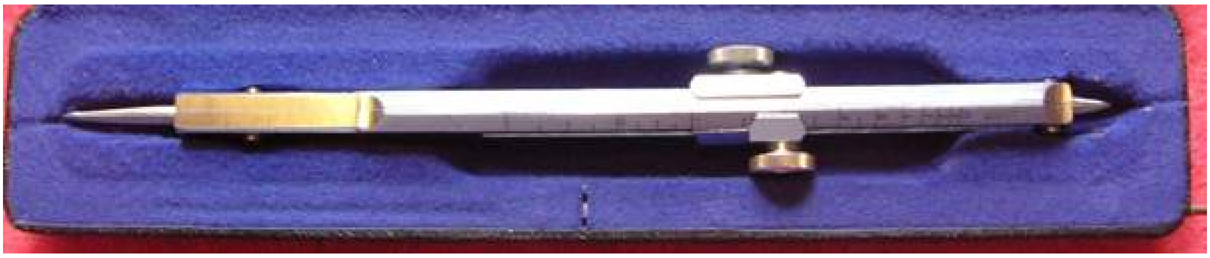
Fig. 122 ***Halden proportional dividers with bar and micrometer screw for fine adjustment***

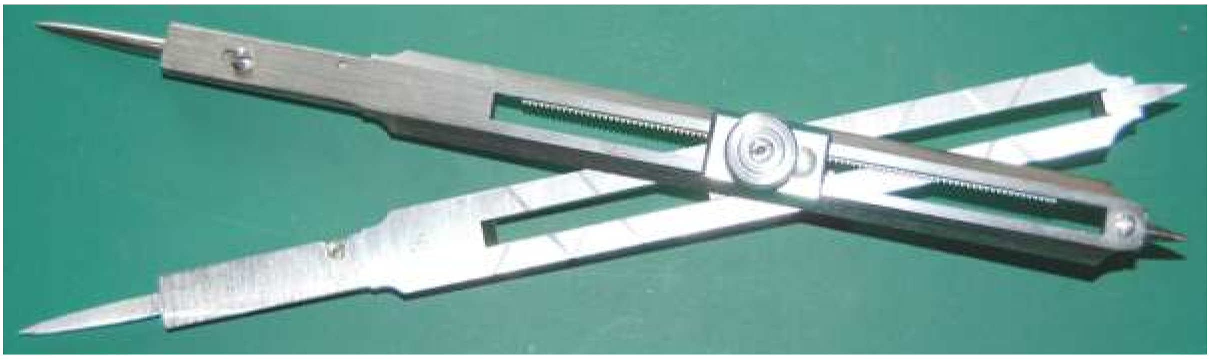
The proportional divider by J Halden of Manchester has a setting bar with a micrometer screw at one end. The bar can be placed in either of two positions. As shown in Figure 122 the bar is set parallel to the axis of the upper leg by placing the screw into the hole above the slider. With the proportional dividers closed and both screws slackened the slider is moved close to the setting required on the appropriate scale. It can then be adjusted exactly to the setting by the micrometer screw on the end of the bar. With the slider clamped by the screw on the under side, the dividers are opened to the approximate distance required. The slider screw is removed from its first position and moved to the projecting socket on the lower leg, as shown in Figure 123. Once tightened there the micrometer screw can now be used to set the dividers to the exact opening desired. Robertson says T Heath invented this type in 1746.

Figure 124 shows hook ended proportional dividers by W F Stanley. These had the advantage that if a point was damaged it could be re-sharpened without affecting the scales.

Another method of improving the setting accuracy was the provision of rack and pinion adjustment, as on these dividers by Gebrüder Wichmann. The rack runs up the edge of the slot in the upper limb and the upper screw rotates the pinion. The longer points on this instrument are adjustable so that they can be reset if worn or damaged.. Typical of German proportional dividers it is approximately eight inches long. This instrument is stainless steel.

Fig. 124 ***Stanley hook ended proportional dividers***





Figs. 125 & 126 ***Rack adjusting proportional dividers by Gebr. Wichmann, Berlin, nr.1078***

Pencils

The draughtsman required pencils that were of high quality. They had to be both black and hard enough to keep their point and hence produce a line of constant thickness, dark enough for copying. He needed different grades for drawing and lettering. To avoid the constant sharpening required of wood cased pencils the lead holder, originally called the artist's pencil, was developed.

By the end of the 19th century the propelling pencil had been adapted to take the artist's leads produced by A W Faber and others. The next development was the twist lock clutch pencil such as the Rowney 'Kandahar' one. Here the cone around the end of the lead can be rotated to unlock the lead so that it can be drawn forward and to lock it.

The Rexel pencil, dating from the 1960s has a push button at the top end to release the clutch holding

Fig. 127 **English lead holders: (a) Propelling pencil for artist's leads; (b) Rowney & Co twist lock clutch pencil; (c) Rexel push button clutch pencil;(d) Chisilient draughtsman's pencil**

Fig. 128 **Lead pointers (1960s/1970s)**

Fig .129 **Refills of leads for the Chisilient, Koh-I Noor and Rexel pencils**

the lead, and to advance it. There is also a lead pointer in the push button, which can be removed from the pencil to sharpen the lead. Separate lead pointers were also made (Figure 128).

The leads for these pencils varied from 1.8 to 2.2 mm in diameter. Initially they were supplied in stout card boxes with individual compartments for each lead. Later glass tubes were used, and finally, plastic boxes. Pencils for this size of lead became obsolete after Pentel invented the thin, plastic lead, drawing pencils with leads in a range of thicknesses to match line widths, for drawing on drafting film.

The A W Faber-Castell TK9400 clutch pencil (top of Figure 131) has a ribbon lead. This did not require sharpening and the point was much like the chisel point used by draughtsmen for ruling lines. The chisel point was produced on ordinary pencils by sharpening with a knife and a clutch pencil lead could be sharpened to a chisel point using a sanding block or small file.

Fig. 130 **Boxes of six black leads for Artist's Pencils by Hardtmuth, A W Faber and Johann Faber, ca. 1900**

Fig. 131 **Faber-Castell and Staedtler clutch pencils**

A Miscellany

The opisometer was used for measuring the length of curved lines. In use the wheel was wound back to the end of the screw. The opisometer was then wheeled along the line to be measured. Finally it was wheeled back again along a scale and the measurement noted when it reached the screw end again.

Fig. 132 ***Opisometer***

Fig. 133 ***Tracers: (a) ivory handle with agate point; (b) metal handle with retractable agate point; (c) ivory handle with steel point***

In the 19th century the chief way of reproducing drawings was by tracing using a sheet of paper, coated with rubbed on red chalk, black chalk or black lead, interposed between the original and the copy. Tracers, like (c) above, were commonly found in the larger sets of instruments.

To simplify placing commonly used words on a drawing stencil plates could be purchased. This one is from a set of architect's plates by W F Stanley. The ink was stippled on with the brush. There were also plates for alphabets and decorative work.

Pencil could be erased with India rubber or stale bread but ink was difficult to erase and a knife or steel bladed eraser was usually used for this.

Before the advent of plastic boxes, drawing pencils often came in tins holding twelve pencils. Why not collect some of these? They make useful containers for collections of lead holders, pens and similar instruments.

The ink used is known as India ink and was supplied in stick form (see figure 137), which was rubbed up in a saucer of water to the consistency required.

Fig. 134 ***Brass stencil plate and brush***

Fig. 135 ***Bone handled eraser***

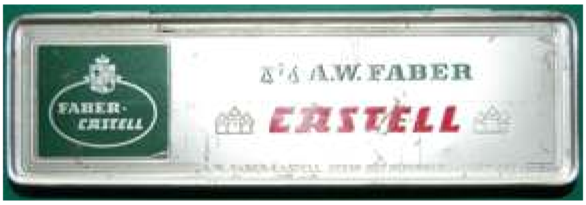


Fig. 136 ***A W Faber pencil tin***

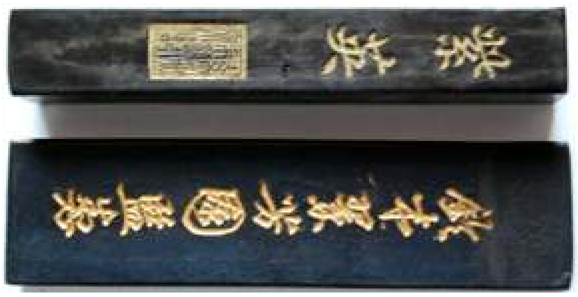


Fig. 137 ***Sticks of India ink***

Fig. 138 ***Heath & Co triangular divider***

The triangular or three pointed divider is a rarity and consequently quite expensive. They were used to transfer the position of three points from one drawing or map to another. Early ones were made of brass and the third leg was similar to the first two without the long sliding point. Sometimes the third leg was supplied in magazine cases for fitting to one of the ordinary dividers.

The electrum one shown has its own Morocco case. It was made by Heath & Co at their New Eltham works in the first half of the 20th century, possibly after they were taken over by W F Stanley in 1926 as Stanley moved their manufacturing there from Great Turnstile.

4. Planimeters, Pantographs and Ellipsographs

In this chapter I have described some of the more specialised and complex instruments. Surprisingly some of them can be obtained quite reasonably. For instance an Allbrit planimeter can be purchased for the same money as a fairly modest, mid-20th century set of drawing instruments and about a quarter of the price of a Napier compass.

The Planimeter

The polar planimeter was used for measuring areas on drawings and maps. Other forms, such as the radial planimeter were associated with charts and chart recorders. The polar planimeter was invented by Jakob Amsler in 1854. He was professor of mathematics at Zurich University, Switzerland, but lived and had his workshop - founded in the end of 1854 - in Schaffhausen, Switzerland.

Amsler planimeters are readily available but are more expensive to purchase than later types. There are three commonly found variants. The simplest of these is the Amsler type 2, which is a fixed scale, German silver instrument, also available in brass, when it is known as the type 1.

The Amsler type 4 (type 3 in brass) is an adjustable scale planimeter. The carriage can be moved along the tracing arm to set the scale and there is a screw for fine adjustment.

Fig. 139 ***Amsler type 2 fixed scale polar planimeter no. 22935 dating from ca. 1896***

Fig. 140 ***Amsler type 4 adjustable scale polar planimeter no. 15090 dating from ca. 1888***

Fig. 141 ***Amsler type 6 planimeter no. 81352 from ca. 1939, retailed by Dobbie McInnes***

The Amsler type 6 is a development of the type 4 with an additional feature for use with engine indicator diagrams. On top of the carriage and tracing arm are a pair of points (covered by point protectors when in the box). For use with indicator diagrams the carriage is moved along the tracing arm until the distance between the two points exactly matches the base length of the diagram (a measure of the engine stroke). Tracing the diagram with the planimeter then enables the mean effective pressure (used in calculating the indicated horsepower) to be determined directly. Dobbie McInnes, who retailed this instrument, were makers of engine indicators.

The Allbrit range of planimeters, made by W F Stanley, are compensating planimeters. The pole arm and tracing arm are separate. They have a greater range of movement than the Amsler type and, by placing the pole arm first on the left of the tracing arm and then on the right and taking the mean of the readings, all instrumental errors are compensated.

Like the Amsler planimeters the Allbrit planimeters were available in fixed scale and adjustable variants and they could be had variously calibrated in metric or imperial units. Indeed, manufacturers would calibrate them to any scale the customer required.

Fig. 142 ***Allbrit adjustable planimeter no. 6477, made in September 1944 by W F Stanley***

Fig. 143 ***W F Stanley 'Allbrit' fixed scale planimeter no. 3208 supplied to the War Office on 24th April 1937***

Each Allbrit planimeter came with a magnifier, a checking bar and instructions. The latter are frequently missing but otherwise the planimeter should have a sound box and the two accessories.

For measuring areas that were too long for the polar planimeter rolling planimeters were used. Stanley made a pole wagon that could be used with the tracing arm and carriage of a polar planimeter to convert it to a rolling planimeter. These were heavily constructed with knurled wheels and an adjustment on the ends of the axle to take up slack but ensure that the axle turned freely as it was important for the pole wagon to travel in an exactly straight line.

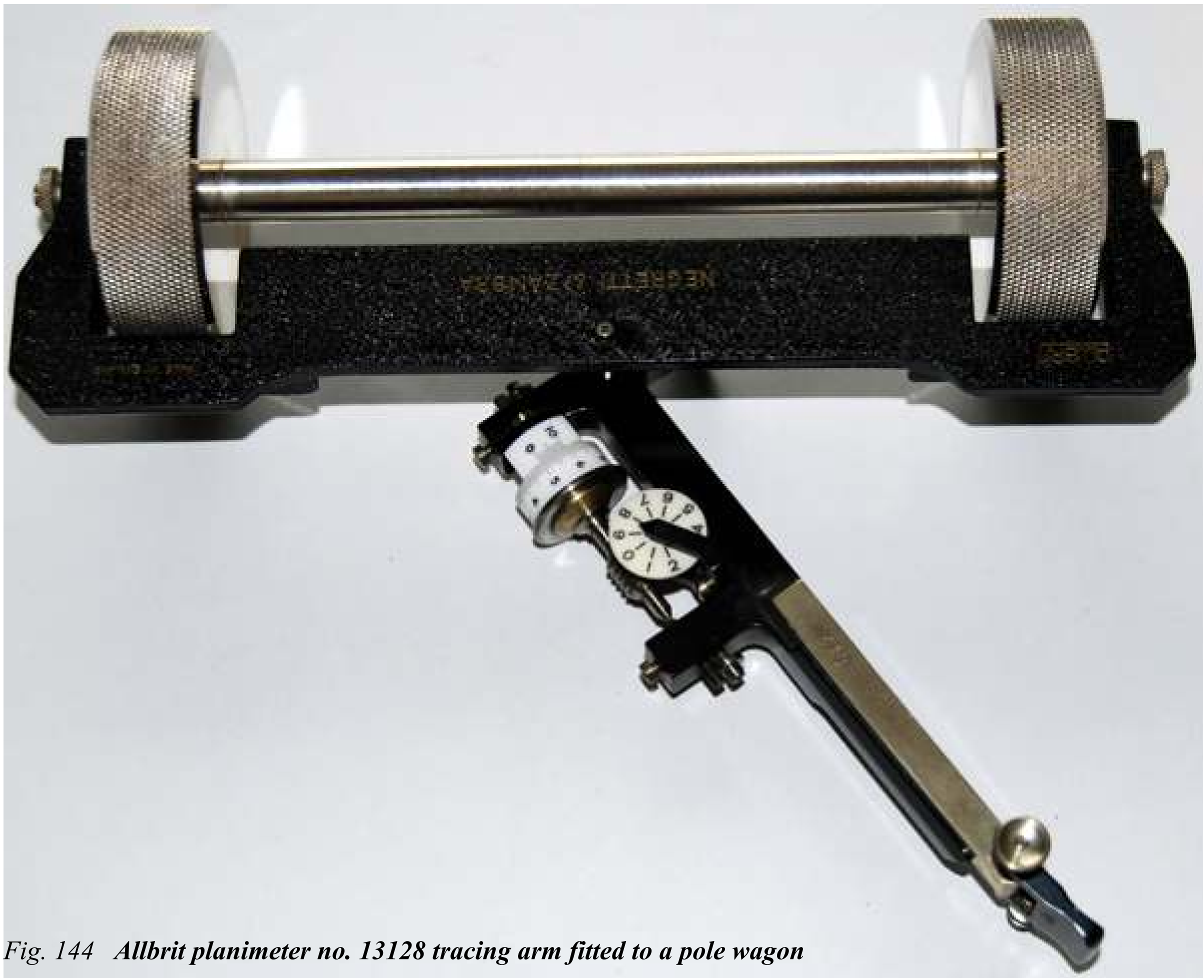


Fig. 144 ***Allbrit planimeter no. 13128 tracing arm fitted to a pole wagon***

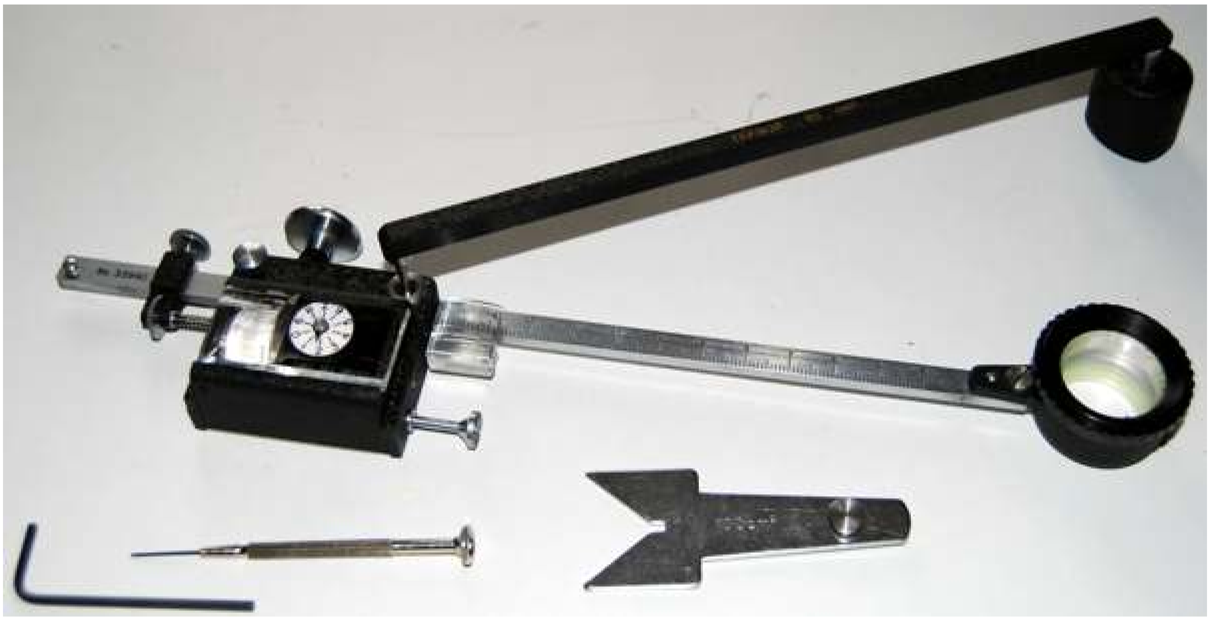


Fig. 145 ***Teknor 95 IMP zero setting compensating polar planimeter, serial no. 33940***

The Teknor 95 IMP is an adjustable planimeter, made in Japan. It is actually a Koizumi KP-27 planimeter and dates from ca. 1972. Being zero setting, it is only necessary to take the final reading rather than taking readings at the start and finish of tracing the area and subtracting one from the other.

The Pantograph

In Georgian and early Victorian times the form of pantograph, used for enlarging and reducing drawings, was similar to the Elliott & Sons one pictured here. The arms were made of flat brass and the instrument was housed in a shaped & fitted mahog-

Fig. 146 ***Elliott & Sons pantograph in its fitted case***

Fig. 147 ***Elliott & Sons 36 inch brass pantograph dating from 1850 - 1853***

Fig. 148 ***W F Stanley 26 inch pantograph with box section arms, probably early 20th century***

any case. These instruments are frequently missing the tracing and pencil points when found and I have made replacements for the Elliott & Sons one. The pantograph was improved in the latter half of the 19th century by the use of box section arms in place of flat ones, making it much stiffer and hence more accurate. The **eidograph**, invented by William Wallace, Professor of Mathematics in Edinburgh, in 1821, was more accurate still, but was also more expensive.

Fig. 149 ***Adie & Sons brass 30 inch eidograph, probably ca. 1870***

The Ellipsograph

Ellipsographs and elliptical trammels are rare and any pre-20th century are beyond the scope of the average collector. Gebrüder Haff of Germany still make an acrylic one and there are a couple of other 20th century designs. The Omicron model 17 is really a semi-elliptical trammel as it can only draw half of the ellipse at a time. It can draw ellipses of over 12 inches major axis.

The Friedmann Elliptical Compass is a true ellipsograph. Similar ones were available from a number of American firms in the 1930s. It may be possible to find one of these for a reasonable sum.

Fig. 150 ***Omicron Model 17 Ellipsograph, 1950s, aluminium, steel and acrylic.***

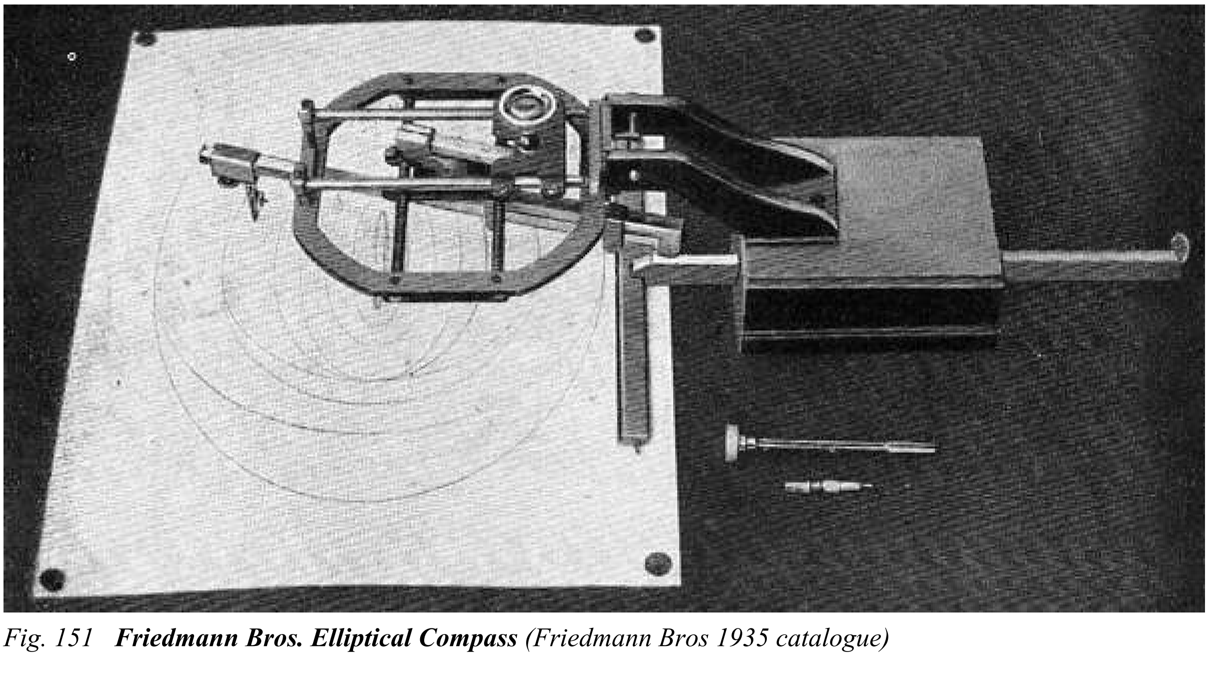


Fig. 151 ***Friedmann Bros. Elliptical Compass*** *(Friedmann Bros 1935 catalogue)*

Fig. 152 *Fowler ellipsograph model A-140*

Since publication of the first edition I have obtained a further two ellipsographs. Figure152 shows a Fowler Engineering, Whittier, California, USA ellipsograph. US patent 2,612,691 issued Oct 7, 1952, Rotating the handle hinged to the right hand gear wheel rotates the left hand one in the opposite direction. An adjustable cross-head, mounted on the left hand wheel, runs in a groove in the underside of the bridge and thus imparts the longitudinal motion on the plate in which the two wheels are mounted. It is complete with card box and a table of settings for isometric ellipses.

Figure 153 shows a Finney Elliptograph (ellipsograph) made by W F Stanley. It is probably early 20th century but could be earlier. It was originally the property of the London County Council Polytechnic Architecture School as it is marked 'Poly. Arch. Sch. L C C'. The major and minor axes can be set using the lower and upper thumb wheels respectively. Each has an index and scale for accurate setting. To use it the large brass wheel is depressed to bring the pencil lead in contact with the paper and then rotated. It has a fitted mahogany case.

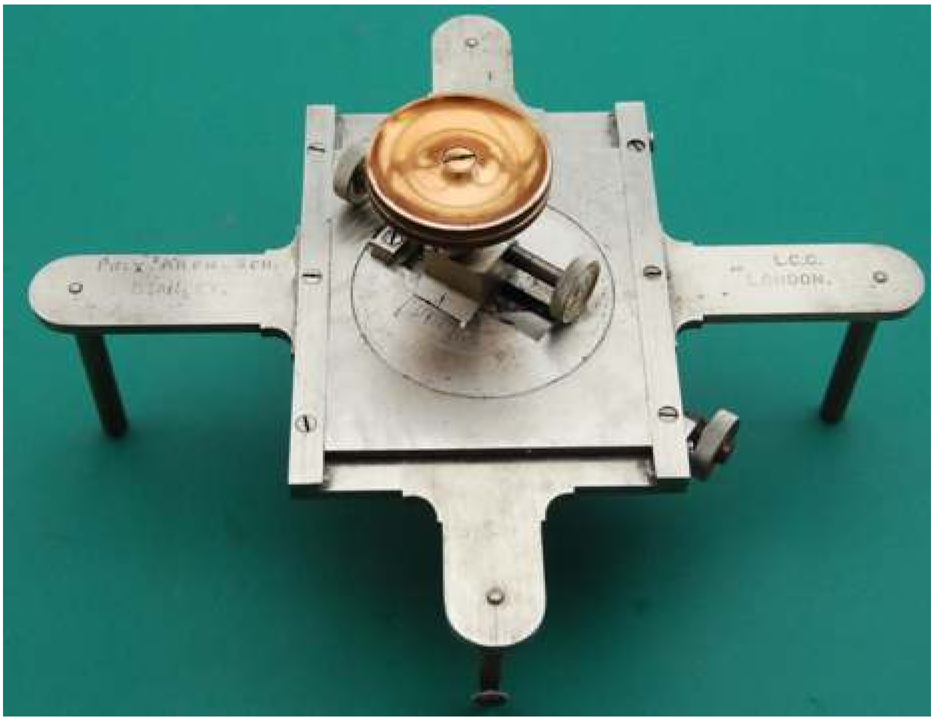


Fig. 153 ***Finney Elliptograph (ellipsograph) made by W F Stanley.***

The Station Pointer

The station pointer, also known more descriptively as the three arm protractor, was used for plotting ones position on a map or chart, usually at sea. Three landmarks would be selected and the angles

Fig. 154 ***Heath & Co, London SE9, station pointer, aluminium & steel, mid-20th century, No. 5157***

between the outer ones and the centre one measured with a sextant. The arms would then be set to these angles and the station pointer would be placed on the chart such that the bevelled edges of the arms touched the positions of the landmarks on the chart. The centre of the protractor would then indicate your position. The best station pointers had Verniers which could be accurately set using clamps and tangent screws like the Heath & Co one, which also has extension arms and a pocket magnifier for reading the Verniers.

The Verniers in this case read to 1 minute of arc. The protractor diameter is six inches and the arms are fifteen inches long, extending to twenty-four.

The Bottomly station pointer has a four inch diameter protractor and fifteen inch arms. It is a simpler, lighter instrument.

Fig. 155 ***Heath & Co station pointer, protractor***

Fig. 156 ***Bottomly, 11 Billiter Street, London, station pointer, dating from the 1880s***

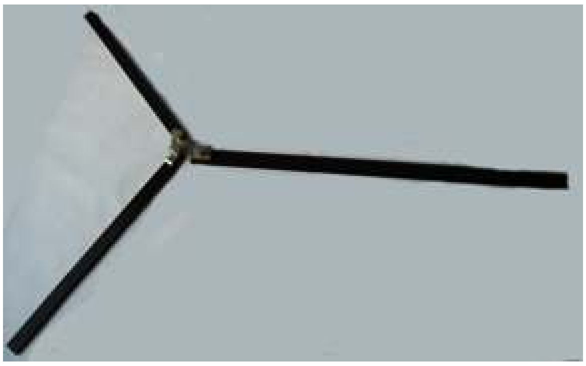


Fig. 157 ***Norton & Gregory centrolinead***

Fig. 158 ***Centrolinead joint detail***

The Centrolinead

The centrolinead was an instrument for perspective drawing where the vanishing points lay off the drawing board. To use it the eye line was drawn and then two guide pins were placed near the edge of the board. The centre joint of the instrument was then adjusted so that as the arms were worked around the guide pins the desired degree of perspective was achieved. This Norton & Gregory one is made of ebony and electrum and the ruling arm is 30 inches long. These are rare items.

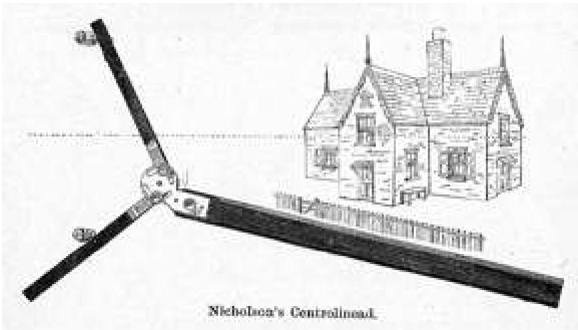


Fig. 159 ***Perspective drawing with Nicholson's centrolinead*** *(W F Stanley, 1900)*

Fig. 160 Riefler vulcanite excentrolinead

The Excentrolinead

The excentrolinead was used for drawing radiating lines that did not actually pass through the centre of the circle. An example would be drawing the spokes of a wheel as shown in the illustration from W F Stanley's book on drawing instruments. The metal arm can be moved round to give the desired eccentricity. At its free end is a point which is placed at the centre of the circle. These are quite rare.

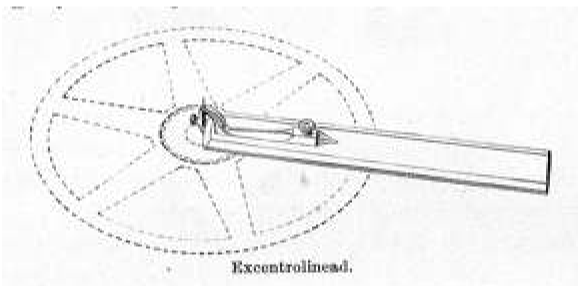


Fig. 161 ***Drawing the spokes of a wheel with the excentrolinead*** *(W F Stanley, 1900)*

In this chapter I have deliberately shown some items which the purist may not consider to be drawing instruments. The planimeter is a measuring and calculating instrument; it was not used for drawing but it was used by draughtsmen for measuring cross-sectional areas, for instance for working out the weight of a component.

The station pointer may be considered a navigational instrument. However an important use for it was accurately plotting the position of soundings on hydrographic surveys. Both of these instruments in my view add to the interest of a drawing instrument collection and are quite easily found at reasonable prices.

Georgian and early Victorian pantographs will be around the top end of many peoples budgets, as will the eidograph. Later, box section pantographs are still available very reasonably. The Omicron ellipsograph may be the only one that can be afforded, and indeed found, except for purchasing a new one from Haff. It may be possible to find a Victorian elliptical trammel that is still affordable.

5. Country Characteristics

During the nineteenth and early twentieth centuries most of the main manufacturing countries in Europe had their own traditional patterns for hand made instruments. A knowledge of these can help the collector narrow down the origin, and sometimes the date of an instrument or set. It also helps with the process of assessing the authenticity of a set. Late 19th century French instruments substituted into an English Georgian set, for instance, should be easily spotted, a not uncommon situation.

Fig. 162 ***Elliott Bros. oak case***

France

English hand made instruments were expensive and many of the English makers and retailers imported cheap brass sets from Europe for sale to students. Most of these seem to have come from France so I shall begin with the characteristics of French drawing instruments using their equivalent of the full set and its case as a starting point.

Fig. 163 ***Typical French rosewood veneered case***

The Case

The Elliott Brothers case is a typical English case for a 'full set'. It is approximately 8 x 6 x 2 inches and these dimensions were pretty standard. The cartouche and lock escutcheon are rectangular with scalloped edges (here Stanley was an exception, using an oval cartouche and round escutcheon). Woods used were solid oak, mahogany and walnut, and rosewood and burr walnut veneers on a mahogany ground. The brass or electrum banding was an option. The lid was usually watered silk lined, the tray velvet lined and the base often divided into compartments with some velvet lining.

Fig. 164 ***High quality French case***

The equivalent French case (figure 163) is about a half inch longer and an inch narrower, the dimensions again being pretty standard. Inside the lid is a flap with a paper lined pocket behind to house a small brass semicircular protractor. On the outer face the flap is padded and plain silk covered. The tray is lined with velvet but the bottom of the box is not, nor is it compartmentalised. The cartouche is a simple rectangle and the escutcheon is round. The lock is often a double turn type, a French peculiarity found on their old furniture. Sometimes the lock is stamped 'BSGDG' which is an abbreviation for 'breveté sans guarantie de gouvernement' (equivalent to 'patent applied for').

High quality French cases (figure 164) usually had brass banding and in the larger sizes the cartouche was replaced by an ornamental metal inlay. The veneering on this case uses two contrasting woods, rosewood and flame mahogany with cross banded edging to the top.

Pocket cases would be of the typical continental type, black leather or cloth covered, with a pin lock (English cases were usually fitted with a snap lock). Inside, the flap and lining materials were similar to those used in the wooden boxes. Once again the typical shape was longer and narrower than used in Britain.

School instruments were housed in small, varnished pine boxes with hook fastenings. These were frequently given as school prizes in England.

Neither Breveté nor Deposé are makers; their English equivalents are Patent and Registered Design respectively. UNIS was not a maker either but a French manufacturers' association active in the early 20th century.

Fig. 165 ***Set of brass drawing instruments typical of those imported from France for student use.***

Fig. 166 ***Better quality set of nickel silver French instruments***

A typical French set

Although of different qualities, both of these sets have similar contents. In the tray there are: a six inch compass with divider, pencil and ink points and a lengthening bar; five inch dividers; a four inch compass with divider, pencil and ink points; pencil and ink spring bows; a drawing pen and a compass key. There is a brass semicircular protractor behind the flap in the lid. There may be small wooden set squares in the bottom of the box.

The compasses are distinctively shaped, and narrower than their English counterparts. The head joint, a type of long joint, has three plates, all brass or nickel silver on the cheaper instruments, two nickel silver and one steel on the better quality instruments. The ink, pencil and divider points have either a square or pentagonal spigot which fits into a recess in the compass leg. A screw holds the point in place, bearing on the flat side of the spigot. The needle points are held in place by a screw directly pressing on them.

The cheaper sets contained plain dividers, whilst the best sets had hair dividers.

Two, very different types of spring bow were made in France. The cheaper set illustrated has spring bows with just a single spring leg recessed into the brass body. This type of spring bow was also made in Switzerland. They were made in both brass and nickel silver and the better quality ones had ivory handles. Divider spring bows were not made to this pattern.

The other set has 'all steel' spring bows with finely turned ivory handles. Pencil, ink and divider spring bows were made to this pattern.

Pens have either bone (cheap) or ivory handles, often with a pricker on the end of the handle inside the ferrule, from which it unscrews. There are a number of different handle and finial designs. Mostly the pens do not have opening nibs in the cheaper sets but may have lifting nibs in the more expensive sets.

The illustrations that follow show some of the individual instruments and some variations.

Fig. 167 ***French spring bows, two with ivory handles***

Fig. 168 ***High quality French compass half set in German silver***

Fig. 169 ***Cheap French brass compasses, (a) school compass, (b) medium size compass, (c) smallest size***

Fig. 170
French brass protractor, stamped from thin sheet. *(I also have one of these stamped 'Made in England')*

Fig. 171 ***French drawing pens - from the top: (a) bone handled pen from cheap brass set, (b) ivory handled fine line pen, finely turned finial, German silver ferrule, from a top quality set (c) lifting nib pen with ivory handle and pricker inside from the same set as 'b', (d) ivory handled pen from better quality brass set, (e) ivory handled pen with handle unscrewed to show pricker.***

Fig. 172 ***French ivory handled road pen and dotted line pen.*** *The finial on the dotted line pen is a particularly fine example of that seen also on the road pen and pen 'b' in Figure 165.*

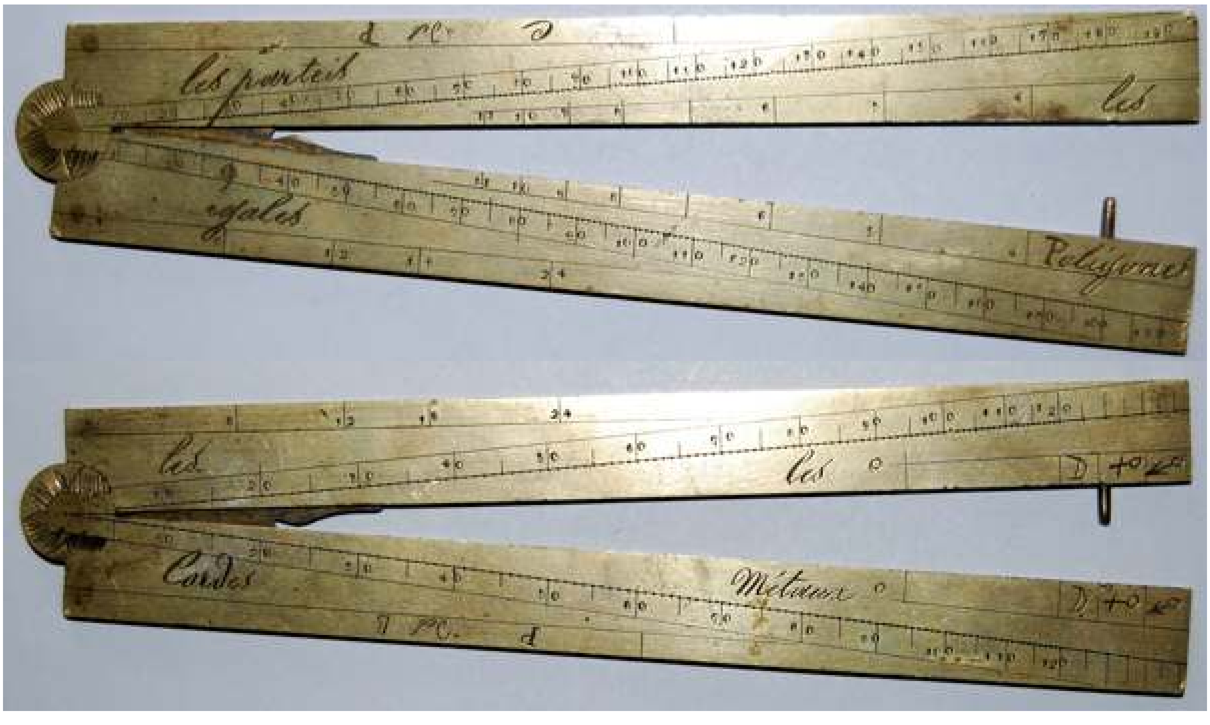


Fig. 173 ***French brass sector showing upper and lower faces***

The French sector has rather different scales to the English one, some of the scales being for gunnery. On the upper face the scales are: les parties égales (scale of equal parts), C de P (calibres de pièces, gun calibre), les polygones (polygons). On the lower face are: les cordes (chords), P des B (Poids des boules, weight of shot), les métaux (metals).

The brass folding square was frequently included in French cases in the 18th and early 19th centuries. The two arms fold together about a diagonal hinge. The large hole and a small hole at the other end of the lower arm are for use with a plumb line. The lower arm is 6 Pouces (French inches) long and graduated in Pouces and 1/12 ths (lignes). The upper arm is graduated in Nouvelle Mesure (new measure - cm and mm). The metric system was introduced in the 1790s and became compulsory in 1837.

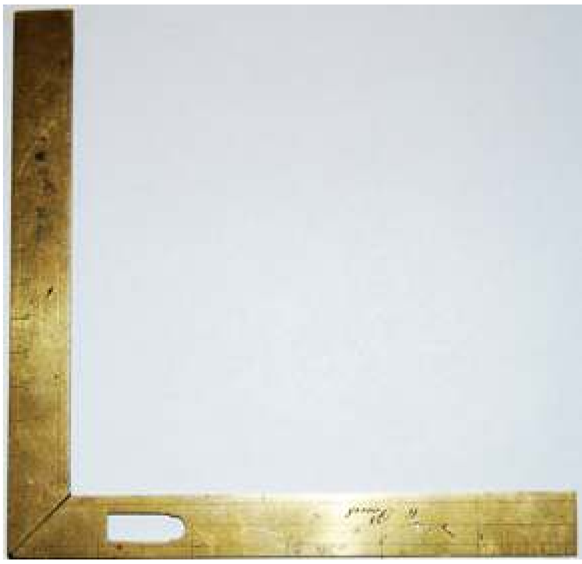


Fig. 174 ***French folding square, early 19th century***

Germany and Switzerland

I have lumped these two countries together as there was little difference in style between them for most of the instruments. The 'square' pattern, sometimes known as the 'American' pattern because of its popularity there, was made in both Switzerland and Germany, and also by Theo Alteneder in the USA. Many American makers imported this pattern from Europe and sold the instruments under their own names such as Frederick Post, Eugene Dietzgen and Keuffel & Esser.

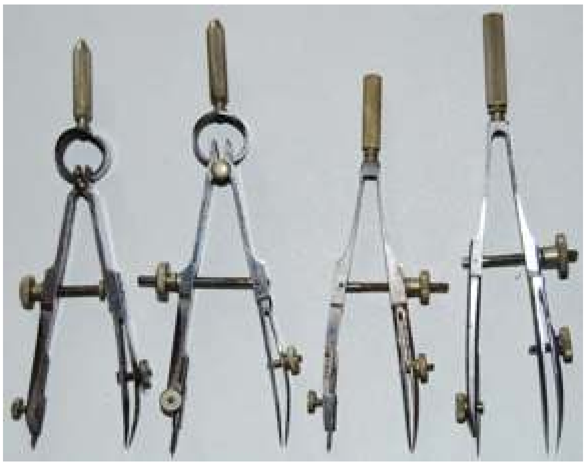


Fig. 175 ***German and Swiss ink spring bows - from the left: (a) Schoenner, (b) Schoenner, (c) Eugene Dietzgen, (d) Kern*** *(Note: three different types of needle fastening)*

Frederick Post claimed that they were made in their own factory 'located in a peaceful valley in the Alps'; the instruments in my 'College' set are marked 'Germany'! Eugene Dietzgen's instruments were made by the Bayerische Reisszeugfabrik A G, which Joseph Dietzgen purchased in 1909. This was the firm that also made Ecobra instruments. A close look at their instruments will often reveal the mark D.R.P. indicating a German patent.

Fig. 176 ***Kern, Aarau, Switzerland, German silver square pattern set dating from the 1914-26 period***

Fig. 177 ***Schoenner, Germany, square pattern set dated 1912***

Fig. 178 ***Swiss set made by Gysi***

Figure 177 shows a set of square pattern instruments made by Schoenner in Germany in 1912. The 'C' spring bows are more usually associated with flat pattern sets, which are described in the next chapter.

Figure 178 shows an earlier pattern of instruments that was made by several firms in Switzerland including Kern and Gysi. The Gysi set dates from about 1870. Compasses with both legs having detachable points were a feature of this pattern.

Features to note for the spring bows in Figure 179 are: (a) shaped ivory handle and two spring leaves attached to the handle by a screw; (b) thick curved point on hexagonal handled bow - English bows of this style had thinner, straight points.

Fig. 179 ***19th century Swiss spring bows***

Fig. 180 ***German spring blade pens: (a) Eugene Dietzgen, (b) Schoenner from 1912 set, (c) Schoenner*** *The two Schoenner pens have a release to open the blades for cleaning. The upper pen has a release patented February 4th 1904 with a separate pivot. The lower one pivots about the adjusting screw. all three have vulcanite handles although aluminium was also used.*

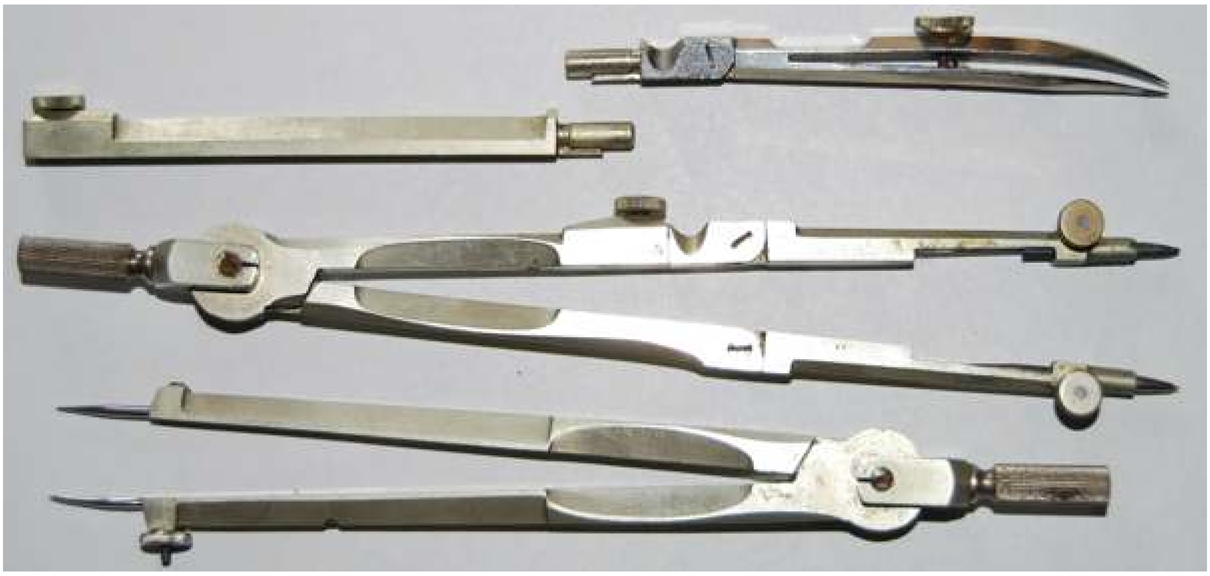


Fig. 181 ***German made compass and hair divider from a Keuffel & Esser Doric set.*** *The compass and divider heads have a hidden straightening device. The compass ink and pencil points have a circular cross section spigot with a steel feather. The socket has a clamping screw directly pressing on the spigot. unlike the Schoenner, Post and Kern examples where the socket is slit and the clamping screw compresses the socket around the spigot.*

Fig. 182 ***Head joints - from the left: (a) Kern, (b) Schoenner, patented 17.3.1903, (c) Post's pivot joint with clamping screws from the College set, (d) Eugene Dietzgen***

There were many detail variations in the design of square pattern instruments , particularly in the head, where many manufacturers had their own patent.

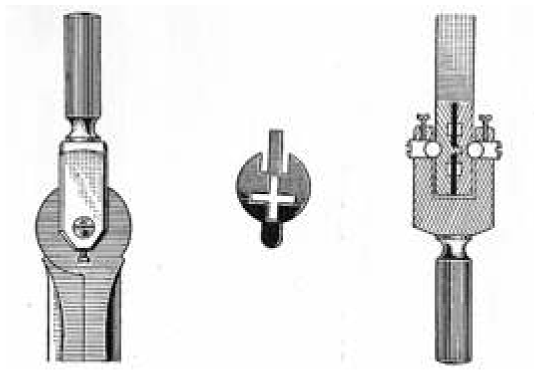


Fig. 183 ***Post's Excelsior*** *(Post catalogue, 1936)*

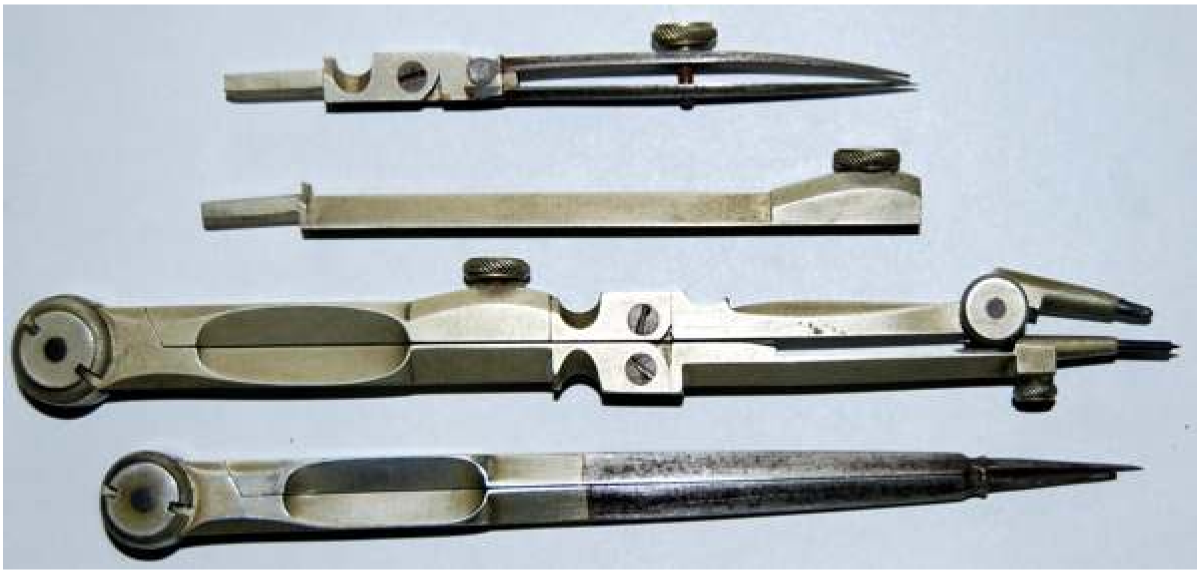


Fig. 184 ***Compass and divider made of German silver***

Fig. 185 ***German pens with lifting nibs.***

The instruments shown above are unsigned or from sets with English retailers' names. Their pattern indicates that they were made in Germany or Switzerland. They all date from ca. 1900. The compass illustrated in Figure 184 is similar in construction to the French compass in Figure 168 but the proportions are quite different. It is both shorter and heavier with a much more rounded finger recess.

The Netherlands

The H Meeuwig set is heavily constructed from brass in a style that is unique to the Netherlands. The pen and compass ink point have lifting nibs. The pen nib is half the length of the pen, which has an octagonal section, brass handle The compass pencil point is distinctly ornamented and has a separate lead holder.

Fig. 186 ***H Meeuwig, den Oude Gracht, Haarlem brass instrument set, 4th quarter 19th century***

Italy

Italian instruments are also very distinctive. The dividers and compasses have long joint heads with three brass or nickel silver plates and two steel plates and the finger recess is asymmetric. Dividers were frequently provided with a sheath so that they could be carried in the pocket.

The pens were also distinctive with their turned brass handles.

Italian instruments and sets from the Netherlands are only very rarely found in Britain.

Fig. 187 ***Italian nickel silver sheathed dividers***

Fig. 188 ***Italian dividers with the sheath removed and opened to show the long joint and the screw thread for attaching the sheath.***

Fig. 189 ***Italian brass compass***

Fig. 190 ***Brass handled drawing pen from a Compassi di Milano set retailed by Gaetano Pistolesi, Cartoleria, Roma***

Japan

In the 20th century Japan made sets for export that are occasionally found in Britain and, I think more commonly, in the USA. These imitate the traditional patterns of Britain and France and two such sets are shown in Chapter 11 (Gallery). Where ruling pens are in the British style they have a distinctive feature that is purely Japanese; the cap unscrews to reveal a pricker in the end of the shaft as in figure 191.

Other instruments also exhibit novel features. The dotted line pen, although modelled on British pens, has a rotating, ink-feed, wheel above the dotting wheel, shown in figure 192. Figure 193, below, shows a curved line variant of the road pen of a continental pattern in which the screw to release it to swivel is accessed by unscrewing the top half of the handle.

Fig. 191 *Japanese ruling pens with removable caps revealing pricker in handle*

Fig. 192 *Japanese dotted line pen with revolving ink feed wheel*

Fig. 193 *Japanese curved line railroad pen*

China

In the latter half of the twentieth century the firm of BOFA made flat pattern sets for export. These sets were in the German style and figure 316 in Chapter 11 shows a large case intended for presentation; it is in as new condition.

Russia

Since the break-up of te Soviet Socialist Republic, Russian sets have begun to reach Britain. These are flat pattern sets and Germanic in appearance.

6. Later Patterns

The Round System

The first of the new patterns designed for machine production was the round system, patented by Sigmund Riefler in 1877. He was the son of the firm's founder, Clemens Riefler. The round system was so successful that it continued to be made with little variation for nearly 120 years.

It had its imitators but these were few as most manufacturers chose to produce flat system instruments once Richter's patent ran out. However Kern did produce some round system instruments, to a slightly different design, and, after the second world war, Lee Guinness, in Northern Ireland, produced their version of the round system.

Fig. 194 ***Riefler A82 round system set, dating from the 1930s***

Fig. 195 ***Riefler round system compasses ca. 1900/1910***

The round system gets its name from the circular cross section of the compass and divider legs. Figure 195 shows the compass from an early set. It has one detachable point, ink and pencil points and a lengthening bar. The ink and pencil points attach via a slip joint. The cylindrical spigot has a short steel feather that mates with a slit in the side of the socket. The early compasses have the needle and the pencil lead both clamped by a side screw, as shown in this example and the ink point has a lifting nib. Unlike the later compass (figure 196) this compass does not have a self centring handle.

Fig. 196 ***Later type of Riefler round system compass dating from the 1930s***

The later six inch compass has nut and bolt needle points and the handle is fitted with a centring device. This compass has removable points on both legs so that the two lengthening bars can be fitted one to each leg. The ink point is the cross joint type with the opening blade at the bottom.

The larger sets, like the A82, include four inch compasses as well as six inch ones. These are similar to their larger brethren.

Riefler drop bow compasses are a rather distinctive pattern of which there are a number of varieties resulting both from development and options. Figure 198 (a) shows an early one. It has a needle clamped by a screw bearing on it. The movement of the compass about the central rod is restricted to up and down by a key in a slot and this can be locked by the left hand milled screw. Rotation about the rod is only possible if the handle is partially unscrewed. Figure 198 (b) shows a 1930s one, which has interchangeable pencil and ink points. It is mechanically similar to (a) but has a nut & bolt needle fixing. Compass (c) is free to rotate about the central pin which ends in a plain point. The adjusting screw has been moved to the other side and it is chrome plated.

Fig. 197 ***Smaller size Riefler compasses, (a) ca. 1900/1910, (b) 1930s***

Fig. 198 ***Riefler drop bow compasses, (a) ca. 1900/1910, (b) 1930s, (c) 1970s***

Fig. 199 ***Riefler round system pens: (a) lifting nib and ivory handle, ca. 1900/1910 (b) earliest type of cross joint pen, ca. 1900/1910, (c) second type of cross joint pen, ca. 1930, (d) third type of cross joint pen, 1950s***

Riefler pens went through an evolutionary process although it should be noted that a new one did not directly supersede the previous one and sets can contain more than one type. The lifting nib had been in existence long before the invention of the round system and Riefler initially continued producing this type of pen. However this was only one of the ways a pen could open for cleaning. The cross joint (swing nib) was very popular in Europe because it could be opened without disturbing the setting for the line thickness. The earliest version's top blade hinged at the base of the nib. The second version used the adjusting screw as the pivot but it was still the top blade that swung. The third version had a spring upper blade so the moving blade had to be the bottom one.

Fig. 200 ***Riefler cross joint pens, detail***

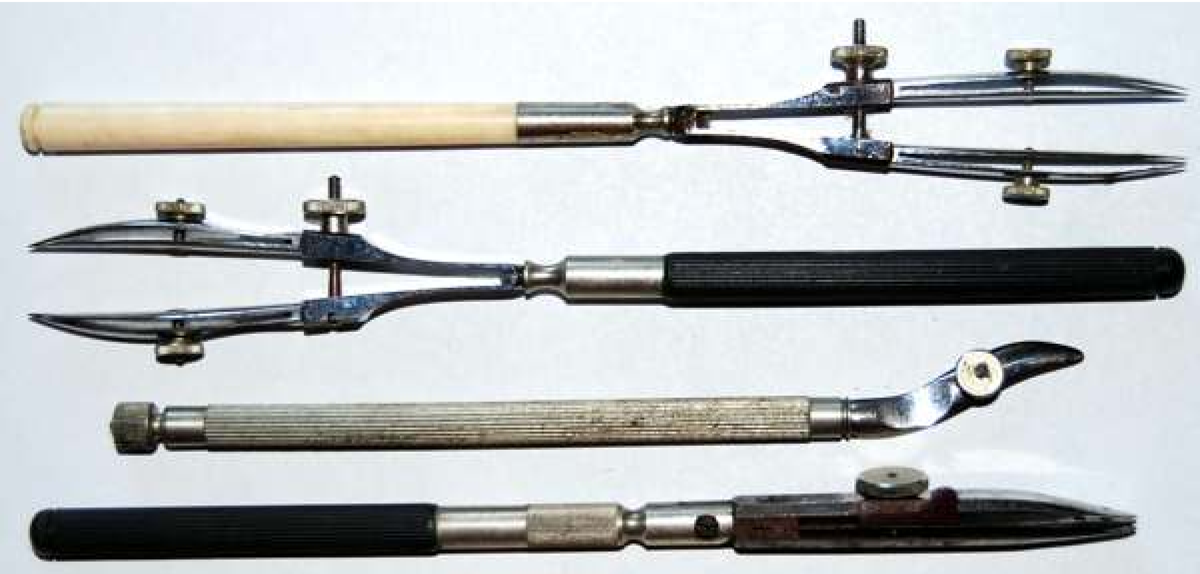


Fig. 201 ***Riefler pens - from the top: (a) Ivory handled road pen ca. 1900/1910, (b) black handled road pen, 1930s, (c) curved line pen, (d) three bladed pen, 1930s***

Fig. 202 ***Riefler pens: (a) three bladed pen showing centre blade opened for cleaning, (b) dotted line pen, 1930s.*** *Both of these pens are actually compass fittings and can be detached from their handles, either of which could also be used with the compass ink point.. Both are also jointed.*

Fig. 203 ***Riefler dotted line pen disassembled to show spigot for fitting to compass leg.*** *It has wheels for three types of dotted line.*

Fig. 204 ***Riefler dividers, (a) ca. 1900/1910, (b) 1930s***

The dividers show some of the same characteristics and changes with time as the compasses. Early dividers had conical plain points and these continued to be an option until at least 1939 although nut and bolt needle points had been introduced before then. The later divider is of the hair spring type; this was available on the earlier type as well.

The spring bows are of the steel spring type and Riefler continued to produce these rather than the 'C' spring type until the end of round system production. There appear to be two distinct phases with the change occurring about 1930.

The first type are typical in some respects of German and Swiss production in the late 19th and early 20th centuries. The divider spring bow is larger and has plain points. The ink and pencil spring bows have needle points with a clamping screw bearing directly on the needle.

The second type have nut and bolt needle points to all three spring bows in a set. There is also now available a universal spring bow with interchangeable needle, ink and pencil points.

Dating of Riefler round system instruments and sets is difficult because of the length of time the pattern was produced. The dates given here are approximate and based on comparison with a small number of catalogues, which do not necessarily show the full range. It is also clear that when a new form was introduced the previous one often continued to be on sale for several years in parallel and sets sometimes contain a mix of new and old forms.

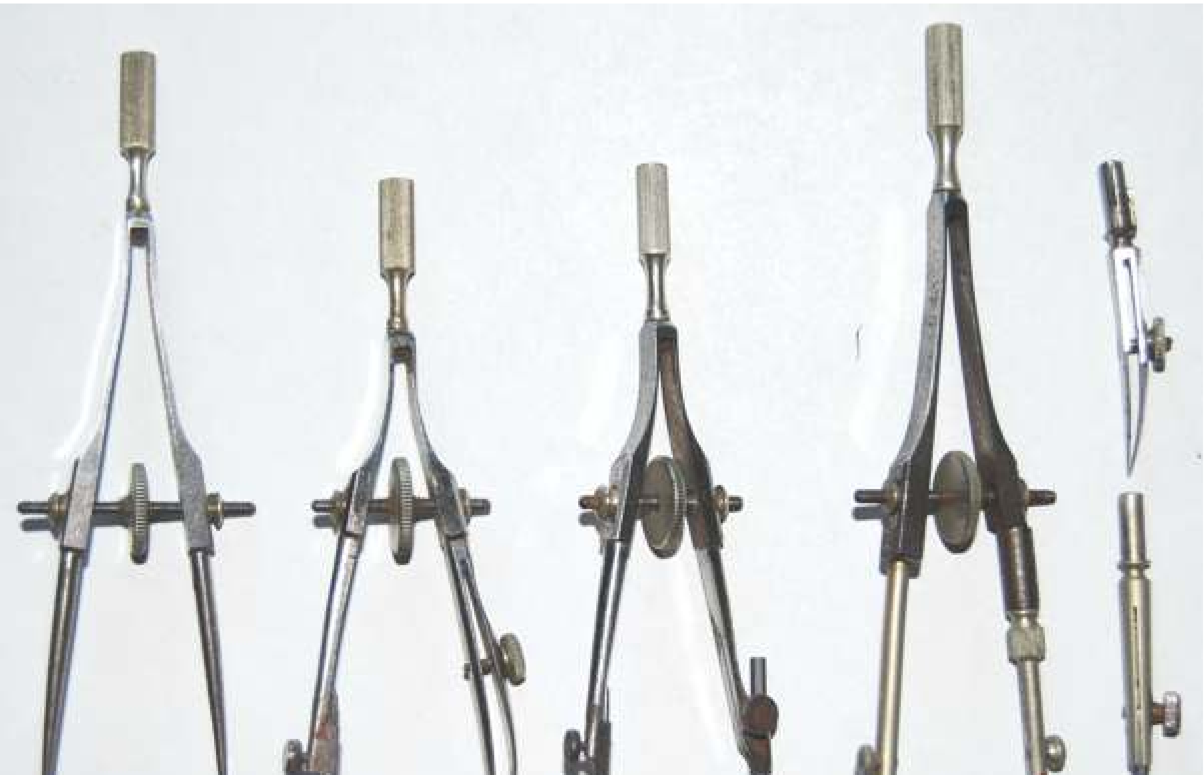


Fig. 205 ***Spring bows from Riefler sets. The first three are ca. 1900/1910, the last is from the 1930s and has interchangeable divider, ink and pencil points.***

Fig. 206 ***Lee Guinness S301 round pattern set, ca. 1950***

The S301 set by Lee Guinness shows their version of the round system, which was in most respects a close copy of the Riefler design, so much so that the pens, with their cross joint nibs, and the spring bows could be mistaken for Riefler instruments.

Similarly the compass has two detachable points and two lengthening bars and the same style of spigot and socket as Riefler used. The only real difference is the design of the head joint used on the compass and dividers. The Lee Guinness one incorporates a centring device for the handle, which is the same type as used by Riefler in their later compasses.

Fig. 207 ***Lee Guinness compass head***

The Flat System

E O Richter patented the flat system in 1892 and an early flat system set is illustrated in Figure 199. When the patent ran out in 1905 it was widely copied by other European makers. Prior to the first world war the well known British firm of A G Thornton imported both Richter flat system and Riefler round system instruments. The war provided the impetus for Thornton to start making their own copies branded Minerva and Kinwest respec-

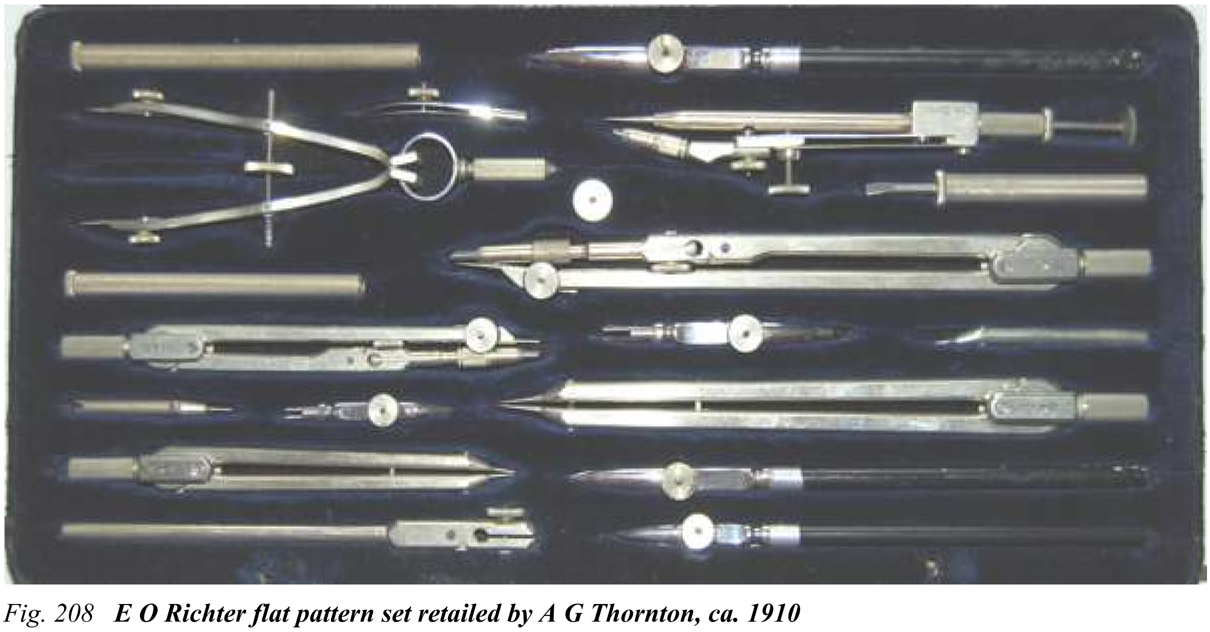


Fig. 208 ***E O Richter flat pattern set retailed by A G Thornton, ca. 1910***

Fig. 209 ***E O Richter flat system compass***

tively. Although production of the round system by Thornton was short lived, the Minerva series of flat system instruments continued in production for over forty years and was highly successful.

The main features of the flat system compass can be seen in Figures 209 & 210. The head devised by Richter has a pivot which passes through the centre of the joint, at the ends of which are two outward facing hemispheres. A fork encloses the head and rests on these two hemispheres. The tension (pressure on the hemispheres) can be adjusted by the screw at the lower end of the fork. The optional straightening device consists of two arms, pivoted in the legs, and meeting at a slider running in the fork extension.

The double ended compass needle is held in a split, reversible sleeve. This enables it to be set at an angle and also to be reversed so that either the plain or shouldered point can be used.

The pen, pencil and needle point parts are held in place in their socket by the clamping action of a T-bolt and milled nut. The pencil lead is held in a collet and the pen has a cross joint nib.

Fig. 210 ***E O Richter compass head***

Pens were made in a variety of patterns, with handles in various materials. Richter made pens with lifting nibs (hinged upper blade), cross joint nibs or spring nibs, and with aluminium handles. Other

Fig. 211 ***Flat system pens: (a) Cooke, Troughton & Simms, lifting nib, (b) Thornton, ivory handle & lifting nib (1939), (c) Thornton, ivory handle & spring nib (1939), (d) Nestler, cross-joint nib, (e) Ecobra, white plastic handle, spring nib with release***

Fig. 212 ***'C' spring bows: (a), (b), (c) Thornton Minerva series, (1930s); (d) Nestler***

makers also used ivory, fibre and various plastics for the handles.

Although steel spring bows were available from Richter and others for inclusion in flat system sets it was more usual for these sets to include 'C' spring bows. Thornton's, made of hard rolled electrum, were particularly elegant and were available either with side adjustment or with the central adjusting screw shown above. The Nestler one is typical of German 'C' spring bows, which nearly always have a central adjusting screw. The sides are flat German silver, quite broad, with a slit running down the centre, enlarged in the middle to hold the adjusting screw bearings. Sets frequently included a drop bow compass with ink and pencil points, in which case

Fig. 213 ***A G Thornton Ltd., 'Minerva' set in a Morocco case (1930s)***

Fig. 214 ***W H Harling BE112A, British Empire pattern set (1936)***

Fig. 215 ***W H Harling British Empire pattern compass half set***

they had only a divider spring bow. Alternatively they had a spring bow with interchangeable ink, pencil and needle points.

The British Empire pattern of instruments was introduced after the first world war. It was a standard pattern produced by several English makers and was the usual pattern purchased by the British government. Two of the makers were W H Harling and A G Thornton. They were machine made and all the parts were interchangeable.

The head joint (Fig. 216) was one of the distinctive features. The self centring device, the edges of which can be seen in the picture, was optional.

Fig. 216 ***British Empire pattern compass head***

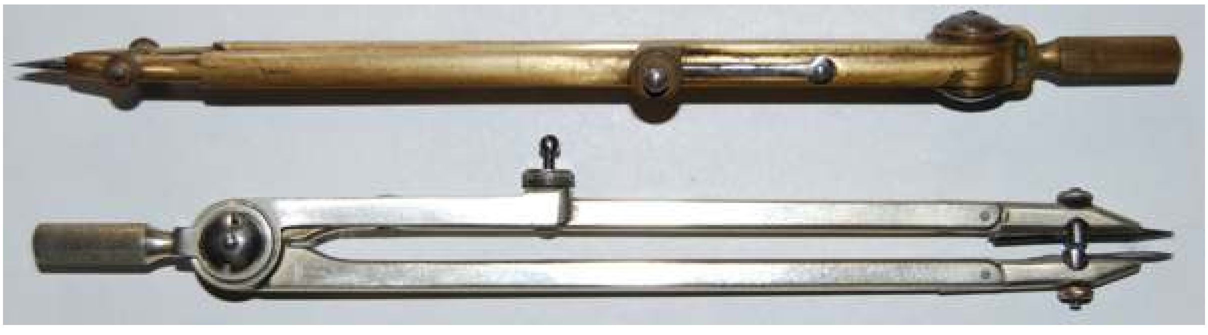


Fig. 217 ***Harling hair dividers, the lower pair dated 1941, made for the UK government.***
Note the unusual form of the hairspring adjustment; the adjusting screw moves the whole leg.

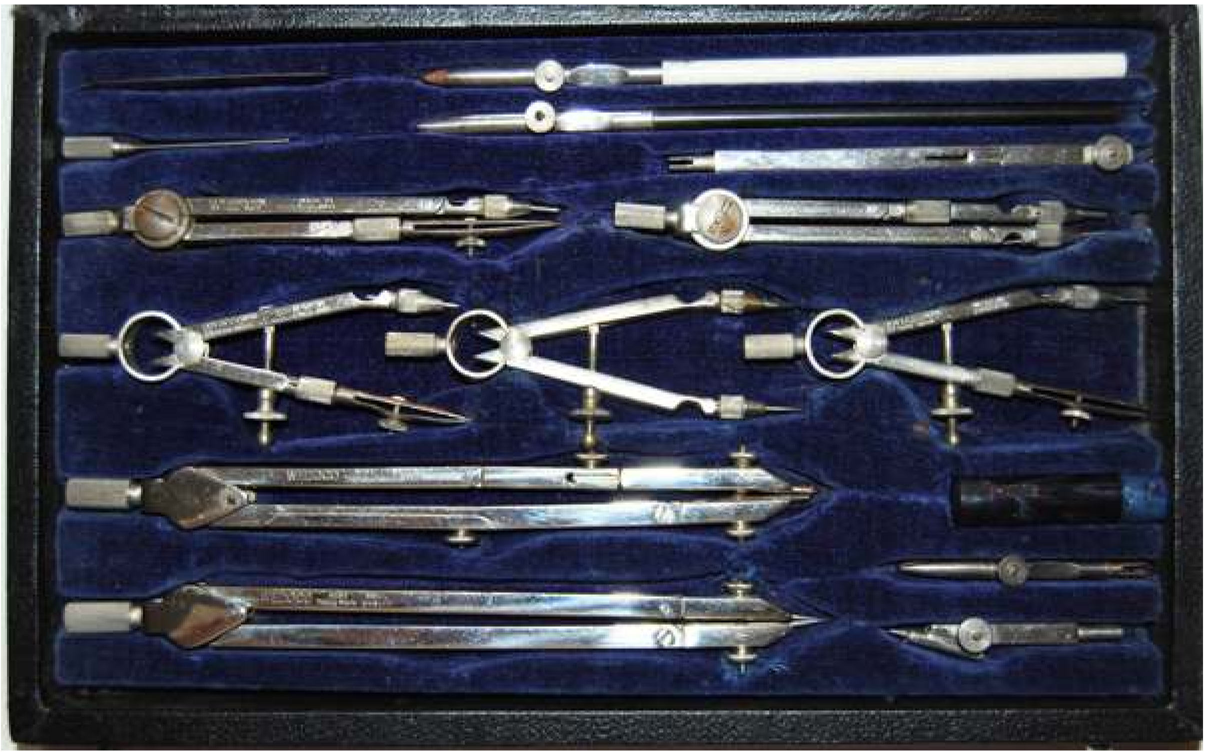


Fig. 218 ***WEDOCO set of drawing instruments in a wallet case (made in England, probably in the 1940s)***

Another distinctive feature was the method of mounting the needles in the compass legs, which can be seen in Figure 215.

WEDOCO was the registered trade mark of Henry Weinberger, London EC1. Their flat system instruments have some unusual features on the spring bows and bow compasses. Both the needles and pencil leads are held in collets and collets are also used to hold the pencil and ink attachments in place. Quite why these are detachable on bow compasses and spring bows is not obvious. The head screws for the bow compasses are crude.

A number of European firms used a self centring head in which the two compass legs had gear segments formed on the end. These included Mars (Bavaria), Lotter, Proebster, and Esmond Hellerman.

All of these are similar in principle. The handle is connected to an outer fork. Inside is another piece which has separate pivots, side by side, for the two legs, arranged so that their respective gear segments mesh. Thus opening one leg will open the other leg by the same amount. There are frequently one or two screws through the outer fork which can be

Fig. 219 ***WEDOCO spring bow***

Fig, 220 ***Hellerman geared head***

Fig. 221 ***Hellerman geared head, internal detail***

Fig. 222 ***Mars, Bavaria, 'Telescopic' compass***

tightened to set the pressure on the pivots and hence the stiffness of the leg movement.

There are a number of firms that produced telescopic compasses, making a lengthening bar unnecessary. Lotter produced a telescopic version of their round pattern design and Mars, Bavaria, produced the one illustrated here. Both of these have gear type self centring handles which, of course, do not remain upright when the compass is extended. This is a disadvantage of any self centring handle as it equally applies to any compass with a lengthening bar on one leg only.

Besides the types of drawing pen already described with their various means of opening for cleaning there were the types illustrated below. Both of these can be opened for cleaning without affecting the setting for line thickness.

Fig. 223 ***Mars, Bavaria, 'Telescopic' compass***

Fig. 224 ***Click and knife spring pens***

The upper, metal handled pen, is known as a 'click' pen. The adjusting screw is fixed at its lower end into a piece of steel that has two projections that fit into slots in the lower blade. The projection nearer the tip also projects forward so that it will, when the adjusting screw is pushed towards the tip, lock the upper blade down and, when pushed the other way disengage and let the upper blade spring up.

The knife spring pen, patent no. 624,224 (lower pen in each illustration) has a hinged upper blade, the end of which bears against a spring in the lower blade. This acts like the spring in a pen knife, either holding the blade open or holding it shut against the pressure of the adjusting screw. This pen has a white plastic handle. From my point of view, as a user of these pens from time to time for ruling lining on model railway carriages and locomotives,

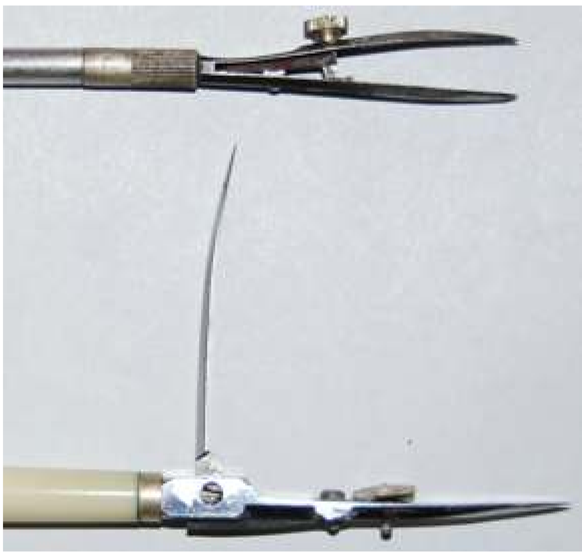


Fig. 225 ***Click and knife spring pens, opened***

Fig. 226 ***Universal compass (turn about compass)***

this is the best design as it is both easy to clean and holds its setting very well.

Universal or turn-about compasses were a cheap alternative to a compass half set. They were generally considered a poor alternative as they were inclined to be rather unsteady. Turn about spring bows were also made; these are usually found in cheap student's and school sets.

The Master Bow

The master bow appears to have originated in America (but possibly made in Germany) in the mid-1930s. For example, Keuffel & Esser catalogued a robustly constructed 5½ inch pencil spring bow in 1936 in their Special Arrow range.

The V & E Manufacturing Co, founded in 1940, started making steel drawing instruments during World War II. The range included a large (6½ in.) spring bow, which, like other instruments in the range, was of 'open truss' design, the sides being stamped from sheet steel. By 1947 Eugene Dietzgen were also manufacturing a master bow in the USA in hard nickel silver. It was available as either a pencil compass or with interchangeable ink and pencil parts.

Over the next twenty years master bow compasses increased in popularity with manufacture in the USA, Germany, Britain and other countries, becoming the type recommended in many, possibly most, colleges and universities in England in the 1960s. I purchased a Thornton one in 1963 when embarking on a mechanical engineering degree at Leeds University.

It was justifiably claimed that these, with a few accessories, would do the work of a full set of compasses to the old patterns. The Kaufmann Universal Giant Bow is a typical example. The set includes the six inch compass with interchangeable pencil and ink parts, a pen handle for use with the ink point, a lead box and a lengthening bar.

The compass has joints in both legs so that points remain perpendicular to the paper at all times. The pen nib is of the cross joint type. The lengthening bar has a sliding needle point holder and fits into a socket just above the needle point in the compass leg. It was patented and made in Germany.

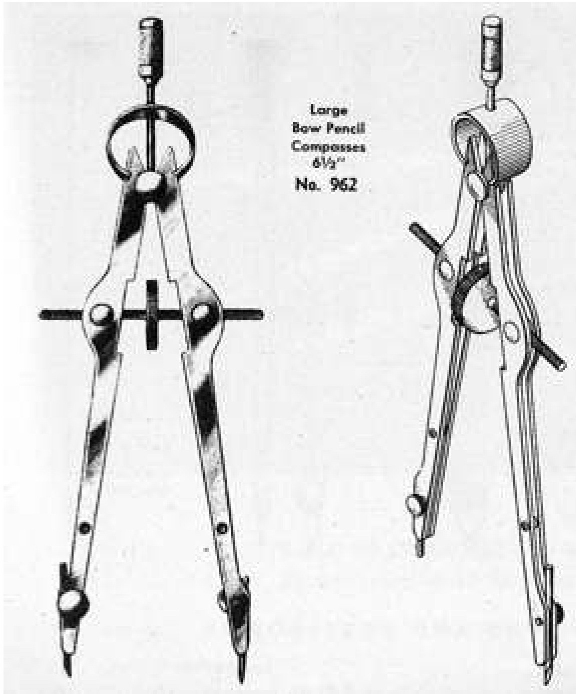


Fig. 227 ***VEMCO Large Bow Pencil Compass***
(Instruments Limited Catalogue No. 47)

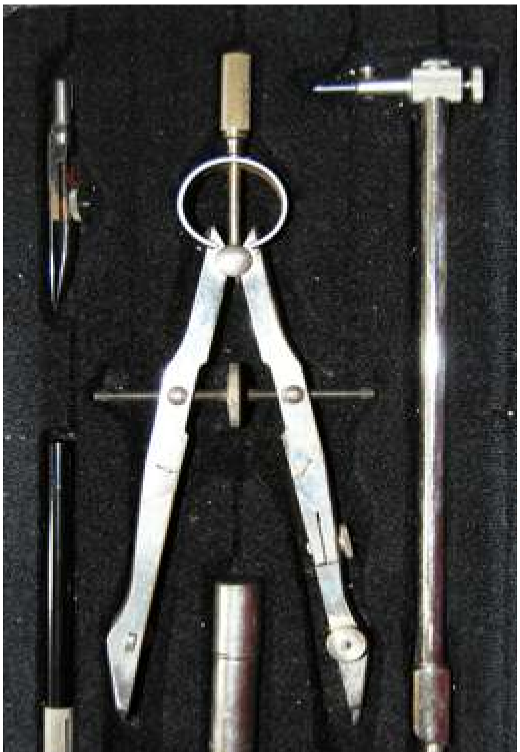


Fig. 228 ***Kaufmann 2001 Universal Giant Bow***

This was not the end of compass development at this time for, coincident with the development of the master bow, tubular nib pens had arrived on the scene. The next step was to integrate the two but first we must look at the pens.

Tubular Nib Pens

These first appeared on the market in the 1920s, one of the first being the Normograph, sold by Keuffel & Esser. It was intended for lettering, using a range of stencils also supplied. As with all tubular nib pens there was a range of pen sizes to match the sizes of their lettering stencils.

A W West & Partners, London introduced the UNO pen and stencils in the 1930s. These were very similar to the Normograph with an open reservoir and clearing wire. The stencils were blue plastic (initially celluloid) with the stencil plate mounted between two thicker pieces of plastic so that the ink would not run underneath.

Like the Normograph, the original UNO Standard pen could be fitted to an ordinary pen holder as well as a UNO one. There was also a UNO De Luxe pen, which was fixed to its handle via a pivot screw so that its angle could be adjusted. The cleaning wire was attached to a rod with a knurled top; the rod passed through a screwed cap on the top end of the ink reservoir.

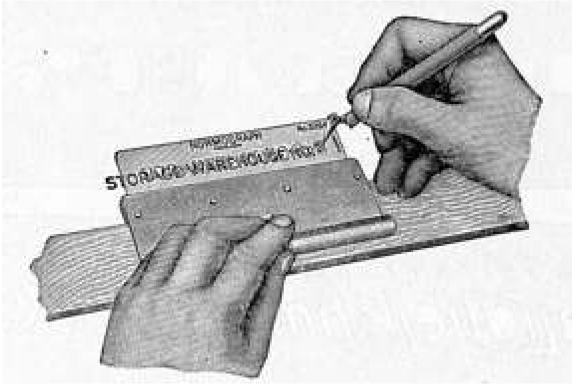


Fig. 229 ***The Normograph*** *(Keuffel & Esser, 1928)*

Fig. 230 ***UNO Standard & De Luxe pens***

The Standardgraph No. 44S pen was similar to the UNO De Luxe but the cleaning wire was spring loaded. All these pens were limited to lettering with stencils as they could not be fitted to a compass.

Fig. 231 ***Standardgraph No. 44S pen***

Fig. 232 ***Tubular nib pens: (a) Rotring Rapidograph fountain pen, (b) Rotring Variant double ended pen, (c) Rotring 2000 Isograph, (d) Staedtler MarsMatic 700 pen***

There was also the danger of spilling the ink from the reservoir.

In 1952 Wilhelm Riepe of Hamburg-Altona introduced the Rapidograph, a piston fill fountain pen with a tubular nib. From this the Rotring Variant range of drawing pens was developed with a detachable ink reservoir that could be filled with a dropper incorporated in the cap of the ink bottle. A standard thread was used for both fitting the cap and fitting the pen unit into the tubular body. This thread then formed the basis for fitting the pen unit to a range of specially adapted compasses. With a suitable adapter supplied by Rotring the pen unit could even be fitted to an ordinary drawing compass. Staedtler and Faber-Castell later made similar pens and used the same standard thread.

The Rotring range included some very high quality Master Bow compasses; the top of the range 532 101 was based on the Haff quick set compass, The worm can be pulled down against a spring to disengage it from the curved rack for quick setting, the final adjustment being made with the knurled wheel attached to the worm once re-engaged.

Fig. 233 ***Rotring 532 101 Master Bow Compass fitted with a Variant pen unit***

Fig. 234 ***Rotring 532 101 compass with lead holder and lengthening bar fitted.***

Fig. 235 ***Rotring 531 146 Master Bow Compass with lead holder and lengthening bar fitted.***

The Rotring 531 146 was a cheaper alternative, based on a Riefler quick set compass. This compass has two levers on each leg, which, when pressed in, release the screw thread so that the legs can be moved in or out. The screw can be used for fine setting as usual.

Both Rotring and Staedtler also catalogued drop bow compasses adapted to take tubular nib pens and the Staedtler Mars Superbow is shown overleaf, fitted with a Rotring Variant pen unit.

Rotring also took over production of the Graphos drawing pen described earlier and adapted it so that it too could be fitted to their compasses.

Fig. 236 ***Staedtler Mars Superbow with Rotring Variant pen attached***

Fig. 237 ***Nestler compass with Rotring Variant pen unit attached.***

The Rotring system was a comprehensive one and Variant pens were supplied with an adapter to enable them to be fitted to ordinary drawing compasses of both flat system and master bow types. One is illustrated above fitted to a Nestler six inch compass.

7. Novel Designs

The Parallel or Vertical Compass

One of the things that I find fascinating about collecting drawing instruments is discovering unusual instruments, which are clever but perhaps too complex to be major sellers. Parallel compasses are a good example.

In a catalogue issued ca. 1925, J Halden & Co devoted a page to their 'New Vertical Drawing Compass' no. 1220. Supplied with two lengthening bars, pen, pencil, and needle point it was priced at £2 5s. The case was five shillings extra.

They listed half a page of advantages, including:

- The handle and points always remain vertical no matter how far the compass is extended.
- All adjustments can be done with one hand only.
- By virtue of its rigidity heavy circles could be drawn in black lead.
- For the same reason, two extension bars could be fitted enabling a circle of twenty inches diameter to be drawn.
- Being vertical the needle point would not make as large a hole in the paper or be liable to be broken.

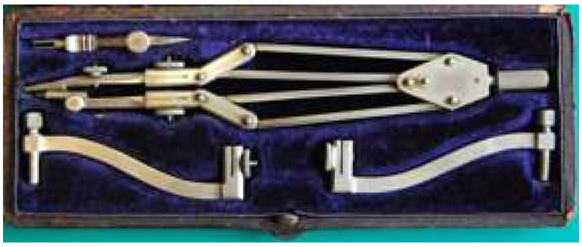


Fig. 238 ***Halden Vertical Compass in its case***

Fig. 239 ***Halden Vertical Drawing Compass***

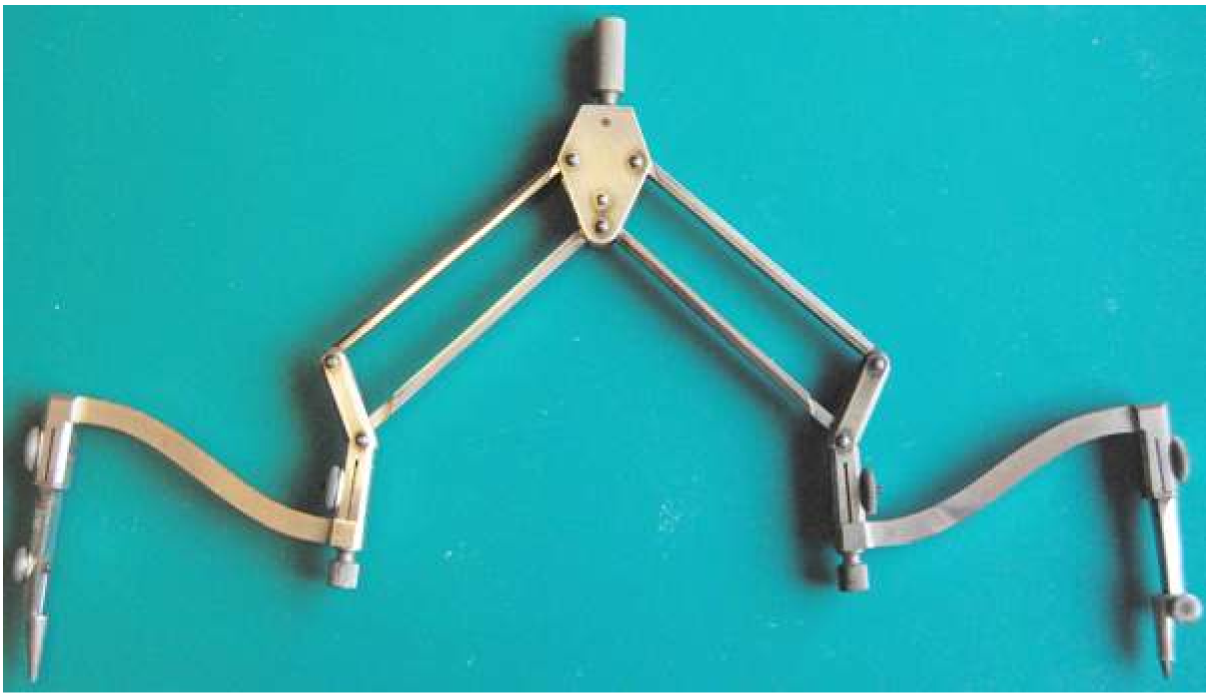


Fig. 240 ***Halden Vertical Drawing Compass with lengthening bars fitted. The compass was made of finest quality electrum.***

Fig. 241 ***Original Lotter (Germany) Precision Parallel Compass set 201A***

Fig. 242 ***Original Lotter Parallel Compass***

On one leg the Halden compass is marked "NUNN'S PAT 4319-10" referring to the 1910 patent of George Vaughan Nunn.

Lotter in Germany also made a parallel compass with a similar method of operation. This example dates from the 1950s. It has a single lengthening bar, which is telescopic and pencil, ink, and needle points.

Also included in the set are a pen with cross joint nib, a pen handle, a screw driver, a lead container and a plastic tube of spare parts.

The compass legs can be locked at any setting by the milled screw in the head fork.

The parallel compass was also included in some of the larger Lotter sets.

Fig. 243 ***Original Lotter Precision Parallel Compass with its telescopic lengthening bar fitted and fully extended***

Fig. 244 ***J J Threadwell No. 631 set***

Unusual Compasses

This J J Threadwell flat pattern compass has a lengthening bar that is the type usually associated with master bow compasses. It dates from about 1950. Like most Threadwell instruments and sets it is anonymous. The instruments and cases are however distinctive and this set appears in Threadwell's 1948 catalogue.

J Parkes and Son made some robust but cheap instruments for students to their patented tubular design shown below. They were available in both brass and nickel silver

This particular set was a 'Department of Science and Art Reward' set. More usually these reward sets were cheap, brass, English pattern ones; T Grew of Plaistow, Essex made that type.

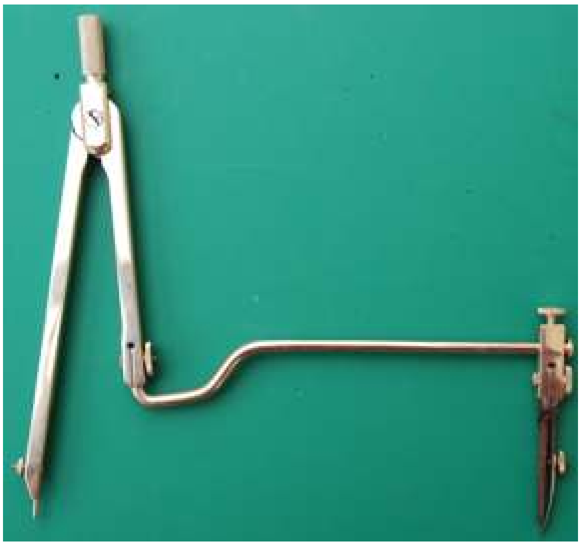


Fig. 245 ***J J Threadwell compass with lengthening bar fitted***

Fig. 246 ***J Parkes & Son nickel silver Department of Science and Art Reward set, ca. 1900***

Fig. 247 ***Jackson Bros, Leeds and Armley, brass school compass set, ca. 1900***

This Jackson Brothers brass compass set is quite unusual. The compass has ink and pencil points but can also take a very thin pencil, which would have been available for compasses at that time. The lengthening bar also fits in the pencil holder and has at its other end a large swivelling block with a screw that both locks it and clamps the pencil or ink point in place.

The pen is clearly to J Parkes's patent design and the tubular construction of the compass and divider is also clearly a derivative of Parkes's patent. It is possible that Parkes made it for Jackson Bros. There was much more trade between the drawing instrument makers than is generally realised.

Fig. 248 ***Jackson Bros. compass with lengthening bar fitted***

Friedmann Bros. Drawing Instrument Co., New York patented a rather novel beam compass, which used the spring bows in a set as one of the trammels. The fittings even came clamped to a short length of beam, as shown here, in the case. The alternative piece shown above the fittings would clamp under the right hand fitting in place of the piece that is there in the illustration to hold a pen or pencil.

The instruments were made in Germany; the rest of the set was a conventional flat pattern set, similar in construction to those originally patented by E O Richter.

The complete 23A set was priced at $16.50 according to an overprinting in my 1935 catalogue although the 1939 price list gives the price as $33. A sticker on the front of the price list says Friedmann Bros. will give a 50% discount., hence the $16.50.

Fig. 249 ***Friedmann Bros. Universal Micromatic Beam Compass from a 23A set, ca. 1935***

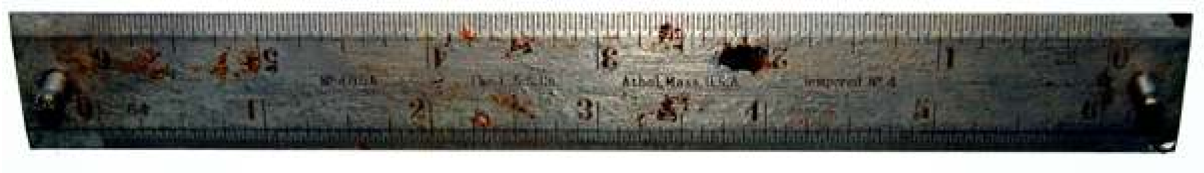


Fig. 250 ***No. 405A The L.S.S.Co., Athol, Mass., USA Tempered No. 4 patent tilting rule***

The nickel plated steel draftsman's scale, above, was patented by Robert J Simpson and assigned to the L S Starrett Co. on May 13th 1902.. The scale was graduated on both faces and the studs tilted the rule such that the edge remained in contact with the paper either way up.

This example came in the bottom of a box of drawing instruments and I had no idea what it was; I thought it was actually part of something else and nearly threw it away. It was some years later that I found the patent doing a general search of American drawing instrument patents, of which there are a great many.

Fig. 251 ***Unusual brass spring bow***

The ink spring bow above, brass with a single steel spring leg, is mid-19th century and probably German.

8. Major Makers and Retailers

W F Stanley

W F Stanley is probably the best known English maker of drawing instruments and there will be hardly a collector who does not have some examples of the work of this firm.

The history of the firm has already been well documented in 'A Century of Scientific Instrument Making, 1853-1953' by Cecil J Allen and I have drawn most of the information that follows from there.

William Ford Stanley was born in Hertfordshire on February 2nd, 1829. In 1853, at the age of 24, he set up business in London as a drawing instrument maker. His first premises was a rented shop in Great Turnstile. At this time he just made wooden instruments such as curves, set squares, tee squares and parallel rules. In the early 1860s, having become established, he started making metal drawing instruments and also patenting some of his inventions, such as the nut and bolt for securely holding the needle of a drawing compass in place. His instrument patents are described in my paper "William Ford Stanley - The Instrument Patents" (see Bibliography).

The first metal drawing instruments were made at additional premises at 5, Lincoln's Inn. The Great Turnstile premises were expanded to take in two adjacent shops. Stanley also had factories at Tichbourne Court and South Norwood, and a further showroom at 13, Railway Approach, London Bridge.

He published his first treatise on drawing instruments in 1864 and, in 1866, published the first edition of 'Mathematical Measuring and Drawing Instruments', eventually published in eight editions, the last, posthumously, in 1926. This is a book that every collector should read and, fortunately, the 1878 edition has recently been reprinted by Kessinger Publishing. He was also the author of a number of other books, including a similar volume on surveying instruments.

In 1900 Stanley turned the business into a limited liability company with himself as Chairman and Managing Director., relinquishing the latter post at the age of 78. On 14th August, 1909, he died, aged 80 years.

The firm did not die with him but continued to move forward and expand. J J Hicks, a maker of meteorological instruments, was acquired in 1911, followed by Motion, Smith & Son Ltd. of Singapore in 1919 and Heath & Co. Ltd. in 1926.

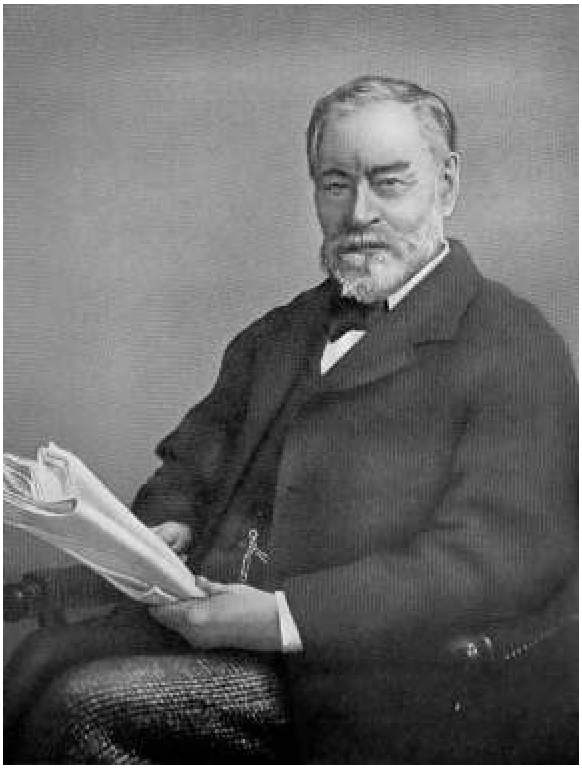


Fig. 252 ***William Ford Stanley, FRAS, JP.***
(A Century of Scientific Instrument Making, 1853-1953, Cecil J Allen)

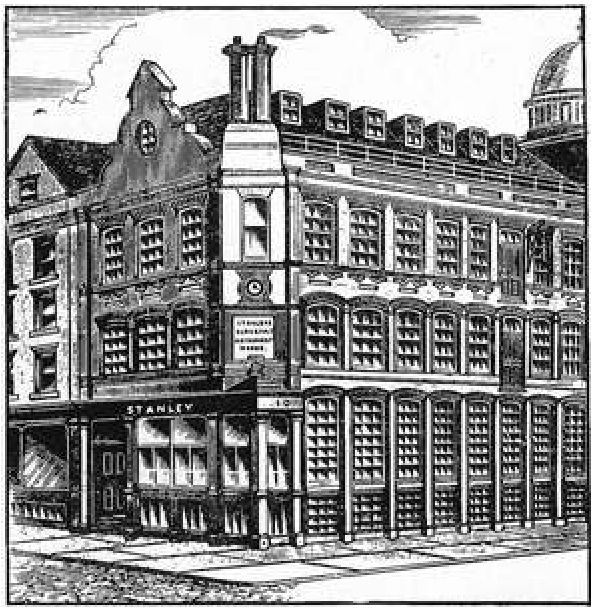


Fig. 253 ***10, Great Turnstile, London WC***
(A Century of Scientific Instrument Making, 1853-1953, Cecil J Allen)

Heath & Co. had a modern factory at New Eltham, SE9, which had opened in 1916 and this became the new headquarters and factory of W F Stanley & Co. Ltd. after the acquisition. The name of Heath & Co. Ltd. continued to be used for navigational equipment so, for instance, it is not safe to assume that a station pointer with that name on was made before 1926. Stanley ceased manufacturing drawing instruments in about 1960.

There is an excellent biography of Stanley, covering both his private and business lives, by Eloise Akpan, that I have listed in the Bibliography.

Fig. 254 ***Rosewood veneered case of electrum drawing instruments by W F Stanley, late 19th century.***
This set of electrum instruments is one of Stanley's cheaper products. Neither the compass, nor the bows are double jointed and the slip joint for the compass points is not Stanley's improved pattern. Also the compasses have plain points and are fitted for lead pencils rather than pencil leads.

W H Harling

William Henry Harling (1830-1895) established W H Harling in 1851 at 6 Retreat Place, Hackney, moving to Mare Street by 1860 and 9 London Place by 1870, opening office and retail premises at 40 Hatton Garden in 1877. In 1833 his works moved from London Place to Grosvenor Works, Hackney. Both the Haton Garden and Grosvenor Works appear on the trade label inside the lid of a set of cone fitting compasses in my collection.

In April 1899 his retail and office premises moved to 47 Finsbury Pavement. Ca.1922 47 Finsbury Pavement was re-named 117 Moorgate, London EC2 and in 1930 the firm became W H Harling Ltd.

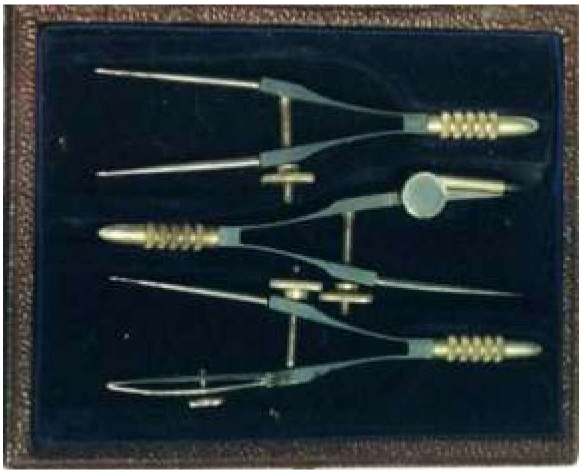


Fig. 255 ***W H Harling spring bow set***

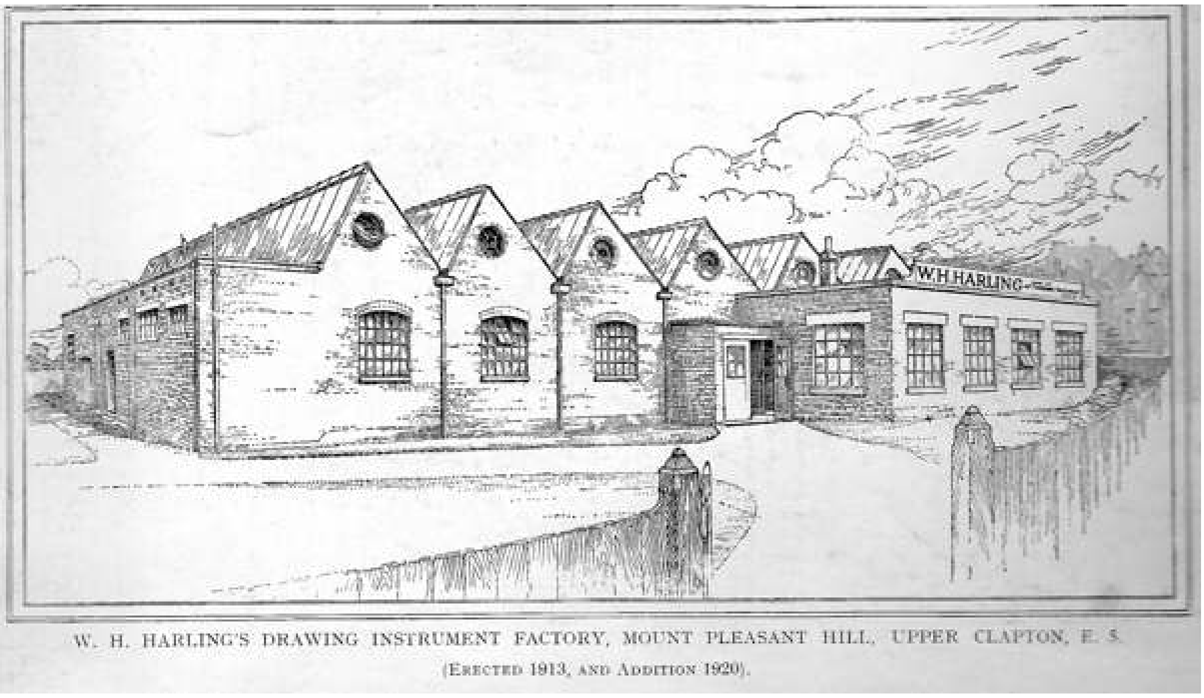


Fig. 256 ***W H Harling's Drawing Instrument Factory at Mount Pleasant Hill, East Clapton.***
(W H Harling catalogue, 1930)

W H Harling had a new Grosvenor Works erected in 1913 at Mount Pleasant Hill, Upper Clapton, London E5. This was extended in 1920.

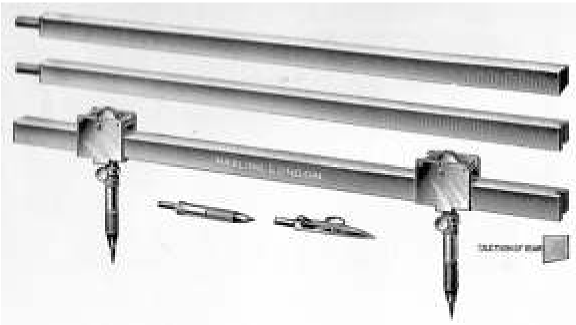
Blundell Rules Ltd (BRL) purchased the assets of W H Harling Ltd in January 1964 and in April 1968 BRL became Blundell Harling Ltd. Blundell Rules Ltd. had been set up in 1947 and moved to Lynch Lane in Weymouth in 1956 making slide rules. The manufacture of drawing instruments moved there from Harling's London works after the 1964 takeover.

Blundell Harling Ltd. still exists today making drawing products and navigational instruments. It is currently located at 9 Albany Road, Weymouth. Blundell Harling Ltd. also had an office at 29/29A Sutherland Walk, Walworth, London SE17.

Collectors should note that drawing instrument sets continued to be marked Harling, London for several years after the merger and the move to Weymouth.

W H Harling were major manufacturers of drawing instruments and were probably the principal makers of the British Empire pattern from its introduction until the 1950s at least.

Fig. 257 ***Harling spring bow, probably 1960s date***



Fig, 258 ***W H Harling New Portable Beam Compass***
(Harling catalogue, 1930)

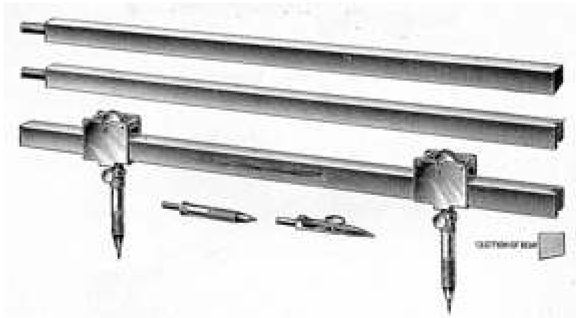


Fig. 259 ***Portable Beam Compass***
(C F Casella catalogue no. 564)

Associated with this series was the New Portable Beam Compass, a roller type beam compass with a a three (later also five) section Duralumin beam. The two pictures above are from catalogues of W H Harling and C F Casella. It is clear that they are both from the same original engraving, The Harling one has the makers name 'HARLING, LONDON' on the beam. On the Casella one this has been crudely obliterated. The same engraving also appears in the 1930 A W West and Partners catalogue with the Harling name obliterated by a different hand. It is likely that both Casella and West obtained their stock from Harling but did not wish to admit they were not the manufacturers.

In the 1947 Instruments Ltd. catalogue there are engravings of British Empire pattern compasses, which also have the makers name obliterated.

It will become increasingly clear through this chapter that the name in a case, on an instrument, or in a catalogue is not necessarily the maker of that instrument or set, even where the name is that of a well known drawing instrument maker. There was in fact a considerable trade within the trade, as was the case with other scientific instruments.

Fig. 260 ***W H Harling, 47 Finsbury Pavement, full set of small size (4½ inch) drawing instruments with screw off needle points, late 19th century. A top quality set in a Russian leather case.***

William Elliott, Elliott & Sons, Elliott Brothers

We are fortunate that the archives of Elliott Brothers have survived and have been researched by Dr. Gloria Clifton and by Ron Bristow. Both contributed excellent papers to a meeting of the Scientific Instrument Society in 1992 which were subsequently printed in the 36th issue of the Scientific Instrument Society Bulletin. The notes that follow have largely been gleaned from these two papers.

William Elliott was born in the parish of St. Andrew, Holborn in 1780 or 1781 and was apprenticed to William Backwell in 1795. William Elliott is known to have been in business from 1804, when he took on his first apprentice. The first recorded address, in 1817, is 26 Wilderness Row, Goswell Street, London. From 1817 to 1827 he was at 21 Great Newport Street, St. Martins Lane, London. The last two addresses recorded for his business are 227 High Holborn (1830-33) and 268 High Holborn (1835-49). Judging by the number of instruments surviving from the latter period the business must have been a pretty successful one.

In 1850 William Elliott took his two sons, Frederick Henry (1819-1873) and Charles Alfred (1822-1877) into partnership at which time the firm's name became William Elliott & Sons. The address was now 56 Strand, London. Figure 143 shows a pantograph from this period. William died in 1853.

In 1854 the firm became Elliott Brothers, still at 56 Strand. In about 1856 they took over the long established firm of Watkins and Hill and their premises at 5 Charing Cross. Francis Watkins took over the shop at 4/5 Charing Cross in 1747 from his former master Nathaniel Adams. His nephews Jeremiah and Walter continued the business from 1784 to 1798, when Walter died, after which Jeremiah continued as head until 1810 when he too died. The firm continued as J Watkins under the management of William Hill until 1819, after Francis Watkins had completed his apprenticeship, when the firm became Watkins and Hill. Both Watkins and Hill died in 1847 and the firm was managed by A Day until 1856.

Elliott Brothers vacated both 56 Strand and 5 Charing Cross to move to more commodious premises at 30 Strand in 1858. In 1864 the building is said to have been required to make way for the rebuilding of Charing Cross Station and the firm moved again to 449 Strand (showroom) and also 112 St. Martins Lane (manufactory). They appear to have remained at 449 Strand until 1886. Various St. Martins Lane addresses appear in the Post Office London Directories, namely 101, 102 and 112, up to 1900, as noted by Dr. Clifton.

From 1900 they had a factory at Century Works, Conington Road, Lewisham. By the end of the 19th century the nature of their business was moving away from mathematical, optical and surveying instruments to electrical and telegraph apparatus.

In 1917 the firm became Elliott Bros. (London) Ltd. and from 1957 to 1964 Elliott Automation Ltd., eventually becoming part of GEC.

Fig. 261 ***William Elliott, 268 High Holborn, set of brass drawing instruments in a mahogany case, dating from 1835-49.***
Missing lengthening bars and compass key

Fig. 262 ***William Elliott box with trays removed to show ivory items and spaces for water colours and brushes***

Fig. 263 **Elliott Brothers, London six inch brass protractor and mahogany case**

Fig. 264 **Elliott Brothers set of electrum instruments in an electrum bound oak case**

A G Thornton Limited

For this section and the following one on Joseph Halden & Company I have referred to another article in the Bulletin of the Scientific Instrument Society, this time by Jenny Wetton (see Bibliography) as well as several Thornton and Halden catalogues in my collection. However the comments on the trade between Thornton and other makers are based on my own observations.

Alexander George Thornton was probably apprenticed to W H Harling. From 1874 to 1878 he worked for a Glasgow booksellers and stationers, and then, in 1878, he set up business at 8 Albert Square in Manchester, in partnership with Joseph Halden, as wholesale drawing material importers and mounted paper manufacturers.

The partnership was short lived and ca. 1880 Thornton set up on his own at 109 Deansgate. Soon after, he started the manufacture of high quality drawing instruments (the 1930 catalogue states Thornton had been making them for over 45 years). By the 1890s, according to Jenny Wetton, he also had a works in John Dalton Street, which by 1895 had moved to South King Street.

If that is correct, it is a mystery why Thornton says in his 1895 catalogue that 109 Deansgate is his only address. The wide range of drawing & surveying instruments in this catalogue suggests, if he was indeed making most of them, that he must have had a separate works.

In 1897 the firm moved to 11 St. Mary Street with works on Bridge Street. In 1904 the showrooms, offices and warehouse were moved to the Paragon Works at 41 King Street West, and, in 1907, the works (now named 'Minerva Works') moved to Sydney Street, Salford. There were also a Minerva Works (branch), which housed the woodworking department, and Albert Mills, where photographic papers and printing of drawings were carried out.

In 1912 the Minerva Works (and branch?) moved to Cross Street, off Lloyd Street in Hulme. Further works were acquired in 1924 at Heald Place, Rusholme and North George Street, Salford, presumably the Kellton Works, Rusholme and Althorn Works, Salford illustrated in the 1930 and 1938 catalogues.

Jenny Wetton says that the Minerva works moved to the Rusholme and Salford addresses but I do not believe that that was the case. The Minerva works was also described and illustrated in the 1930 and 1938 catalogues and appears to be the same buildings as illustrated in the 1916 catalogue. However both later catalogues show expansion, first linking the Minerva and Minerva branch works, and then, by 1938, adding a new range of buildings to the right of the existing ones. The Albert Mills is not illustrated or mentioned by 1930 and I suspect it was this that was replaced by the new premises in 1924.

The Paragon Works, King Street West, was destroyed in World War II leading to a variety of premises being used in Manchester by different departments. The offices were located at 41 Gartside Street, Manchester and the showrooms in Bridge Street.

In 1949 the firm moved to new, purpose built premises at Longley Lane, Northenden, bringing everything under one roof except for slide rule and cabinet manufacture, which took place at the Derby Works, Openshaw.

In 1967 the firm became British Thornton. In 1992 the firm merged with ESF (Education and Science Furniture) and moved to Burley, Yorkshire. The firm is now (2009) called British Thornton again and is located in a new factory in Keighley making school furniture.

From the earliest days the firm was always innovative and there were quite a number of patents taken out by A G Thornton and his successors. The 'Farkas' pen, already illustrated, was one of the firms patents, as was a patent rapid adjustment for spring bows, illustrated below in an excerpt from the 1916 catalogue. The patentee was Alexander James Thornton, presumably Alexander George Thornton's son.

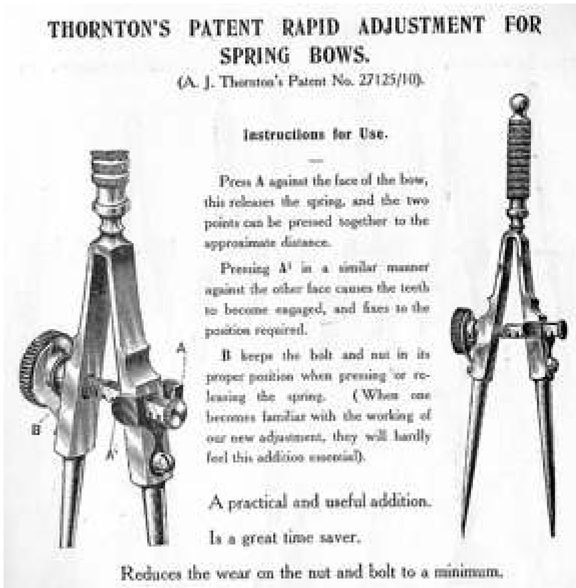


Fig. 265 ***Thornton's Patent Rapid Adjustment for spring bows No. 27125/10*** *(1916 catalogue)*

I have already mentioned the trade between the different makers and in the case of A G Thornton this occurred in both directions. By the end of the 19th century Thornton was well established as a

Fig. 266 ***The Works of A G Thornton Limited*** *(A G Thornton Limited, Catalogue D, 1916)*

maker of hand made English pattern instruments but, on the Continent, new patterns had appeared and were gaining in popularity.. Looking at the 1895 catalogue it is evident that Thornton were augmenting their stock with items from at least two Continental suppliers. Curve line and other specialist drawing pens were being imported from Germany, and also cheap sets of brass instruments for schools were being imported, probably from France.

In the early 20th century they did not have their own facility for machine production of flat system instruments, which at the start of the century were still in any case protected by Richter's patent. Instead they imported sets from E O Richter and stamped the lid of the case A G Thornton Ltd., Manchester.. Figure 208 shows one of these sets.

The 1916 catalogue uses some illustrations that clearly originated with E O Richter. For instance the engraving of a dotted line pen shows Richter's trade mark above the word 'patent'. The 'Minerva' series instruments illustrated in this catalogue are clearly the original Richter pattern and not the style of Minerva series instrument that Thornton made for many years. However advertisements in the Model Engineer in 1920 and 1922 show the British Empire pattern and the Minerva series in the familiar form that Thornton made. These adverts clearly state that the instruments are British made in their factory in Manchester.

Thornton made a cheaper version of the Minerva series for students which was the Techset series. The head joint was particularly distinctive. Similar in principle to the Minerva head, it did not have a centring device but the fork was extended below the adjusting screw and each side was turned inwards to prevent the adjustment being over tightened. This enables these instruments to be instantly recognised even when the name on the instrument or case is something different.

Figure 270 shows a set labelled J H Steward Ltd., 406 Strand, London. The wallet case with its green velvet lining and all the instruments are the distinctive Thornton Techset design. Steward were not manufacturers of this type of instrument and I am certain that these were made for them by A G Thornton. Techset instruments are also found branded D.O.S. (Drawing Office Supplies, London) and Halden Premier (Technical Series).

The Minerva series instruments were similarly sold by other vendors. I have examples branded Halden Premier (Figure 271) and J A Reynolds. Not all of the instruments in these cases were necessarily made by Thornton. It is possible that the pens in Halden Premier sets were made by J Halden & Co.

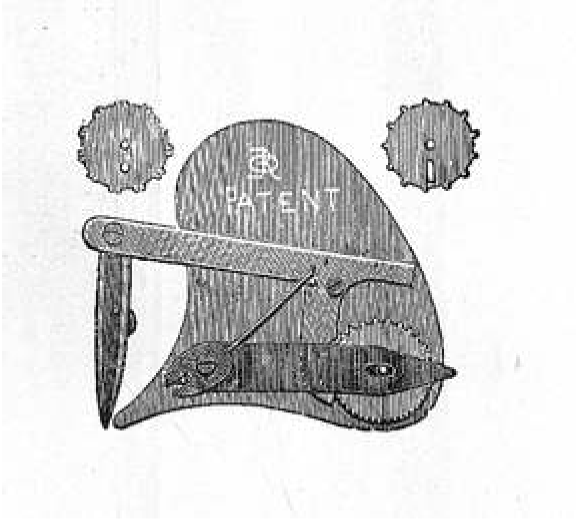


Fig. 267 ***Richter patent dotted line pen***
(A G Thornton catalogue D, 1916)

Fig. 268 ***Advertisement in the 15th January 1920 edition of the Model Engineer & Electrician.***

Fig. 269 ***Thornton Techset compass head***

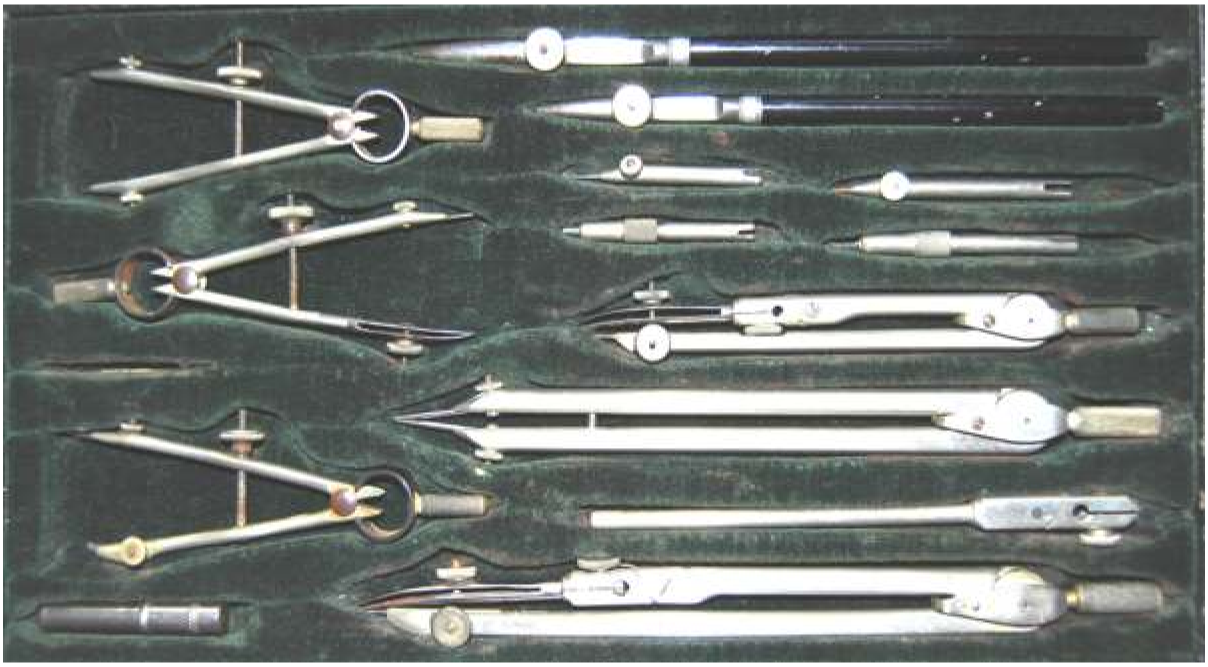


Fig. 270 ***Set retailed by J H Steward, Strand, London.***

Fig. 271 ***Halden Premier set, ca. 1930***

J Halden & Co., Ltd.

Joseph Halden set up in partnership with Alexander George Thornton in Manchester in 1878. After Thornton left the partnership, Halden continued in business on his own at the 8 Albert Square address.

Like Thornton, he started making drawing instruments. The business expanded and in 1889 he acquired premises in East Street off Lower Mosely Street. 17 East Street subsequently became the offices and warehouse.

By 1902 the firm additionally had works at Lund Street, Cornbrook, Manchester (acquired in 1900) and Low Friar Street, Newcastle-upon-Tyne, and depots at 8 & 9 Great Chapel Street, Victoria Street, London SW, 65 Moor Street, Birmingham, 29 Grainger Street West, Newcastle-upon-Tyne, 49 West Campbell Street, Glasgow and 21 Heiligegeiste Strasse, Berlin. Clearly it was now a substantial business.

Further warehousing at Altrincham Street, off London Road, Cornbrook was obtained in 1903 and, in 1904, 37 Brazennose Street, next door to 8 Albert Square was added.

In 1908 the Lund Street works burnt down and new works were built at Reddish, Stockport. The Altrincham Street warehouse was then disposed of. The Reddish works were considerably extended eleven years later.

From the 1910 catalogue it is apparent that the addresses of several of the depots outside Manchester had changed and some new ones had been added. The Newcastle one was now at 8 Grainger Street, whilst the Glasgow addresses were now 31 Cadogan Street and 178 Hope Street, and the Berlin depot had moved to Gormann Strasse 14. Further depots had been opened at 14 Park Row, Leeds and in the Avenue de la République in Paris.

In 1969 Halden were taken over by the Ozalid group and the Reddish works was closed.

Returning to 1910, it was about this time that the company began to concentrate much of its efforts on equipment for drawing reproduction. The mid-1920s catalogue includes a large range of photocopying machines and frames for which J Halden & Co. had been awarded eight patents with a further two applications in the pipeline. Through the 1930s and into the post war period the company moved its business increasingly in this direction

Theodolites and levels in the ca. 1925 catalogue are mostly, possibly all, the products of E R Watts & Son, whilst the 1902 catalogue showed a picture of their level shop, at which time they apparently made

Fig. 272 **The Halden showrooms at 8 Albert Square, Manchester** *(Halden catalogue)*

their own surveying instruments. Drawing instrument manufacture did continue but it is clear that they also bought in stock from A G Thornton Ltd. and possibly other makers.

Fig. 273 ***Halden six inch proportional dividers with adjusting bar. These differ from those pictured earlier and the adjusting bar is steel.***

Fig. 274 ***Halden hand made English drawing instruments dating from 1925. The set is unusual as it has beam compass fittings instead of a six inch compass half set. The case is mahogany.***

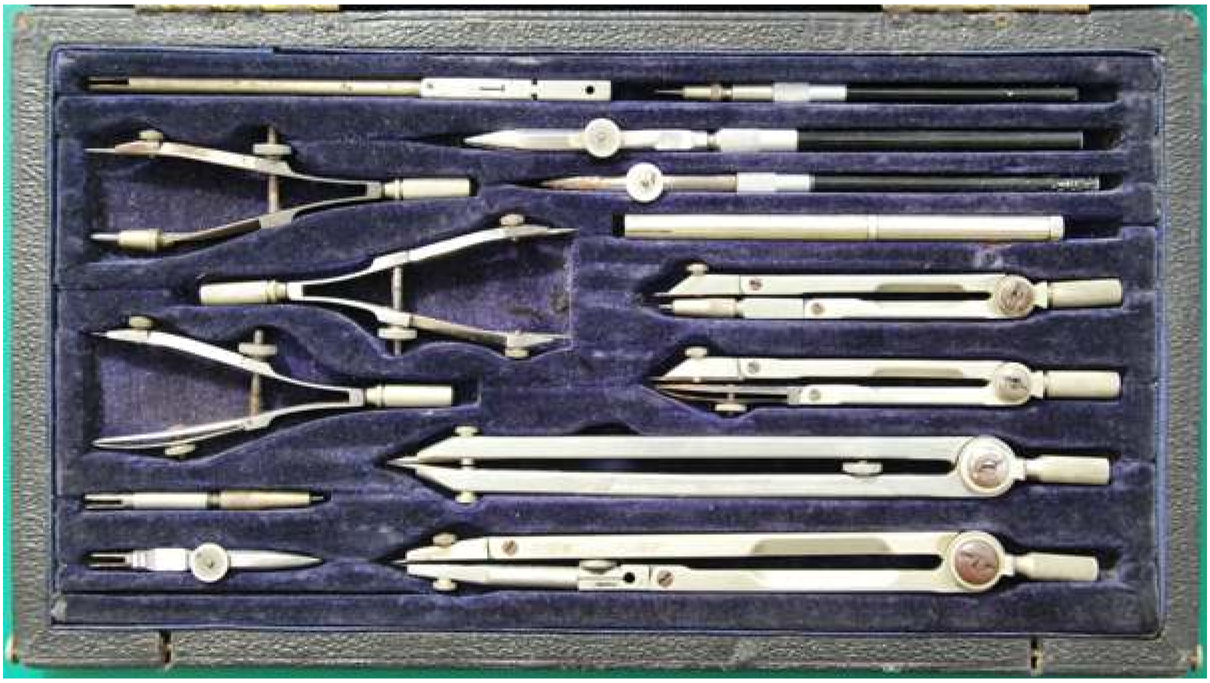


Fig. 275 ***Halden flat pattern set, probably ca. 1920. This is a variant of the British Empire pattern.***

J J Threadwell & Sons

J J Threadwell are not a well known firm but, as I hope to show, they were major makers of drawing instruments in Britain. This is because they only rarely marked their work with their own name.

The firm was established in 1860 but I know little of its history until the inter-war period. At this time they had headquarters at 127 Dames Road, Forest Gate, London E7 and a factory at Pevensey Road, Forest Gate.

At this time they made three series of nickel silver drawing instruments:

- Original English hand made instruments
- Stainless steel series machine made
- Carbon steel Technical series machine made

The latter two series were flat system instruments. The higher quality series, in addition to the main steel parts being stainless, featured self centring compass and divider heads.

By 1948 the firm had become J J Threadwell & Sons Ltd. and moved to the Commerce Estate, Raven Road, South Woodford, London E18.

The range of drawing instruments was essentially the same although the stainless steel series were now called the Precision series. Later an Advanced School Series was produced and the Technical Series received the self centring head.

In later years drawing instruments were not the major product of the firm, which then produced trolleys for television and medical applications. The firm ceased trading in 1986.

In 1998 I visited a lady who was an instrument maker at Threadwell for about 40 years. She provided me with photocopies of office copies of Threadwell catalogues, instruments and spare parts having retired when the firm ended.

I had already noted that certain instruments with other firms' names on them bore a distinct resemblance to the machine made ones in the Threadwell catalogues. She confirmed that W F Stanley and Charles Baker, amongst others were customers for Threadwell instruments. They even stamped the instruments for W F Stanley 'Stanley'. They also made instruments for many government organisations including the WD, HMSO and the GPO. The initials J. J. T. Ltd. can be found alongside the broad arrow on some of these. GPO instruments were stamped GPO. I have since obtained a set of Cooke, Troughton & Simms flat system instruments that are clearly Threadwell manufactured.

Fig. 276 ***J J Threadwell & Sons Ltd. (a) lithographic pen, (b) lifting nib pen, (c) pricker, (d) tracer, (e) fine line pen, late 20th century***

Fig. 277 ***J J Threadwell & Sons Ltd. ten inch proportional divider, late 20th century***

Fig. 278 ***J J Threadwell & Sons mahogany boxed set of instruments made for the British government. Some of the instruments are marked J J T Ltd beside the broad arrow. Note the mix of brass and nickel silver in this 1940s set due to material shortages.***

E O Richter & Co.

E O Richter (ca. 1841 - 1907) trained as a clock maker before founding his own firm in the summer of 1875. As recounted earlier he patented his flat system of compasses in 1892, which, in the mid 20th century, became the dominant form of drawing instrument.

The firm was based in Chemnitz and specialised in drawing instruments and particularly the flat system. The range of instruments and sets produced was huge. In 1928 they employed about 500 people.

Besides the patent for the flat system there were other Richter patents. One was for a mechanical dotted line pen and a later one, D.R.P. 398274, was for a drawing pen with a large ink reservoir in the handle. There was also a version of this pen for drawing broad lines

In 1945 the firm, being then in East Germany, became a VEB Kombinat, a form of state owned business and later new patterns of instrument were developed, derived from the flat system.

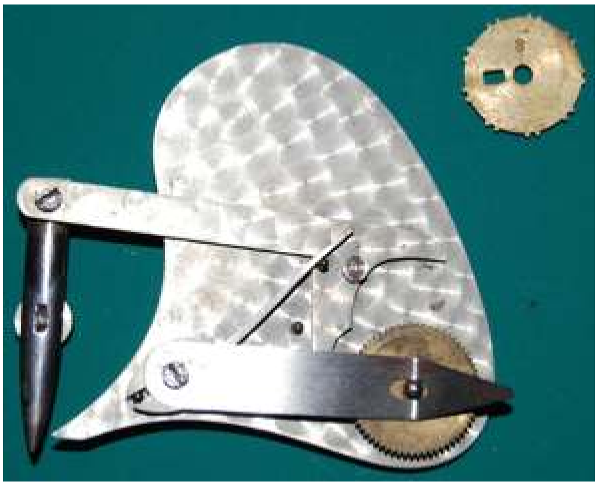


Fig. 279 ***Mechanical dotted line pen***

Fig. 280 ***Richter Industrie brass drop bow compass***

Fig. 281 ***E O Richter Präcision No. 1836 drawing instrument set, ca. 1939***

Richter drawing instruments enjoyed a reputation for high quality and were sold by many other firms around the world. These included:

- A G Thornton (up to WW I)
- New York Blue Print Paper Co.
- Gebrüder Wichmann, Berlin
- The Hughes-Owens Co. Ltd., Canada
- The H Cole Co., Columbus, Ohio

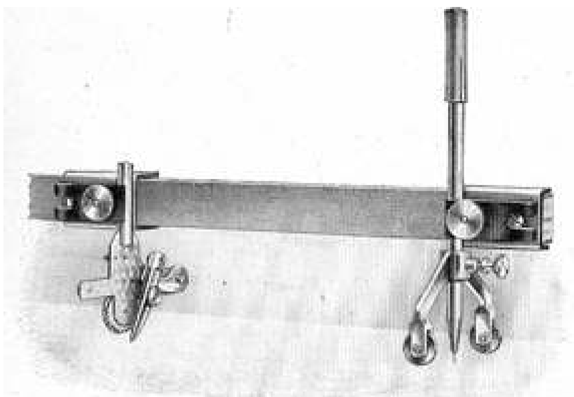


Fig. 282 ***Richter beam compass with carriage and dotted line pen*** *(1928 Richter catalogue)*

Clemens Riefler

Clemens Riefler (1820-76) was apprenticed to Ertel in Munich before founding his own firm in 1841 in Nesselwang. The founder's son, Sigmund Riefler (1847-1912) patented the round system That was described in some detail in Chapter 6. In 1877, this was the first pattern of drawing instrument that could be made by machine.

The firm also made extremely high precision clocks.

Today they are still located in Nesselwang. The firm is now Riefler Industry GmbH & Co. KG., address Rieflerweg 3, 87484 Nesselwang. Their present product range is mainly drawing office furniture and CAD work stations.

Fig. 283 ***Riefler pen set and leather case***

Fig. 284 ***Early 20th century set of Riefler round system drawing instruments. The set also includes an ex-centrolinead and a horn centre behind a flap in the lid. There was also a protractor, now missing.***

Fig. 285 ***Riefler R2 beam compass, total length 42 inches, early/mid 20th century***

Jakob Kern (17th August 1790 - 4th February 1867) founded his business 'Jakob Kern' for making mathematical instruments in Aarau, Switzerland, in 1819. He had previously been apprenticed to Ludwig Esser, who was also a drawing instrument maker in Aarau, and then studied under Frauenhofer in Munich.

In 1857 the firm moved to Ziegelrain in Aarau. Jakob Kern had two sons, Adolf Kern-Saxer (1826-1896) and Emil Kern-Rychner (1830-1898) who joined the firm at this time, and in 1863 Jakob Kern retired.

In turn, Adolf retired in 1885 and his son, Heinrich Kern (1857-1934) assumed management responsibility for the business that now became Kern & Co. Emil Kern also retired in 1897.

In 1914 the company Kern & Co. AG was formed. On 1st June 1920 the firm moved again to Schachen, Aarau, where it remained until 1979.

Heinrich retired in 1933 and was succeeded by his son Walter Kern (born 1888) and, in 1961, Peter Kern (born 1921) joined the board of directors. On 13th May 1988 Kern & Co. AG merged with the Wild Leitz group and, in 1991 the Aarau factory closed.

Much of this information has come from some excellent web pages on Kern and Wild Heerbrugg. These have pictures of the Kern family, their factories and their products. There is a link to this site in Internet Links.

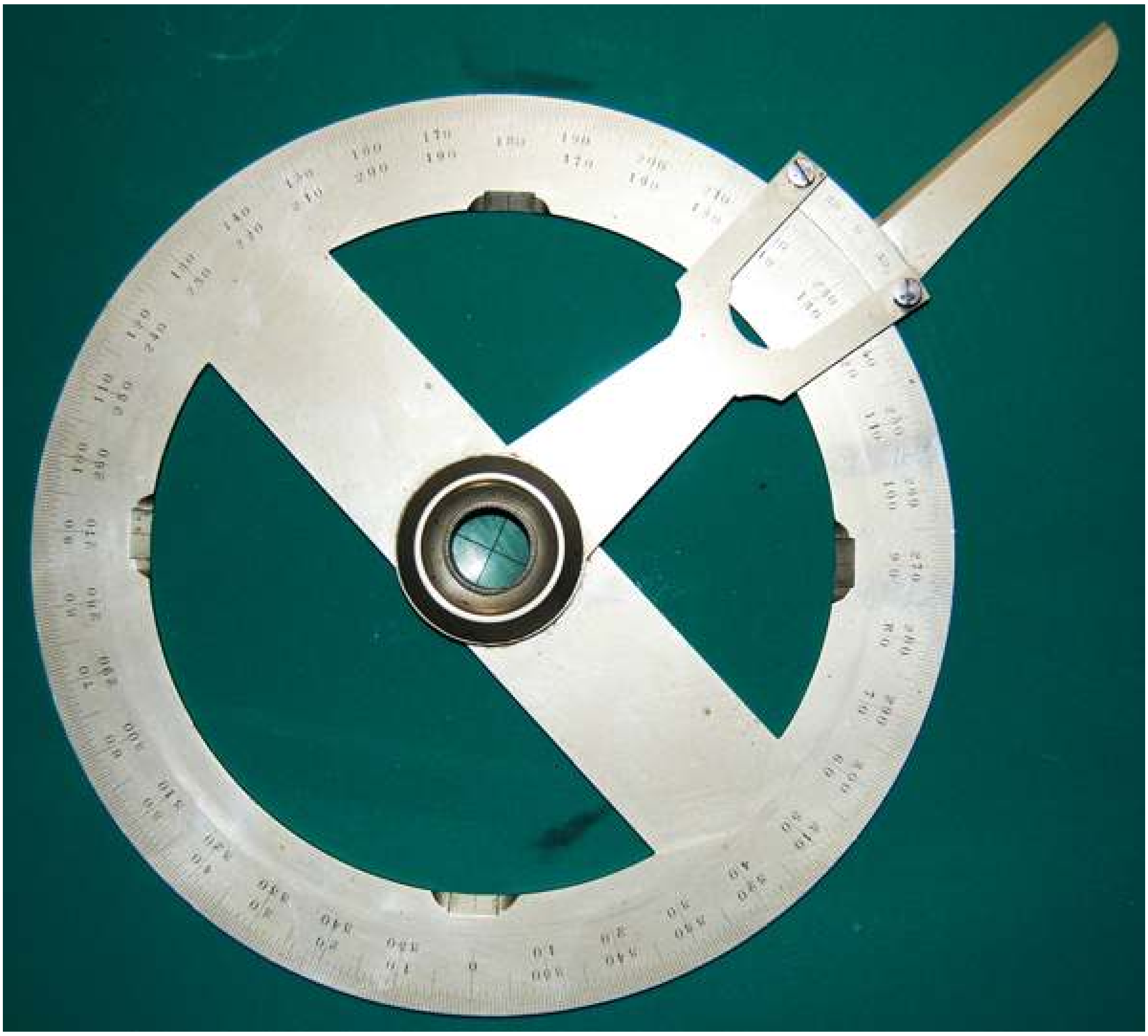


Fig. 286 ***J. Kern à Aarau en Suisse nickel silver, six inch vernier protractor (pre 1885). The vernier reads to three minutes of arc. It has a shaped leather case.***

Fig. 287 ***Kern brass set, pre-1885***

Fig. 288 ***Kern set dating from ca.1910. Note the unusual spring bow that has two pencil points and two pen points as well as the two plain points so it can be used to draw pairs of ink and pencil lines as well as being used as a compass***

Ecobra

Ecobra is a brand name of the Bayerische Reisszeugfabrik. The firm was founded in 1893 as Eichmüller and Co. In 1909, after Eichmüller died, Joseph Dietzgen acquired the factory. Joseph was related to Eugene Dietzgen whose mathematical instrument business in the USA was a major customer of Eichmüller's.

In 1922 the name was changed to Bayerische Reisszeugfabrik.. Eugene Dietzgen Co. continued to be a major customer.

The firm was located in Nürnberg, Bavaria. In 1929 the firms address was Brunhildstrasse 5-9, Nürnberg-28. The drawing instrument factory and offices were located in Nürnberg, whilst the case factory was in Emskirchen. At that time their catalogue listed eight ranges of flat system instruments ranging from the Ecobra brand (the highest quality) to school versions, and also a range of round system instruments.

Fig. 289 ***Two views of the Bayerische Reisszeugfabrik drawing instrument factory in Nürnberg*** *(1929 Preis-Liste)*

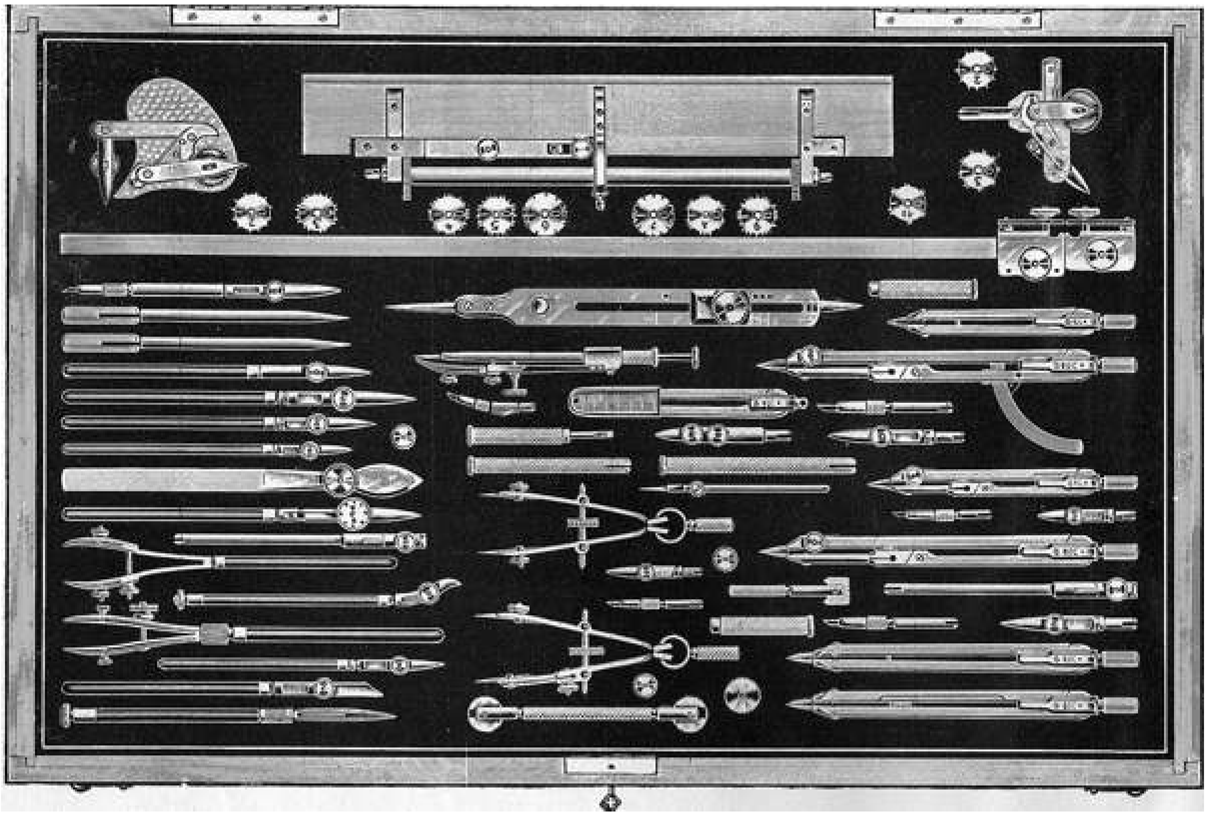


Fig. 290 ***Ecobra 846 E XXII set in a wooden case. This was the top of the range set in 1929 and contains a comprehensive collection of instruments. Large sets of German instruments, though perhaps not quite as large as this, are relatively common and hence affordable.*** *(Bayerische Reisszeugfabrik AG Ausgabe 1929 Preis-Liste)*

Keuffel & Esser

William J D Keuffel and Hermann Esser started their business selling drawing materials and instruments in 1867 in a tiny office at 79 Nassau Street in Lower Manhattan, New York. Both were recent immigrants from Germany. This was a time of expansion in the United States and there was a growing need for drawing instruments from architects and engineers. Railway building was in full swing and New York was rapidly growing.

They soon moved to larger premises at 71 Nassau Street. In 1868 they brought out their first catalogue, the first ever devoted entirely to drawing materials and instruments. They realised that importing would not fulfil the demand and in 1870 moved to 116 Fulton Street so that manufacture, initially of curves and set squares, could begin.

Expansion was fast and additional space at 3 Dutch Street was soon added. In 1873 they opened a shop and show room at 111 Fulton Street. Once again larger premises were required and it moved to 119.

In 1875 manufacturing was transferred to Hoboken, whilst in 1878 the retail side and offices moved again to 127 Fulton Street. In 1880 they built a new factory at Third and Adams Streets in Hoboken. In 1892 both premises were much enlarged by the addition of further storeys.

Branch offices opened in Chicago (1891), St. Louis (1894) and San Francisco (1900).

Hermann Esser retired in 1902 but William Keuffel continued in the business until his death in 1908. By then the business had expanded into surveying and optical instruments, and also slide rules.

During the first world war drawing instruments could no longer be imported from Germany. A new range of tubular instruments, suitable for machine production, was designed. This was the MINUSA series. MINUSA was derived from 'Made IN the USA'.

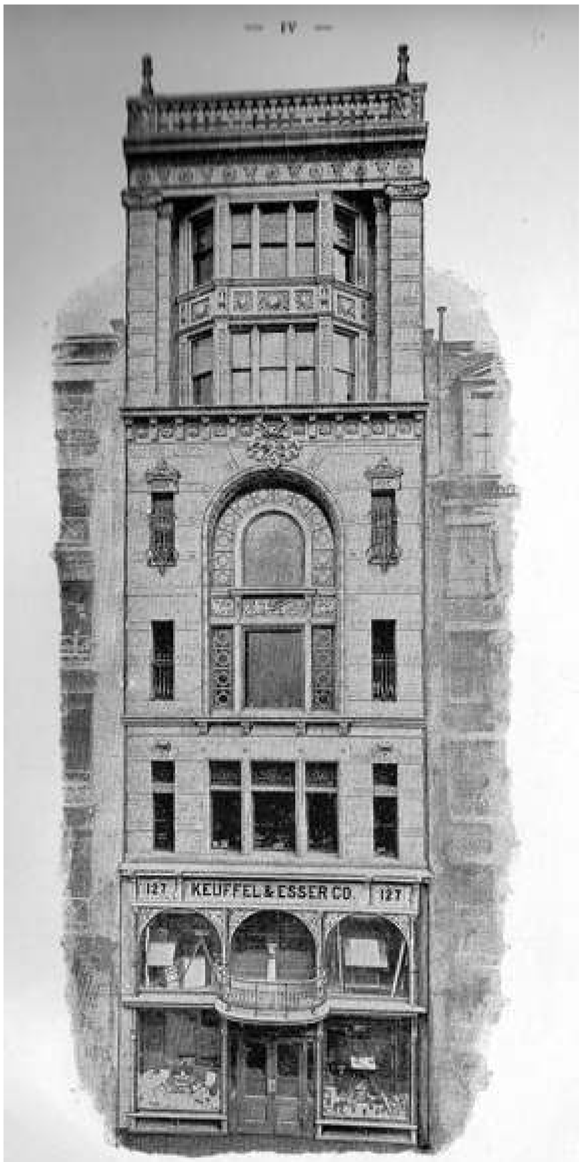


Fig. 291 ***Keuffel & Esser 'Parent House', 127 Fulton Street, New York*** *(1913 Keuffel & Esser catalogue)*

Fig. 292 ***Six inch compass from a Keuffel & Esser MINUSA set.***

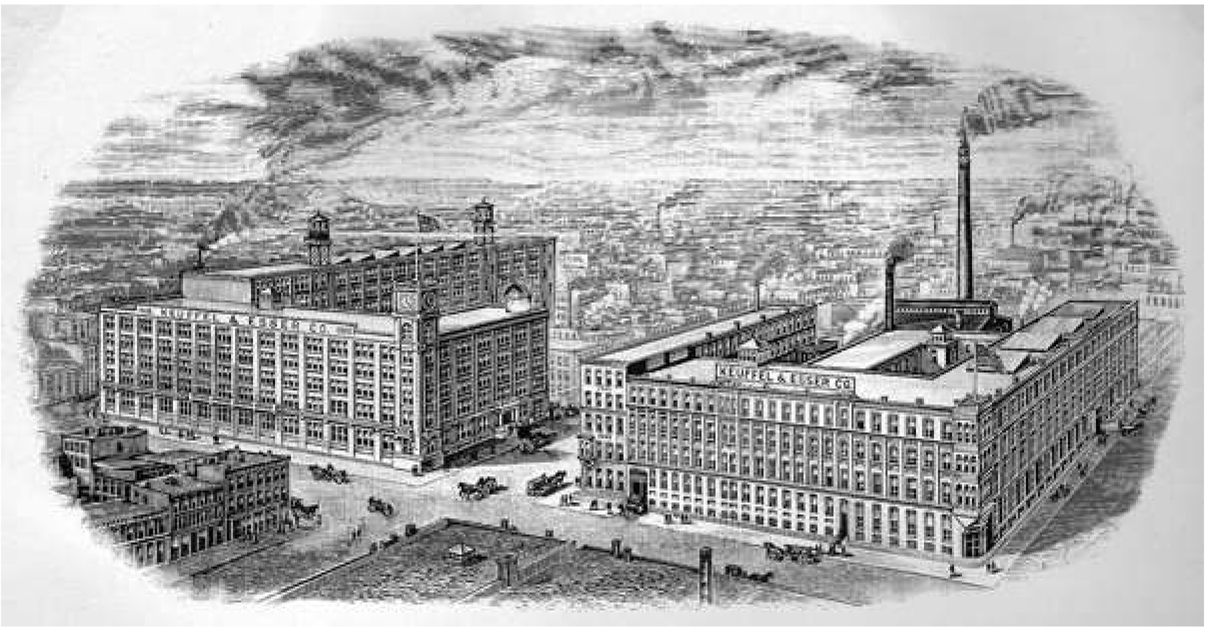


Fig. 293 ***The Keuffel & Esser factory in Hoboken New Jersey, completed in 1907***
(1913 Keuffel & Esser catalogue)

The business survived the Wall Street crash in 1929 and continued to develop. In the 1930s the LEROY lettering system was developed. This novel system uses templates that are engraved but not pierced through. A 'scriber' is used to follow the template, to which is fitted a pen of the appropriate size. Sets of these were supplied in polished mahogany cases. There were also templates for sets of symbols and special templates with any design could be made to order.

Returning to their various stores and factories the 1913 catalogue lists Montreal as a further branch, and by 1928 they had an uptown store at 22 E. 41st Street New York. By 1936 this had moved to 60 E. 42nd Street and they had a further branch in Detroit.

During the second world war, the MINUSA range was revived and a new 'Mercury' range was added to supplant it.

In 1967 the firm celebrated its centenary with a book 'Partners in Creating - The First Century of K&E 1867-1967', the text of which is now available on the Internet, and from which much of the information in this section has been obtained.

Fig. 294 ***Keuffel & Esser Leroy lettering set (ca. 1963)***

Eugene Dietzgen Co.

Eugene Dietzgen founded the business in 1885. Like Keuffel & Esser he was of German descent and his relative, Joseph Dietzgen acquired the Eichmüller and Co business in Nürnberg, Bavaria in 1909. They were major suppliers of drawing instruments to Eugene Dietzgen in the USA.

Dietzgen was probably Keuffel & Esser's biggest competitor in the field of drawing instruments, although Theo Alteneder, the Frederick Post Co., and B K Elliott were also major competitors in this field. Like K&E, Dietzgen regularly published comprehensive catalogues.

Dietzgen was based in Chicago, where they had a large factory as well as sales rooms, and by 1928 advertised branches in Chicago, New York, San Francisco, New Orleans, Pittsburgh, Philadelphia, Washington, Milwaukee and Los Angeles.

In 1928 the Dietzgen Chicago address was 166 W. Monroe Street; in 1930 their address was given as 2425 Sheffield Avenue.

Besides their catalogues, Eugene Dietzgen Co. published in 1930 a little booklet 'Use & Care of Drawing Instruments' copies of which are still plentiful.

Fig. 295 ***Some of their Offices & Salesrooms*** *(Picture from the 1928 Eugene Dietzgen Co. catalogue)*

Fig. 296 ***Eugene Dietzgen Co. 1188P set of German made instruments***

9. Building the Collection

Where do I Start?

In the Introduction I suggested that there are a number of questions that you need to answer and some decisions to be made. These are:

What is my budget?
How much space do I have?
Do I wish to display my collection?
What is the period I wish to collect?
Will I collect worldwide or specific countries?
Will I specialise on one maker?
Will I just collect certain types of instrument?

Inevitably the first two will put bounds on your collecting. Answering these two will help you answer some of the others. At the time of writing I hadnever spent more than £300 on a single item (the Jacob & Halse set in a shagreen case was the most expensive). Since then I have spent about £750 on a couple of very special items but otherwise the £300 maximum has been maintained. However I must now have spent a five figure sum on the collection as a whole. I have now been collecting for thirty years and I guess my finances are typical of a professional engineer, now retired.

Assuming you have a limited budget then you must decide whether you want to collect a few rare, high priced items or a collection of items that a typical engineer, architect or draughtsman might own. There are plenty of nice sets in this category that can be purchased for under a hundred pounds.

If you have just one show case in which to house your collection then buying the best items you can afford may be the answer. Whichever option you choose do make sure that what you buy is complete and in good condition if possible as this will make it easier to sell if you subsequently decide to upgrade or change your collecting theme.

I personally think it is nice to display at least part of one's collection but there are some pitfalls here that I shall mention later.

In this book I have described instruments spanning two hundred years from 1780 but many collectors like to limit the period to, say, pre-1900. The problem here is that it isn't possible to date some items that closely. However this theme could be modified to collecting instruments that could have been made before 1900 using catalogues and other published work as a guide.

If you wish to limit the scope of your collection, why not just collect items from the country you live in. Mind you, that's not simple either as the label on the case might have no relation to where the instruments were made. Oh well; why not just collect from one maker/retailer instead?

There are collectors I know who just collect one type of instrument or set. One collector just collects pocket compasses: pillar compasses, Napier compasses and the like. Another collects ellipsographs and perspective aids, but most of these will be beyond the average collector's pocket presuming that enough can be found to constitute a collection. I chose the other option. I wanted my collection to be as varied as possible, even encompassing some related navigational instruments such as parallel rules and station pointers, and mathematical instruments such as planimeters. In fact I now collect many other types of scientific instrument as well.

Whatever you decide at the beginning, just remember that the only rules are your rules and that you can change them at any time. Place too many constraints on yourself and you will soon find that you can't find any fresh items; too few and you will run out of space and money.

Where should I Look?

I started by looking in antique shops and junk shops. For a while this satisfied my collecting urge but I soon exhausted all of the ones within a reasonable distance of home. I did get some good items this way, including the Jacob & Halse set, but some of what I got was pretty mediocre.

The next step was to start visiting antiques fairs. The little local ones were pretty useless but the large one held every couple of months at Shepton Mallet show ground was a good source. I became acquainted with a couple of dealers who regularly added drawing instruments to their stock of antique tools and other items, and from whom I was able to purchase some of the more unusual items.

Auction sales are another place where you might find them. I have purchased microscopes and other scientific instruments at local antiques auctions and, even allowing for the buyer's premium, have got some bargains.

By far my largest source in recent years has been eBay on the Internet I have purchased over 1,000 items that way. Only one failed to turn up and my payment was eventually refunded. I have had very few cases where the item has failed to match up to expectations. Take care to check the seller's feedback and don't be tempted to bid higher than you feel is a sensible price.

Once you have a collection established you might consider creating a website to display it. I created my website sixteen years ago on which most of my collection is shown and provided an email address for people to contact me. I have since had many people do so, some providing information, and some offering me instruments. At first I averaged adding one item a month to my collection from this source. Some were even gratis. However my website is now getting far fewer hits & is no longer a source, possibly due to its format being unsuitable for mobile phones.

How about making an appearance on television? I appeared with my collection on the Channel 4 programme 'Collector's Lot' in 1998 and received several offers of drawing instruments via Channel 4 after that. My eidograph was one of the items purchased as a result.

In 2004 I wrote an article on my collecting for the Bulletin of the Scientific Instrument Society. In it I provided an analysis of the number of sets purchased each year related to changes in the way I looked for items. I have extended this to 2023, below.

Year	*Number added*
1995	21
1996	38
1997	27
1998	36
1999	18
2000	11
2001	5
2002	2
2003	7
2004	8
2005	15
2006	24
2007	20
2008	31
2009	19
2010	20
2015	9
2020	2
2023	8

Looking at the figures, by 1998 I already had what I considered to be quite a mature collection and the number of purchases would have been in decline but for my appearance on television and the additions resulting from it. By 2002 my existing sources were providing very little. In 2003 I discovered eBay with hundreds of sets of drawing instruments auctioned every month. There were ones I never even knew existed and my purchasing received a big boost as my experience in finding sets and making bids increased. Early in 2008 I established my website and this proved another useful source as already mentioned. By 2015 it had again become more difficult to find new items for my collection and by 2020, not helped by Covid and Brexit it had become almost impossible. In 2022 I widened the scope of my collecting by adding late 20th century items I had previously ignored.

Things to Avoid

1. Fakes and reproductions

Fortunately fake and reproduction drawing instruments are rare. However electrotyping can be used to make reproduction brass instruments such as sectors and some have been made legitimately by museums in the past. There have also been some 18th century French sectors on the market with famous names such as Bion on them in such quantity that their authenticity has been questioned. It is not difficult for someone to add a signature to an unsigned instrument in an attempt to raise its value and this may have happened in this case or they may have been straightforward fakes.

Mostly drawing instruments are not valuable enough to be worth reproducing.

2. Incomplete and made up sets

Think twice before you buy a set that is incomplete. Some previous authors have suggested that it is easy to find the missing items. Believe you me, except in some special circumstances, it isn't

Pens will be easier to find than some of the other instruments and it is reasonably easy to find replacements for popular machine produced 20th century instruments such as the Thornton Minerva and Techset ranges.

Needles are easily replaced; nuts, bolts and screws surprisingly are not.

Made up sets are a particular danger for novice collectors. Look carefully at each instrument. Do the handles on each of the spring bows match each other. Have they all got the same type of needle point; sometimes the divider spring bow may genuinely have plain points when the other two have needle points however. Check the maker's name on each item. If the compass has the makers name stamped on it then so too should the dividers, pen and pencil bows. However spring bows were often not stamped.

I have already mentioned the practice of replacing missing Georgian brass compasses and dividers with much later cheap French ones. If buying a set of this age carefully examine it noting the characteristics I have described in previous chapters.

Lastly check that each item fits properly in its case. The layout and content of English full set cases was very standardised, so be suspicious of one that looks different.

3. Highly polished instruments

Most brass and gunmetal rolling parallel rules were finished black. Many ex navy ones have been stripped and polished. I avoid these like the plague and recommend you do the same. Other largish brass items, such as protractors, were usually lacquered. If the lacquer is badly worn or has been stripped then the value is considerably lowered.

Researching the Collection

Building a collection is only the start. I certainly want to know as much about each of the items as possible. Who made it? Where was it made? When was it made? How much did it cost? What was it used for and who was it used by? How well did it work?

Answering these questions is not always easy and some research will be required. There are many possible sources of information:

- The Internet
- Libraries
- County Record Offices or Local History Centres
- The National Archives (Kew)
- Museums
- The British Library
- Second hand book shops
- Other collectors

I have listed British sources above but most countries will have their equivalents.

I have, over the years, built up a library of books and catalogues and this is where I start. I have listed the most useful books in the Bibliography and I strongly recommend purchasing some of these. You will find most of them are easier to find using the Internet than via your local book shop.

Some important early books are available as reprints, notably 'The Construction and Principal Uses of Mathematical Instruments translated from the French of M. Bion by Edmund Stone' and 'A Treatise of Mathematical Instruments by John Robertson'.

This definitely applies to old catalogues, which are an invaluable source. These are in demand from collectors so they will not be cheap. American ones, particularly Keuffel & Esser, are the easiest to find on the Internet and hence cheapest, but if you collect English instruments then you will certainly want Stanley and Thornton ones.

Fortunately some catalogues have now been scanned and can be downloaded from the Internet. It is also possible to purchase photocopies of some from libraries and museums.

Don't overlook magazines. By chance I inherited over 1,000 issues of the Model Engineer, dating from 1912 to 1939. Quite a few of these actually included advertisements for drawing instruments, regularly including those made by A G Thornton and Norton & Gregory. It would also be worth looking in 'The Engineer'.

Because London is a three hour journey from Weymouth and there are no relevant institutions nearer to where I live my next source is invariably the Internet where one can find:

- Interest groups
- Museum web sites
- Collector's and dealer's web sites
- ABE Books
- Downloadable catalogues & books

I have listed useful Internet sources in an appendix. The Groups IO Drawing Instrument Group is particularly helpful and members will try and answer any question raised. The Group site has a number of files and databases which can be referred to. One database is a list of makers with brief facts on each. Another is a list of books and catalogues owned by members; many owners will be happy to scan one or two relevant pages and email them to you. All my books and catalogues are included in this database. However the database no longer lists the owners' names.

I have my own website where you can view pictures of my collection in colour. Besides the many pages on drawing instruments there are a similar number of pages on slide rules and calculators, and several pages on other types of mathematical and scientific instruments. There are also links to many other useful websites.

At this stage I ought to mention patents and registered designs. There are very many of these relating to drawing instruments, some of which are easier to access than others.

American patents are the easiest to access once you know the system as all of them are available on line and the complete specification can be downloaded. The difficult part is finding the class/subclass code(s) for the instruments you wish to research. Once you have the class code you can use it to search the historical patents. To find the class code you do a Boolean search for, say, 'ellipsograph' on the database which contains the more recent patents. You can then use this in the database that contains the older ones. For example 33/558.02 is the code for proportional dividers.

Historical British patents are now held by the British Library. They will answer simple questions, sent by email, for free, but charge for more detailed research. You can visit the library but may need to register with them first.

If you wish to research a particular maker there may be archives on file at either a county record office (local history centre) or at the National Archives at Kew. Try an online search or email in the first instance to ascertain whether the archive you are interested in is held. In some cases, where the firm still exists or a successor does the firm may still hold archives and may be willing to help.

There is an on-line database of makers worldwide, known as Webster's database, which can be accessed through the website of the Adler Planetarium. It does, however, need to be used with care.

Whichever country you live in there is almost bound to be at least one specialist science museum and many, like Britain, will have more. It really is worthwhile visiting as many of these as you can. You can then drool over the many lovely instruments that you would love to own if you could find them and afford them. Behind the scenes they will also have many more, perhaps more everyday, instruments that you will probably be able to view by appointment. They are more likely to have some provenance than the instruments you collect so that can help with dating.

Last but not least, why not join the Scientific Instrument Society and meet other like minded people. The Society organises an overseas study trip, another weekend visit in Britain, and has lecture meetings in London each year. It also publishes a quarterly Bulletin with excellent articles in it. The overseas study trip and the weekend visit in Britain consist mainly of visits to museums with collections of scientific instruments, many of which will include drawing instruments. The visits are also social occasions with the opportunity for discussions with other collectors, dealers or museum professionals, perhaps over a pleasant meal.

Dating Instruments

A question I am frequently asked, and probably the most difficult to answer, is 'How old is it?'.

The first thing to look for is a date. Maybe the first owner wrote his name and a date somewhere on the case. If its original owner was a UK government department or the military, signified by a broad arrow, then it may well have a date stamped or printed on. Unfortunately only a small number of sets and individual instruments have a date on them. Even then the owner who dated it may not have been the first.

Then look at the maker's name and address. Some makers moved premises several times so the address will give a date span. If it's a London address ending in a letter(s) only postal district (e.g. 'EC') then it will 1857 or later. Numbers were added (e.g. 'EC1') from 1912. I have listed some useful books for researching addresses in the Bibliography.

If there is an instruction leaflet or other literature look for a date on that. Advertisements and catalogues are also very useful for dating.

American instruments frequently have a patent date on them. This only tells you it can't have been made before that date. Some US makers continued putting patent dates on for more than 50 years after the patent was granted! British instruments may have a UK patent number on them. There are lists for dating these and also those of some European countries on the Internet.

Look at the construction of wooden cases. Machinery was first used for their manufacture towards the end of the 19th century so comb jointing of the corners indicates it is probably 20th century, although some makers, notably W F Stanley, were making boxes that way in the late 19th. Mitred joints or hand made dovetails are likely to be 19th century. Plywood will be 20th century.

If the lining is blue it is probably post 1850; if red or green velvet it is probably pre-1850. However green baize and felt were used until recent times for pads in the cases of larger instruments such as pantographs. Etuis (cases with the instruments placed in vertical wooden compartments) had gone out of fashion for drawing instrument cases by about 1850.

Look at the style of the maker's stamp on the silk lining of the lid. These changed with time and are a further clue to date.

Look at the materials used for the instruments themselves, nickel silver (electrum, German silver) was not used until the 1830s. Vulcanite (hard vulcanised rubber) and Celluloid were mid-19th century inventions. Acrylic will be post WWII. Ivory will be pre-WWII. Aluminium was too expensive to use until the late 19th century, when it began to be used for pen handles.

Look at the construction of compasses. A hand cut wing screw indicates it is probably pre-1800. Milled screws mean the instrument is almost certainly post 1800.

If there are no obvious clues then look carefully at all the features of the case and instruments and see if they, based on experience, considered together give an indication of date. Looking at illustrations in books and instruments in museums will help build up experience. Even then, when I put ‘ca. 1900’ it may mean 1870 to 1930. With some instruments I can’t even get that close.

Fig. 297 ***Faber Castell 71716 set. This is one of the sets I added in 2022 when I decided to widen the scope of my collection to include items dating from the late 20th century***

10. Caring for the Collection

There are really two aspects to caring for ones collection. The first of these is keeping a record; the second is the process of conserving each item. Both of these are essential for different reasons. There is then the option of restoration, which is abhorred by some but which I personally consider beneficial in some cases.

Keeping a Record

There are several reasons for keeping a record. What if an item is lost or stolen? You will need a photograph, description and some evidence of its value. What if you should die? How would your executors know what the collection consisted of and its value?

Disregarding those morbid thoughts, as your collection grows you will find it increasingly difficult to remember key facts about each item.

I guess I'm probably a bureaucrat at heart as I photograph, catalogue and document everything. I'm sure that I'm not the only collector who adds instruments to cases and moves them around. It's only fair to the next owner that he is informed what is original and what is not. The same is true of any restoration work, which I think should also be recorded.

I now have aover 500 cases of drawing instruments containing several thousands of individual instruments and parts. Keeping track of these would be very difficult if I didn't list each individual item and label any that might be mobile. Labelling is important but please use tie on labels, not sticky ones. I hate dealers who use sticky labels, especially when they stick them to textiles.

Should you keep a written record and print your photos or just keep it all on the computer? Personally, I do both. Computer databases are great because they are searchable; they can also be arranged and re-arranged in any desired order making comparisons easy. Digital cameras are ideal for photographing the collection so it is easy to put ones pictorial record on the computer. The same pictures can be emailed to other collectors or put on a website.

That is all great but computer storage is dangerously volatile. It has to be regularly backed up or you risk losing a significant part of the record when the computer fails, as it inevitably will some day. Backup media does not last for ever either and even if it does not deteriorate the equipment for reading it may become obsolete and fail.

The written record has some advantages as well. It is totally versatile; the format can be changed at will with little effort. It requires no knowledge of computing or expensive hardware. Ledgers and index cards have served museums well for a very long time. What matters in the end is not how you record the data but the quality of what you record..

The records I keep are as follows:

- A photograph/photographs of each set or individual item (printed and on my computer)
- A ledger with items listed by type. Every individual item, whether purchased separately or as part of a set. Each item has a catalogue number, description, location it is kept in, and purchase details.
- A written catalogue of cases in catalogue number order with a list of their contents, details of additions and removals, notes on condition and any restoration.
- A computerised catalogue of cases and items obtained individually in chronological order with details of contents, construction, condition, where obtained, price paid.
- A computerised list of makers with brief historical details, references, a list of items in the collection by that maker.

I also used to keep a computerised version of the ledger on a database. When I replaced my computer with a new one with an updated version of the operating system the database software was no longer compatible. That is another hazard for computer based records.

You will also want to keep a record of any research that you do. You can store downloaded files and emails on your computer, but beware again; my ISP deleted all my stored emails without warning. If it's important keep a paper record as well. The paperless office is fine for records you don't need to keep! I keep my records in a four drawer steel filing cabinet.

Conservation

Let's start by having a look at the things that might harm your collection:

Heat - this affects wooden cases and causes them to dry out. Eventually the wood may split or joints fail. It also causes plastics to distort and deteriorate more quickly. Leather also dries out and cracks.

Light - this causes textiles to fade and become fragile. Some plastics are degraded by light, becoming yellowed and brittle. It will also bleach ivory, which may be advantageous.

Moisture - this will corrode metals, stain and rot wood and fabrics, mark paper and dissolve glues.

Chemical Incompatibility - Cellulose Nitrate (Celluloid) and cellulose acetate slowly decompose giving off acidic vapours which then attack any metal in the vicinity. Different plastics and rubbers may react with each other. Flexible PVC takes up print from card and paper. Treat all plastics with suspicion as various chemicals may leach out of them.

Insect Attack - woodworm and the clothes moth are the best known in the UK. Other insects and invertebrates eat paper and even glue.

Fungi & Moulds - these are a potential hazard to any natural material, encouraged by damp.

Cleaning Materials - these can stain textiles, dissolve glues, attack plastics, remove lacquer and paint, slowly remove the material being cleaned rounding corners and edges.

Conservation itself is best considered for each type of material in turn.

Wood - this was widely used for both cases and the instruments themselves. English wooden instrument cases were normally constructed of hardwoods. Oak, walnut and mahogany might be used on their own or mahogany might be veneered with burr walnut or rosewood. Leather and fabric covered cases would have a wooden carcase, usually pine, which would also be used to form the pockets for covering in velvet.

Most cases would be jointed and glued, with screws only used in the larger cases, for heavy instruments such as pantographs.

The cases would have been polished, probably French polished or wax polished, possibly varnished later in the 20th century.

Ebony was used for squares and parallel rules. Boxwood was used for scales, whilst pear wood was used for curves and triangles. Ebony became scarce and expensive so often a black stained (ebonised) wood was used instead These woods could be polished or sometimes left bare.

As with all conservation the basic aim is to protect the material from the things that would cause harm but first examine the item to see if there are already problems such as rot or attack by woodworm as these must be dealt with first. In both cases there are proprietary materials for dealing with them.

The next stage is to decide whether dirt on the wood should be cleaned off or left as ‘patina’ and evidence of use. This has to be a personal decision; however if the wood is stained I usually leave it and only remove surface muck. A soft brush is the best means of removing loose dust. A damp, but not wet, cloth can also be used to remove surface dirt. Any more drastic cleaning falls within the realm of restoration rather than conservation and I will consider that later.

Having cleaned the wood, if it is polished or varnished I usually give it a good polish with beeswax based polish (do not use a silicone based one). Unpolished wood may be treated with a furniture cream but this will tend to change the colour so it may be better not to. In both cases the aim is to try and prevent the wood drying out and possibly splitting.

Textiles - typical textiles used include silk, silk velvet, baize, felt. These were used for lining cases and providing a pad for parts of, for instance, a pantograph to rest on in a fitted case. Often the silk lining to a lid covered some sort of wadding.

Silk linings are particularly prone to fraying and other damage. This can be stabilised using a cellulose paste that is sold for the purpose. Textiles can also be reinforced using a nylon gossamer fabric attached to the back with the same paste but it is not always easy to get access without causing further damage. This paste has an anti-fungal compound mixed with it. Being water soluble any work done using it can be reversed, something that is often quoted as a golden rule for any conservation work. Incidentally any water used in a conservation process should be distilled.

Assuming there are not already eggs laid on textile linings there should be little problem with clothes moths so long as the cases are kept tightly closed.

Many later cases are covered in cloth to simulate leather. The main problems here are wear and fraying, which can be stabilised in the same way as the linings. Many continental cases rely on the fabric covering and lining to act as a hinge and this is prone to splitting so minimise opening and shutting and do so with great care.

Leather - this can be subject to insect attack but the usual problem is that it dries out and splits, especially at hinge lines. There are creams that can be used to prevent this as also can saddle soap. Whilst it may be considered restoration rather than conservation I find that a good quality shoe polish both protects the leather covering of cases and brings back their colour and shine.

Shagreen & shark skin - these are hard and durable materials that should only require cleaning and storage in clean dry conditions.

Metals - the following metals will be found: silver; brass; gunmetal; nickel silver (electrum, German silver); steel and stainless steel.

Silver was used for the scales and verniers on some protractors and for mountings on early cases, particularly those with shagreen covering. It can be cleaned with a proprietary silver polish taking care not to stain any adjoining material with the polish.

Brass, an alloy of copper and zinc, was used extensively for drawing instruments, particularly prior to the introduction of nickel silver. It too can be cleaned with a proprietary metal polish. Too frequent cleaning and polishing of both silver and brass will lead to edges being rounded and graduations and engraving becoming worn and illegible. Very dirty brass can be cleaned by pickling in a solution of citric acid but may discolour as a result.

Gunmetal, an alloy of copper and tin, is a type of bronze sometimes used for protractors. It can be treated like brass.

Nickel silver, also known as German silver and electrum, is an alloy of copper, zinc and nickel. It is whiter than brass and more resistant to tarnishing and corrosion. It is best cleaned with metal polish. Whatever the metal, take care that there is no metal polish remaining on instruments when they are replaced in a case. If polish is left on it will stain the case lining and will also eventually leave a nasty, white deposit on the instrument.

The 'ordinary' steel used in drawing instruments is usually a high carbon steel that was hardened and tempered for long life, durability, and spring. Originally it would have been quite highly polished. It is prone to rusting if there is any damp present or in the air. Where this cannot be avoided silica gel sachets can be used to keep the immediate surroundings (in the case or storage box) dry. These need to be removed periodically and dried or replaced. I use a fibre glass pencil to remove surface rust from steel. There are chemicals that can be used with care as well.

Some cases were made of mild steel sheet painted black. If in reasonably good condition I leave these alone. if badly rusted or damaged I might consider stripping, rust removal and repainting but that's restoration not conservation.

Stainless steel began to be used for pens between the wars and was used extensively from the 1950s onwards. It should not need any treatment other than the removal of any ink residues.

Aluminium was used for pen handles, when it was frequently painted black, and, occasionally, on other instruments in the 20th century. It does not usually require any special treatment or cleaning.

Plastics and Synthetic Materials

Celluloid (cellulose nitrate) and cellulose acetate are both prone to decomposing and embrittlement, particularly in transparent form. Keeping them in a dry, stable environment and out of the light will slow this but eventually the items will just fall apart and have to be thrown away. These materials give off acidic vapours which will combine with the slightest moisture to corrode any metal in the vicinity so be warned. Don't keep transparent celluloid items in sealed polythene bags as this seems to accelerate the deterioration. Keep them separate from other plastics.

Polyvinyl Chloride (PVC) comes in both hard and flexible forms. Hard white PVC was used as a substitute for ivory (as was white celluloid) for edging scale rules. The flexible form, which can be transparent or opaque, was used for instrument wallets post WWII. The latter is particularly prone to leaching out plasticiser, making it brittle, but also affecting other adjacent materials and inks. Keep it out of the light and at an even, cool temperature.

Polymethylmethacrylate (Acrylic, Perspex) is a transparent plastic used for better quality set squares, etc. since WWII. Quality items were, and still are, usually machined from thick sheet and engraved. It is much more stable and UV resistant than celluloid or PVC and hence less is known about its really long term behaviour.

Polystyrene has been used for cheap rules and set squares, usually injection moulded. It tends to distort and embrittle with age. It has also been used for instrument cases. If kept out of sun light and excessive heat it should be OK.

Polyurethane and other foams have been used for case linings. These tend to disintegrate after 30 years or so and hence will need to be removed and replaced.

Polycarbonate is another transparent material sometimes used for set squares and similar items. It is pretty stable but possibly more prone to the effects of UV light than acrylic.

Polyethylene (polythene) is still used for bags and these are useful for storing small metal items, such as spare compass fittings. Avoid contact with cellulose nitrate and cellulose acetate items.

All of the plastics so far described are thermoplastics, softened by heat and inflammable, some, like celluloid, highly so.

Vulcanite (hard vulcanised rubber) and Ebonite were used for set squares and as a substitute for ebony. They are usually quite stable but can dull and become brittle with age. They don't require any special treatment.

Bakelite was used for some cases. It is, like other thermo-setting plastics, generally stable, robust and long lasting but can break without warning if dropped, struck , or subjected to excessive force as it is a brittle material.

Restoration and Repairs

Whether to restore on not and how much to do is a matter of personal choice. If you are uncertain whether to carry out any restoration then seek the advice of a museum or professional restorer. I am going to describe below some restoration work that I carry out and the techniques and materials that I use. It would not always meet with the approval of museum specialists.

Where possible I try to keep any work that I do separate or reversible but that is not always the case.

Frequently instruments are missing screws. If these are machine made (most are) then I will try and find a suitable replacement from my stock of spares. As long as the addition of a spare part is noted I cannot see any reason against this. I may also make a hand cut wing screw if the thread is a standard one for which I have a die.

I have on a couple of occasions turned replacement ivory handles from longer, broken ivory handles, and fitted these. This is generally just a case of turning a spigot on one end and a finial on the other and could be done in an electric drill on a stand using needle files if a lathe is not at hand.

I have made replacement parts for my eidograph and pantographs (I have a well equipped workshop). These are completely separate and not adaptations of broken original parts, which I keep.

Most of the restoration work that I do is on cases. I re-glue dried our joints; here I depart from professional practice as I use a PVA wood glue. Similarly I re-attach detached linings and I may repair these using gossamer fabric and a special paste as already mentioned in order to prevent further deterioration. I fit new tapes to trays and flaps so that they can be easily lifted out or opened. This I consider essential to avoid damaging the linings.

I have also re-glued veneers and replaced missing veneer with veneers from my stock used for marquetry. It is well nigh impossible to get an exact match for the grain or figure of the rosewood and walnut veneers used however. I wax polish new veneer even if the original was French polished as it is easier.

If felt or baize padding, or fittings are missing from the cases of the larger instruments I replace these to keep the instrument secure and prevent damage. I rebuild badly damaged cases using new wood as necessary for the same reason.

If a wooden case is stained and soiled beyond what is an acceptable sign of age and use, then I clean it off as far as I deem necessary, using fine wire wool, and wax polish it.

Where the case is fabric covered and the covering fabric is used as a hinge, typically on Continental cases, if it is splitting and the lid is about to become detached, I reinforce it with a textile tape of the same colour fixed with PVA glue. I am sure that would not meet with approval elsewhere but again I do it for practical reasons. I fairly frequently open my cases and I don't want the lid to become fully detached. This is not in any way restoration, just a practical repair.

I also use PVA glue to re-attach any loose fabric covering on cases.

Wood cases are often missing a cartouche or a lock escutcheon. These can be simply made from brass or nickel silver sheet, cut and filed to fit. Epoxy is the best glue for fixing these being careful not to get any on the surrounding wood. The originals were frequently lacquered and, if so, clear varnish carefully brushed on will prevent tarnishing.. A missing hook could also be fashioned from sheet brass.

Some magazine cases contain water colours and a china palette. The latter may be broken in which case super glue can be used to repair it. It may be possible to purchase replacement cakes or pans of watercolours as these were usually of a standard size but I have not attempted this.

Whatever work you carry out I consider it important to record it.

11. Gallery - A Selection of Sets in my Collection

Fig, 298 ***W F Stanley ten inch electrum bound oak case of electrum drawing instruments, ca, 1880***
The case has two lift out trays. The upper tray contains: a six inch compass with ink, pencil, type 'A' and type 'B' points and two lengthening bars; hair dividers; pen and pencil bow double jointed compasses; three spring bows; proportional divider; lifting nib and fine line ivory handled pens and an ivory handled pricker; Swiss pattern beam compass fittings. The lower tray contains an ivory sector, ivory rectangular protractor, and an ivory scale rule. The base of the box contains three vulcanite French curves.

Fig, 299 ***W F Stanley ten inch electrum bound oak case of electrum drawing instruments, ca, 1880***
This view shows the case exterior and the lower tray with the sector, protractor and scale rule.
The cartouche is elaborately engraved with the name of the original owner, 'Mark Edward Drury'.

Fig. 300. ***Rosewood veneered case of electrum drawing instruments by J M & H Cronmire***
In addition to the usual full set the case contains an ivory handled road pen (seen here moved to the pocket for the missing second dividers for the photograph) and an ivory protractor signed J M & H Cronmire, London. There are also two small vulcanite set squares. The ivory handled spring bows can be seen in detail in Figure 11.
On the underside of the tray there is a trade label for 'J M & H Cronmire Mathematical Instrument Maker 10 Bromehead Street, Commercial Road East'. This was Cronmire's address from 1865-9.

Fig. 301 ***A late 19th century set of electrum instruments in a mahogany case with a domed lid.***
The set is unsigned. The compass has plain points yet is double jointed. There are also two boxwood plain scales (only one shown)

Fig. 302 ***Full set of electrum drawing instruments in a Morocco, snap fastening case retailed by A W Gamage, Holborn, London EC, ca. 1900***
The compass and spring bows have ordinary needle points, whilst the pen and pencil bows have nut and bolt needle points.

Fig. 303 ***Sets of spring bows in Morocco cases. Two are by W F Stanley, one is by Robson, Newcastle-upon-Tyne, and one is unsigned.***

Fig. 304 ***A set of small size Elliott Brothers, 101 St. Martins Lane, London electrum instruments in a burr walnut veneered case. The ebony parallel rule and ivory protractor are both signed Elliott Bros., London. Late 19th century.***

Fig. 305 ***A G Thornton, 109 Deansgate, Manchester three tier, 14 inch, oak case of electrum instruments***
D*ating from ca.1890, the spring bows, bow compass and six-inch compass have screw-off points and the latter was made by W H Harling.At this date Alexander George Thornton did not make all of the instruments he sold and some were certainly bought in, so I am pretty certain these were all original to the set. Both Thornton and Harling listed these screw off points as their Improved Needle Points. In every case the spring bows have the same 3 knurled rings on the handle so they were most likely made by the same manufacturer. The lower tray contains a full set of colours by either Rowney or Winsor & Newton. As with many old sets spare space is filled with a miscellany of added items. The base contains a number of twelve inch scales.*

Fig. 306 ***Set of nickel silver instruments by Daimaru, Japan. The instruments include: a compass half set; hair dividers; three spring bows; two drawing pens; a knife key and a lead box.***
Although a copy of the English pattern the pens are unusual as the ends of the handle unscrew to reveal a pricker on the end of the main part of the handle.

Fig. 307 ***Yasukawa & Co., Isezaki-cho, Yokohama, Japan set of nickel silver instruments in a green, cloth covered, pin lock case.***
This set is a mixture of English and French styles. The spring bows are are English pattern but the compass and pens imitate French instruments. The compass pencil point has a separate lead holder.

Fig. 308 ***A small set of French brass instruments with some unusual features. The compass and dividers have spherical heads and are stamped 'Deposé' indicating that the design was registered. The pencil point has a separate lead holder.***

Fig. 309 ***Two cheap sets of brass instruments presented as school prizes. Both have varnished pine cases.***
The left hand one was presented by the City of Manchester Education Committee to Frank Miller at Miston Lane Municipal Boys School for punctual and regular attendance during the year ended 31st July 1907.
The right hand one was presented by Mr A Verey to Ernest King at the Buckland Schools (Dorset) in August 1896 for cleanliness and general neatness in work.
These sets retailed at about two shillings and sixpence. There is usually a small brass protractor behind a flap in the lid. The set on the right does not have the small compass but has a charcoal/pencil holder.

Fig. 310 ***Two Richter Präcision wood cased sets***

The upper one is a XV P set dating from ca.1900. The lower one is a VI P set dating from the 1920s. Comparing the two shows a number of design changes that occurred. The compasses in the XVI P set have self centring handles. Those in the XV P set are stamped DRP indicating the patenting of the flat system.

*The German drawing instrument industry used a standard system for designating sets consisting of two parts: a Roman numeral denoting the size of the set (the higher the number the larger the set), and a letter defining the quality, in this case 'P' for pr**ä**zision (precision).*
This set includes a mechanical dotting pen

Fig. 311 ***Friedmann Brothers Drawing Instrument Co., New York No. 23A set dating from ca. 1935 in a leather wallet case containing their Universal Micromatic Beam Compass. It retailed at $33 with a discount price of $16.50 according to their price list. This was the largest set in the catalogue. The nickel silver instruments were made in Germany.***

Fig. 312 ***Charvos No. 814 set, made in the USA. The set has a sturdy wallet case lined with blue velvet and probably dates from the 1940s. The instruments are plated, probably with chromium.***

Fig. 313 ***Lee Guinness S902 flat system set, ca. 1950.***
Besides making round system instruments based on the Riefler design, Lee Guinness also made two qualities of flat system instruments, of which this is an example of the better quality. Both pens have cross joint nibs. The black handled one is a Lee Guinness replacement and has a pricker on the ed of the handle, which unscrews..

Fig. 314 ***Cooke Troughton & Simms set of flat system instruments dating from the 1940s.***
The metal instruments were made by J J Threadwell. The pricker may not be original.
The compasses and dividers are a curious mixture of brass and electrum the two metals even being mixed in the same instrument due to a shortage of materials at the time of manufacture. The ink points and pen are all stainless steel. The pen and pricker have vulcanite handles and the pen has a lifting nib.

Fig. 315 ***W H Harling W10/5841/VC set made in 1953 for the British War Department.***

This is British Empire pattern set. The larger pen has a lifting nib as do the ink points for the six inch compass and the bow compass. The smaller pen has a spring nib. Both pens have Ivorine (plastic) handles. The protractor and parallel rule are stored in a compartment behind a flap in the lid. The 'Inertica' protractor (W10VC/1390 dated 1967) is a replacement. It is a plastic which is 'not inflammable'.

Fig. 316 ***A flat system set by BOFA of China.***

BOFA P115 set, made in China in 1961. The set has never been used. It was probably intended to be a presentation set. The Chinese copied this set design from a German manufacturer, possibly the Bayerische Reisszeug Fabrik (Ecobra) which catalogued this set layout in the inter-war period.

A large pen wipe with the BOFA logo on it and a dated inspection certificate are also in the box.

Fig. 317 ***Original Richter set made in East Germany, probably in the 1970s. The detail pen and the larger drawing pen have large, graduated thumb wheels for setting the line thickness. The case is steel, covered with leather and lined with blue velvet, which is padded inside the lid with foam.***

Fig. 318 ***Theo Alteneder eight inch stainless steel Vernier protractor. The Vernier reads to one minute.***

Fig. 319 ***Spring bow sets.***
The set on the left is an ***A G Thornton 'Minerva Series' on****e. Both legs have detachable points and there are two each of ink points, pencil points, needle points and lengthening bars. There is also a pen handle. It can be used as either a four inch or a six inch spring bow. It could also be used to draw double lines although I think the reason for providing pairs of ink and pencil points was so that one could be used in the pen handle whilst its counterpart was in the compass.*

The set on the right has an English faux Morocco case but the spring bows are by ***Schoenner*** *and are*

Fig. 320 ***A G Thornton 'Minerva Series' set in a metal case. The case and all the instruments and their parts in the tray are numbered '324'.*** *Oddly there is no pocket for the lengthening bar, which rests in the long space at the back of the tray. The boxwood scale rule is an Armstrong type.*

In the base are some French curves, a small universal set square, a circular protractor and the clinograph seen resting on the lid lining. *All are celluloid and the underside of the tray is quite rusty as a result of the slow decomposition of the celluloid. It is likely that some of these items will begin to disintegrate soon.*

Fig. 321 ***Set of four 12 inch boxwood chain scales signed Elliott Bros., 449 Strand, London in a leather and card case. Like many scales these have the original owner's name stamped on the reverse. The maker would do this for a small extra charge.***

Fig. 322 ***Set of five 8 inch boxwood architect's scales signed Reeves & Sons, Cheapside, London in a leather and card case.***

Fig. 323 ***Compensating planimeter by R & A Rost, Vienna dated 1967. Serial No. 16204. Black leatherette covered, red velvet lined case, calibration chart and checking bar. The planimeter has a grey crackle finish.***

Figs. 324/5 ***Camera Lucida (Chambre Claire Universelle) made in France and imported by Lechertier Barbe Ltd., 95 Jermyn Street, St. James's, London SW1. It is made of brass and has eleven of its original twelve lenses remaining. Complete with instruction leaflet. Probably 1920s.***

Fig. 326 ***W H Harling patent cone fitting set comprising patent cone fitting compass with ink, pencil and plain points, and lengthening bar; pen handle; ink and pencil spring bows.***
These brass instruments in a simple mahogany box were designed for school use. They are robust and serviceable, yet they were cheap to produce.

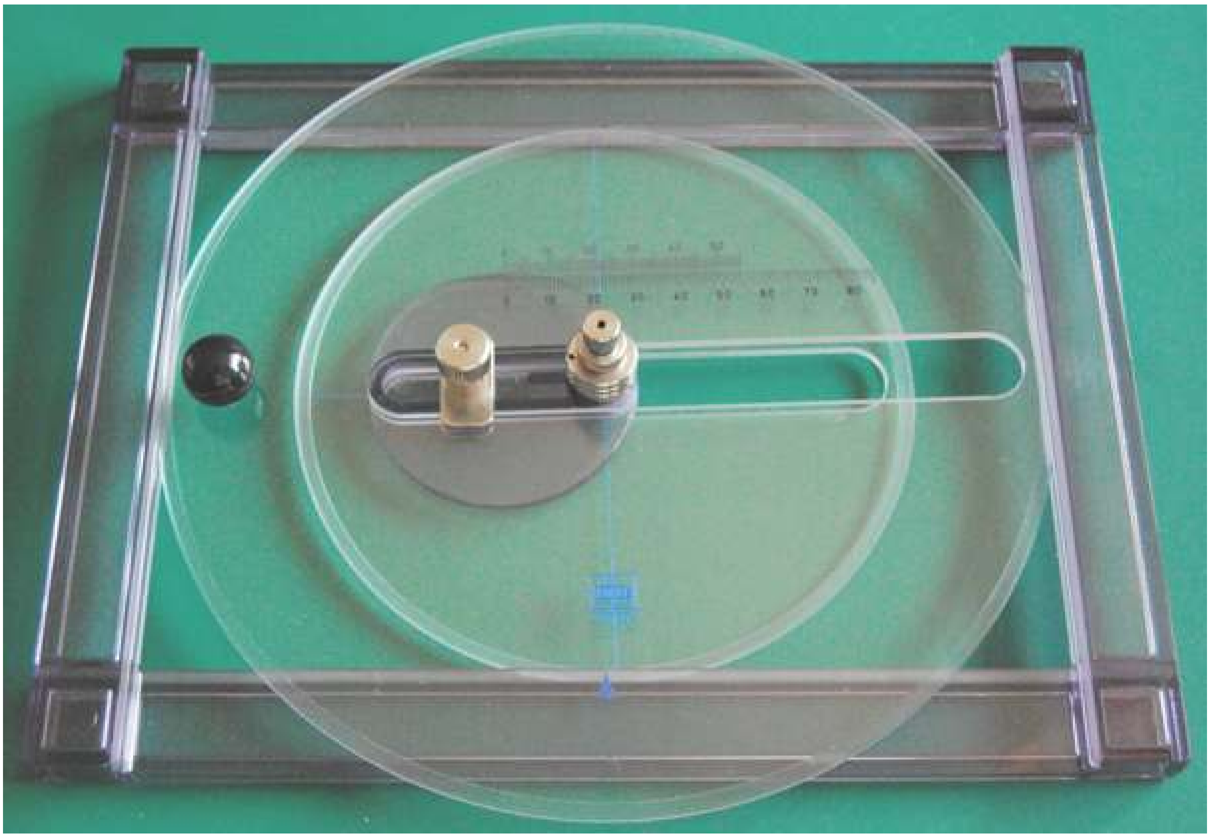


Fig. 327 ***Haff ellipsograph.***

Haff Ellipsograph Nr. 97, made in Germany. Purchased new in 2009. This is a true ellipsograph and works on the same principle as that devised by John Farey in 1810. It is shown with the pencil lead holder in place, but can also be fitted with a technical pen, such as the Rotring Variant.

Fig. 328 ***Stanley Government Standard Pattern set in a Perma case.***

Whilst this set has carbon steel parts it was also available with all the steel parts in stainless. This set is dated 1937. Stanley also sold "Hand Made" pattern sets in Perma cases.but they only produced the one size of case in this material for drawing instruments.

Fig 329 ***W F Stanley oak magazine case***

This was my first departure from my £300 maximum rule. Bought at auction for a hammer price of £600, fees, VAT and transport brought the total cost up to £800 for this well used but nearly complete example.

The upper tray is full of electrum and ivory drawing instruments that include, besides the usual compasses and pens found in the smaller sets, a triangular divider, Swiss pattern beam compass fittings, a nine inch proportional divider, a road pen, a dotted line pen, a tracer and a pen fitted with an index wheel. The large compass is also a special one normally only found in the larger sets, that has two detachable legs and both type A and type B needle points. It is missing the second extension bar.

Fig 330 ***Stanley magazine case trays***

The upper picture is a more detailed view of he upper tray. The lower picture shows the second tray. In the rear compartment are six scales, forur of which are ivory and carrying the original owner's name. The middle compartment houses the 12 inch electrum parallel rule over three sub-divisions, one containing a felt covered block covered with drawing pins, the middle one housing ivory rectangular protractors and a sector, and the right hand one containing keys. The front compartment houses some extra items and two items that have since been removed - a very stained, ivory handled, hatchet seal and an ivory handled pen machine for cutting and trimming pen quills (a valuable bonus).

Below the trays is a space housing squares and protractors.

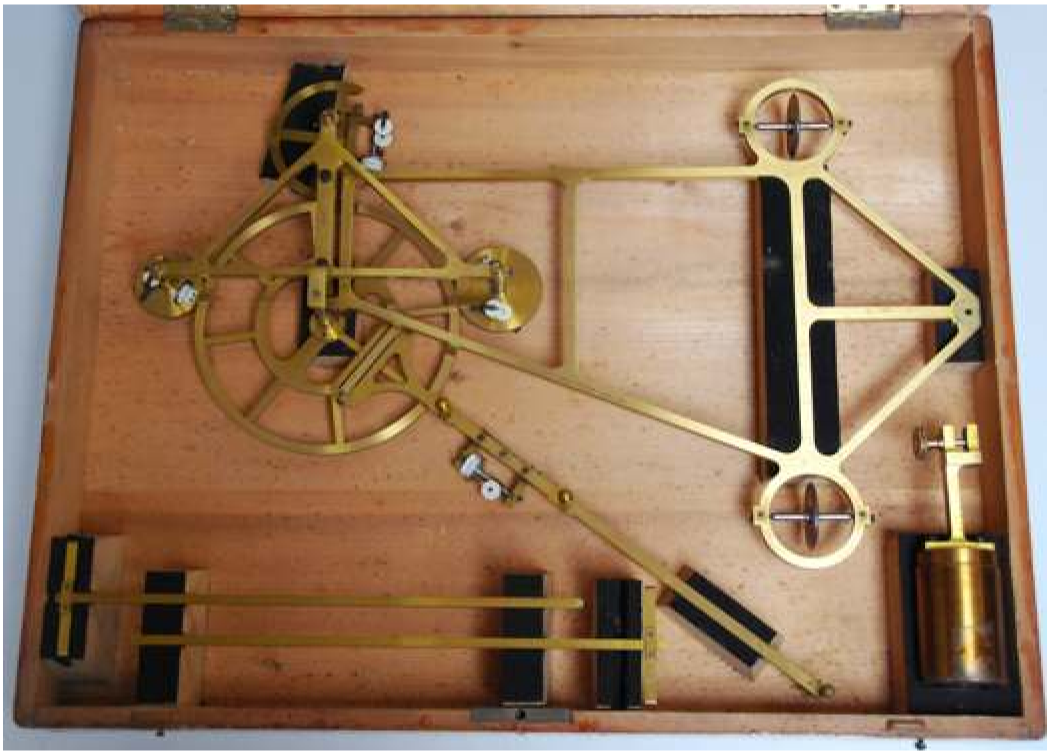
The drawer contains a set of ten water colours, a selection of paint brushes, erasers (fibreglass, rubber and steel), a box of Faber's pencil leads and a stick of India ink. It would also have contained a palette that is now missing.

Fig 331 ***W F Stanley Intergraph no. 106***

It is complete with pen point, pencil point and weight, container of spare leads, screwdriver, lead pusher, magnifier, and a brush. This example has clearly seen very little use, if any, as the lead container still has many unused leads in it, the pen appears not to have been used at all, and neither point fitted into the plotting arm tube until I reamed it. It is missing the handbook that would have been supplied with it. This metric version is listed in the 1958 catalogue as type A8606.

The integraph was used to evaluate definite integrals by tracing the function plot. It would at the same time plot the integral curve. This in turn could be traced to determine, for instance, the centre of gravity and plot the second integral curve. The process could then be repeated again to find the second moment of area (also known as the moment of inertia).

This was my second large purchase, costing £500, from a private seller(website contact).



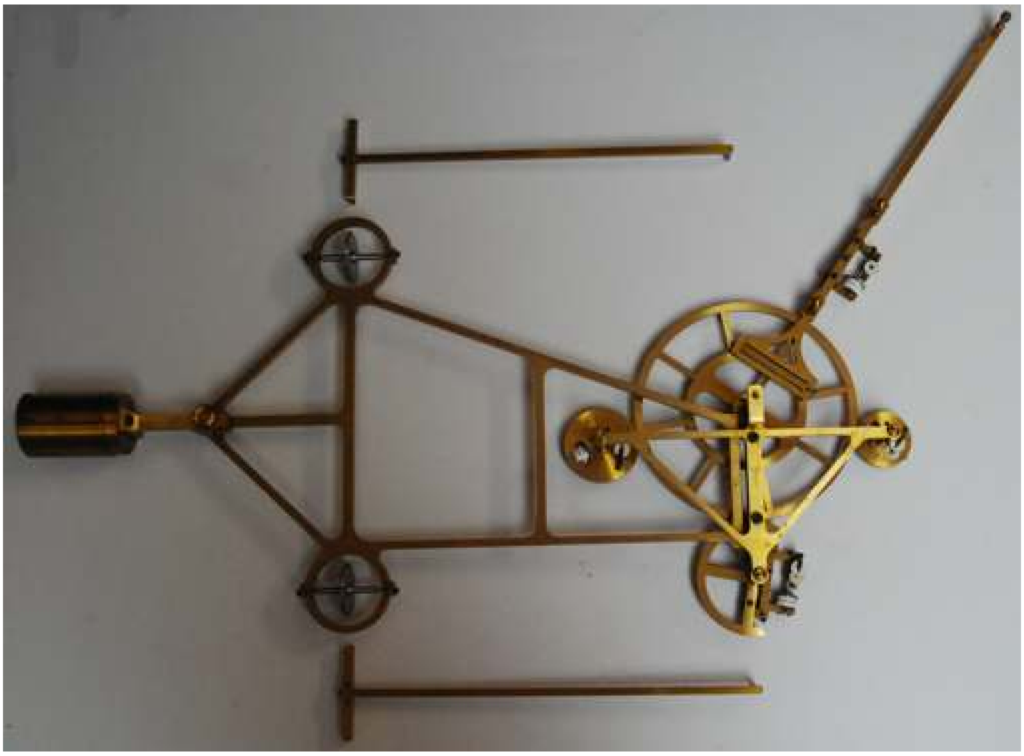


Fig 332 ***Amsler No 4 Integrator***

Amsler No 4 Integrator No 680 sold by W F Stanley and then in 1958 repaired and adjusted by them Stanley further tested and calibrated the instrument in 1959 according to accompanying documents.

This large, four roller, instrument measured the area, first moment, moment of inertia, and the moment of the 4th order. It would originally have had a 78 inch rail, now missing. In 1916 it would have cost £37 12s (ref. Thornton catalogue).

This was originally owned by a Scottish shipbuilding company.

It was my third large purchase, costing £750.

Glossary

Adjustable Set Square - A set square on which the hypotenuse is a movable arm, which can be set to any angle. *See Figure 58.*

Armstrong Scale - A double sided scale rule with a standard set of eight scales, two to each edge, used by architects and engineers. *See Figure 66.*

Beam Compass - A form of drawing compass in which two heads, to which ink, pencil or divider points can be fitted, are mounted on and moveable along a beam, for drawing large radius circles and arcs. *See Chapter 3.*

Block Nib Pen - A drawing pen in which the two blades are soldered into a brass block. *See Figure 34.*

Border Pen - A drawing pen with a heavy, three bladed nib used for drawing thick lines. *See Figure 81.*

Bow Compass - A form of small compass, usually having a handle, for drawing small circles.
See Figures 12 to 15.

Camera Lucida - An instrument which is used to aid sketching an object, such as a building, by making the drawing and the object coincident. The drawer views the drawing and object through a special prism on a telescopic arm. *See Figures 324 & 325.*

Centrolinead - An instrument used for perspective drawing when the vanishing points are off the board.
See Chapter 4.

Chain Scale - A form of scale rule on which the scales are in the form of X (links) per inch, used for plotting survey measurements made with a Gunter's chain, which is 66 feet long and consists of 100 links. This method of land measurement is known as 'chaining'. Sometimes the scale would be divided for X links per inch on one edge and the equivalent feet on the other.

Click Pen - A form of spring blade drawing pen in which the upper blade is released by a sliding catch. *See Figures 224 & 225*

Clinograph - An early form of adjustable set square patented by Harrison. *See Figure 56.*

Clutch Pencil - A form of drawing pencil with replaceable leads held by a clutch that is released either by a push button or by twisting. *See Figure 127.*

Compass - An instrument for drawing circles. *Each of the many types is separately listed.*

Compass Half Set - A compass, usually six or four and a half inches long with detachable ink, pencil and divider points, a lengthening bar, and often a knife key. *See Figure 5.*

Copenhagen Ship Curves - *See Ship's Curves*

Cross Joint Pen - A drawing pen in which either the upper or lower blade pivots, usually about the adjusting screw, to open for cleaning. *See Figure 200.*

Crow Quill Pen - An ordinary writing pen with a small nib used for fine lettering on drawings.
See Figure 90.

Curve Pen or **Curved Line Pen -** A drawing pen having a cranked nib, which can usually be released to swivel freely about the handle, for drawing curved lines. *See Figure 85*

Detail Pen - A broad nibbed drawing pen. *See Figure 83.*

Dotted Line Pen - A drawing pen with a serrated wheel fed with ink for drawing lines of dots and/or dashes. They were frequently supplied with several wheels for different line patterns. *See Figure 81.* There were also **Mechanical Dotted Line Pens.**

Drawing Pen - A pen, usually consisting of two blades, the distance apart of which can be adjusted, for drawing lines of a specific thickness. *See Figures 18 and 19.* Also called a **Ruling Pen.**

Drop Bow Compass - A form of compass for drawing very small circles, also called a **Rotating Compass.** A rod extends from the handle to the point, about which the rest of the compass can move up and down and rotate. *See Figure 280.*

Eidograph - An instrument for copying, enlarging or reducing drawings. *See Chapter 4 and Figure 149.*

Ellipsograph - An instrument for drawing ellipses. *See Chapter 4.*

Elliptical Trammel - An instrument for drawing ellipses.

Eraser - an item or device used for removing ink or pencil marks from a drawing, such as a block of rubber, a type of knife, a fibre glass pencil, or a mechanically rotated piece of rubber.

Etui - A form of pocket case in which the the instruments are stored in vertical pockets. *See Chapter 2 Figures 28 and 32.*

Excentrolinead - An instrument used for ruling lines inside a circle which do not pass through the centre, such as the edges of the spokes of a wheel. *See Figures 160 & 161.*

Flat System - A pattern of metal drawing instruments patented by E O Richter in 1892, which became the norm in the mid 20th century. *See Chapter 6.*

Folding Arm Protractor - A circular protractor having two arms with pricking points on the ends,which unfold outwards, often used for plotting theodolite readings. Also called a **Plotting Protractor**. *See Chapter 3 and Figure 42.*

Framed Set Square - A set square in which the three sides are made from separate pieces of wood, joined at the corners. *See Figure 55.*

French Curves - Also called **Irregular Curves.** Curves of varying radius, in a wide range of designs, used as templates for drawing curves. *See Figures 75 to 77.*

Folding Square - A type of square, usually made of brass, frequently included in French sets in the 18th and early 19th centuries, which folds about a diagonal hinge. *See Figure 174.*

Full Set - A set of instruments comprising a compass half set, divider, three spring bows, two bow compasses, two pens, and sometimes a pricker. *See Chapter 1.*

Graphos Pen - A patent type of pen used for lettering and freehand work on drawings. *See Figure 91.*

Hair(spring) Divider - A divider in which the point on one arm is attached to the leg by a length of spring steel, or in which the arm is split to form a spring so that the opening can be finely set by a screw.

Ink Point - The detachable part of a compass that ends in a pen.

Irregular Curves - *See French Curves.*

Isograph - A form of jointed rule used against a T square for drawing lines at an angle. *See Figure 57.*

Knife Spring Pen - A form of lifting nib pen in which the upper blade is held open or closed by a knife spring. *See Figures 224 & 225.*

Lead Holder - A form of drawing pencil with replaceable leads, such as a **Clutch Pencil** or a **Propelling Pencil.** *See Figure 127.*

Lengthening Bar - A bar used to lengthen one or both legs of a drawing compass.

Lifting Nib Pen - A drawing pen of which the upper bade is hinged at the base to open upwards for cleaning. Also called a **Hinged Nib Pen**. *See Figures 19 & 185*

Litho(graphic) Pen - A drawing pen with specially toughened nib for drawing on lithographic stones. There were also special, robust, **Lithographic Compasses**.

Long Joint - A form of compass head joint used on English compasses in the Georgian period. *See Figure 35.*

Marquois Scales and Triangle - A set of two robust scales and a right angled triangle with the hypotenuse three times the length of the shortest side used for military sketching. *See Chapter 3 and Figure 59.*

Master Bow - A large form of spring bow, often with interchangeable points and a lengthening bar. *See Chapter 6.*

Mechanical Dotted Line Pen - A dotted line pen in which the pen nib is lifted up and down by a cam wheel as the pen is pushed along, thus producing an intermittent (dotted) line. They were usually supplied with several different cam wheels. *See Figures 267 & 279.*

Napier Compass - A form of folding pocket compass with turnabout points on both legs so that it could be used as an ink or pencil compass, or as dividers. *See Figures 95 and 96.*

Needle Point - The detachable part of a compass that holds the needle. *See Figure 6.*

Opisometer - An instrument for measuring the length of curved lines. *See Figure 132*

Pantograph or **Pentagraph -** An instrument for copying, enlarging or reducing drawings. *See Chapter 4.*

Parallel Compass - A drawing compass in which the legs are connected to a parallelogram linkage to keep the points perpendicular to the paper. *See Chapter 7.*

Parallel Rule - An instrument used for drawing parallel lines, which could be walked or rolled across a drawing. There are two basic types, the **Bar Type** with two or three parallel bars joined by links, and the **Rolling Parallel Rule** with a roller mounted through a base plate. *See Chapter 3*

Pencil Point - The detachable part of a compass that ends in a holder for a pencil or pencil lead. *See Figure 8.*

Plain Scale - A form of scale rule found in Georgian and Victorian drawing sets. *See Figures 36 to 38*

Pillar Compass - A form of pocket compass that was effectively three compasses in one. It could either be configured as a large compass or divider, or as two small bow compasses, one ink and one pencil. *See Figures 92 to 94.*

Planimeter - An instrument for measuring an area on a plan or drawing. *See Chapter 4.*

Pricker - An instrument with a needle at one end used for pricking through one drawing to another for copying drawings. *See Figure 20.* It could also be used as a **Protracting Pin.**

Proportional Divider - A divider with two arms, having points on both ends, pivoting about a screw mounted in a slider, which slides in slots in both arms to vary the ratio of the distances between the points on opposite ends. Used for copying drawings and plans to a different scale or for dividing a line into a number of equal parts. *See Chapter 3.*

Protracting Pin - A needle, concealed within the handle of a drawing pen, used for pricking off angles from a protractor. *See Figure 31.*

Protractor - An instrument for measuring or setting off angles. Several types exist which are separately described. *See Chapter 3.*

Quick Set Compass - A form of spring bow or master bow compass with a mechanism to release the adjusting screw for rapid setting to the approximate opening desired. *See Figure 233.*

Railway Curves - Curves of fixed radii, supplied in sets, used for drawing railway track plans. *See Figure 75.*

Rectangular Protractor - A protractor in the form of a rectangle, typically six by one and three-quarters inches in size. It has degree scales around three edges and a variety of other scales, typically diagonal scales and plain scales. *See Figures 21 & 22.*

Road Pen or **Railroad Pen-** A drawing pen with two nibs, the distance apart of which could be adjusted, for drawing a pair of parallel lines. *See Figure 81*

Road Pencil or **Railroad Pencil -** Similar to a Road Pen but with two pencil or pencil lead holders in place of the pen nibs.

Rotating Compass - *See Drop Bow Compass*

Round System - A pattern of metal drawing instruments patented by Sigmund Riefler in 1877.
See Chapter 6.

Ruling Pen - *See Drawing Pen*

Section Liner or **Sectioner -** An instrument for drawing evenly spaced lines, particularly lines to indicate sections on an engineering drawing. *See Figures 60 & 61*

Sector - A jointed rule used for calculating. *See Figures 23 & 24 and Chapter 1.*

Sector Head - A form of head joint used on English pattern compasses and dividers. *See Figure 7*

Set Square - A right angled **Triangle** used against a **T-Square** for drawing lines perpendicular to the T-Square and at angles to it. *See Chapter 3.*

Shagreen - The skin of a ray, polished and dyed, usually green, used to cover drawing instrument cases in the Georgian period. *See Figure 28*

Shark Skin - The skin of a ray or shark, usually dyed black, used to cover drawing instrument cases in the Georgian period. It is rough to the touch in one direction. *See Figure 32.*

Ship's Curves - Curves of varying radii used as templates for drawing hull lines and other curves on ship drawings.

Sketching Protractor - A special form of Rectangular Protractor used by the military in the field. *See Figures 47 & 48.*

Split Steel Pen - A type of drawing pen in which the blades are integral with the handle, which is split longitudinally, the two parts pivoting about a pin in the middle to open for cleaning. *See Figure 79.*

Spring Blade Pen - A drawing pen in which the upper blade is thinned near the root and made to spring open when the adjusting screw is removed or a small lever is rotated. *See Figure 180.*

Spring Bow - A form of compass in which the legs are held apart by the action of an adjusting screw against a spring. There are various forms, which can be categorised as **Steel Spring,** *see Figures 10 and 11,* **'C' Spring,** *see Figure 212,* and **Single Sided,** *see Figure 167.*

Station Pointer - A form of protractor with three long arms used for plotting sextant readings between landmarks on a chart to fix one's position, usually at sea. *See Chapter 4.*

T-Square - An instrument in the form of a T used to draw lines or act as a ledge, usually horizontal, which locates against the left hand edge of a drawing board, that edge being made specially hard and straight.

Telescopic Compass - A drawing compass in which either one or both legs telescope to increase the radius that can be drawn. *See Figures 100, 222 & 223.*

Tracer - A drawing instrument with a blunted agate or steel point used for tracing drawings. *See Figure 133.*

Triangle - An instrument used against a T Square for drawing lines at angles.

Triangular Divider - A divider with three legs for copying the location of three points from one drawing to another. *See Figure 138.*

Tubular Nib Pen or **Technical Pen -** A drawing pen with a tubular nib. Each nib would be for a particular line width. They could also be used for lettering with a stencil. *See Chapter 6.*

Tubular Telescopic Beam Compass - A beam compass with a beam made of different diameter tubes which telescope inside each other for storage. *See Figures 101 & 102.*

Turn-about Compass - A drawing compass in which paired points (e.g. ink and pencil) rotate about a pivot so that the compass can be used in different ways. *See Figures 99 & 100.*

Vernier Protractor - A circular or semi-circular protractor with one or two arms that rotate about the centre. The arm has a Vernier scale for accurate setting. *See Chapter 3 and Figures 43 & 44.*

Vertical Drawing Compass - *See Parallel Compass.*

Wing Compass and **Wing Divider -** A compass or divider with an arc shaped wing for clamping the setting.

Museums

United Kingdom

Museum of Science & Industry,
Liverpool Road,
Castlefield,
Manchester M3 4FP
https://www.scienceandindustrymuseum.org.uk/
https://collection.sciencemuseumgroup.org.uk/

Museum of the History of Science,
Broad Street,
Oxford OX1 3AZ
www.mhs.ox.ac.uk

National Maritime Museum,
Greenwich,
London SE10 9NF
http://www.nmm.ac.uk/

National Museum of Scotland,
Chambers Street,
Edinburgh EH1 1JF
http://www.nms.ac.uk/

Science Museum,
South Kensington,
London SW7 2DD
http://www.sciencemuseum.org.uk

Science & Society Picture Library (Science Museum)
http://www.scienceandsociety.co.uk/index.asp

The Museums Collection Centre,
25 Dollman Street,
Nechells
Birmingham B7 4RQ
www.birminghammuseums.org.uk

Whipple Museum of the History of Science,
Free School Lane,
Cambridge CB2 3RH
http://www.hps.cam.ac.uk/whipple/

France

Musée des Arts et Métiers,
60 Rue Réamur
75003 Paris
www.arts-et-metiers.net

Germany

Deutsches Museum,
Munich D-80306
www.deutsches-museum.de

Staatlicher Kunstsammlungen Kassel,
Bruder Grimmplatz 5,
3500 Kassel 1

Staatlicher Mathematisch-Physicalischer Salon,
Zwinger,
8010 Dresden

Italy

Museo Galileo
Piazza dei Giudici 1,
50122 Florence
www.museogalileo.it/en/collections.html

Instituto Geografico Militare,
La Bibiloteca,
Via C. Battisti,
10 - 50122 Florence
http://www.igmi.org

The Netherlands

Museum Boerhaave,
Lange St. Agnietenstraat 10
2312 WC Leiden
https://museumboerhaave.nl

Universiteitsmuseum.
Lange Nieuwstraat 106
3512 PN Utrecht
https://umu.nl

Russia

The State Hermitage Museum,
St. Petersburg
www.hermitagemuseum.com/wps/portal/explore/collections/Ing=en

Kunstkamera
3 University Emb.,
St. Petersburg
http://collection.kunstkamera.ru/en/

The USA

Adler Planetarium,
1300 South Lake Shore Drive,
Chicago 60605
http://www.adlerplanetarium.org/

National Museum of American History,
Smithsonian Institute,
14th Street & Constitution Avenue NW,
Washington DC 20560,
http://www.americanhistory.si.edu

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National Museums of Scotland, 1989
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Distributed by W W Norton & Company Inc., New York, 2010

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A History of Drawing Instruments in Britain 1600-1850
The Dawes Trust Ltd., 2009

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Yale University Press, New Haven and London, in association with Museum of the History of Science, Oxford and Yale Center for British Art, 2009

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Philip Wilson Publishers Ltd for Sotheby's Publications, 1988

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Heather, J F., MA — **A Treatise on Mathematical Instruments: Their Construction, Adjustment, Testing and Use Concisely Explained**
16th Edition, Revised with additions by Arthur T Walmisley

Crosby Lockwood & Son, London, 1906
Published in many editions from 1850. Later editions have an appendix with details of later instruments. Early editions (e.g. 2nd, 1851) have an Elliott price list at the back.

Pearsall, Ronald — **Collecting and Restoring Scientific Instruments**
David & Charles, Newton Abbot, 1974

Piedmont-Palladino, Susan C — **Tools of the Imagination, Drawing Tools and Technologies from the Eighteenth Century to the Present.**
Princeton Architectural Press, New York, 2007

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Bulletin of the Scientific Instrument Society No. 83, 2004 pp. 34-37

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Bulletin of the Scientific Instrument Society No. 94, 2007 pp. 10-13

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3rd Edition, John Weale, June 1st, 1847
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Kessinger Publishing, USA (print on demand reprint)
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https://wild-heerbrugg.ch

The history of Kern & Co, dating information, 'Milestones of Kern'
https://wild-heerbrugg.ch/historie/milensteine-von-kern

Study Collection Kern Aarau
https://www.kern-aarau.ch

Webster's Database of Instrument Makers
http://historydb.adlerplanetarium.org/signatures/

Collectors' Web Sites

My own website with many images of my collection
www.mathsinstruments.me.uk

Geometricum (M. Geissbuehler) A superb collection, especially of instruments by Swiss makers.
http://www.geometricum.com/

Museum of Obsolete Drafting Technology
https://www.moodt.org

Mathematical Instruments, Switzerland
https://www.mathsinstruments.ch/en/gallery

The Planimeter
http://whistleralley.com/planimeter/planimeter.htm

TCoCd Mathematical Instruments
http://www.tcocd.de/Pictures/Instruments/Instruments.shtml

Planimetrica
https://planimetrica.jimdofree.com/mathematical.instruments/

Societies and Groups

The Scientific Instrument Society
http://www.sis.org.uk/

The IO Drawing Instrument Group (a very useful Internet discussion group for collectors)
https://drawing-instruments.groups.io/g/main

Museums

Please see the Museums list for links.

Index

Drawing instruments have been an important design tool for thousands of years; examples exist from the ruins of Pompei, buried in the ash from the eruption of Vesuvius in the 1st century. Yet the advent of computer aided design in the late twentieth century has largely rendered them redundant for architectural and engineering drawing.

David Riches recognised that they were fast becoming obsolete as a tool of professional engineers and draughtsmen when he was an engineer in the defence industry, and in 1995 began collecting them. Since then he has collected over 500 cases of drawing instruments as well as many individual items and trade catalogues, and has extensively researched them.

In recent years the number of collectors has grown but until now there has not been a major work on collecting them. This book fills that gap and describes the instruments, their development since the eighteenth century, their makers and the different characteristics of those from each of the main manufacturing countries. It also considers the collecting itself and the care of the collection. Above all it is aimed at the ordinary collector with a finite budget and the instruments and sets described and illustrated are from the author's collection.