### Stereomicroscopes: Part 3

Introduction to Greenough Stereomicroscopes: Some Early Makers and 'Black' Models

R. Jordan Kreindler (USA)



Figure 38. Damaged IC seen through Greenough Microscope

### Background: The Greenough Microscope

As noted at the start of the last part of this paper, nineteenth century dissecting microscopes were usually simple microscopes. However, at the turn of the 20th century, there was an increasing demand for improved capabilities from scientists, who were then more frequently using microscopes for analyses. In response, microscope makers increased the size and complexity of their instruments.

A concurrent development, which has continued through today, is portable simple stereo binocular microscopes. Modern versions of these instruments are shown in Figs. 39 and 40. Fig. 39 shows a simple clip-on version, and Fig. 40 a full head-mounted version of a stereo binocular simple microscope. An earlier version of a simple stereomicroscope, the Collin's Lawson simple binocular dissecting microscope, was shown in Part 2.

With the development of the Greenough stereomicroscope (see below), capabilities took a significant step forward, but with further increases in size and weight. At the start of the twentieth century, dissecting microscopes changed from relatively small portables to bench top instruments, although smaller instruments were still available.

Figure 39. Simple clip-on stereo binocular microscope





Figure 40. Simple head-band mounted stereo binocular microscope with side-mounted LED illumination

### Greenough Stereomicroscopes

The new Greenough dissecting microscopes were initially designed as modifications to existing biological compound microscopes. These usually included larger stages, and greater working distance between object and objectives. They often saw the absence of substage assemblies, as most dissecting work was done using reflected, rather than, transmitted light.

The Greenough stereomicroscope was invented by American Horatio Saltstall Greenough. [As an aside, Mr. Greenough was the son of, the same named, Horatio Greenough, one of American's first sculptors, and influential art writer, to gain international recognition. His sculpture of George Washington, originally installed at the US Capital, is now on display at the National Museum of American History. His Uncle, Richard Saltonstall Greenough, also a famous sculptor, is perhaps best known for his greater than life-size, full figure, statue of Benjamin Franklin. The statue, Boston's first of an American, is in front of its Old City Hall, the second City Hall built there.]



Figure 41. Zeiss' Greenough Design c. late 1880s The Greenough stereomicroscope uses dual Porro prisms (named after inventor Ignazio Porro). These are used to provide erect images to the eyepieces from two light paths, which pass through the two adjacent objectives (of two adjacent microscopes), as opposed to the single objective designs of Riddell and Wenham.

Porro prism instruments are easy to identify, owing to the relatively large telltale right angle turn in the viewing path.

Greenough stereomicroscopes are still widely use today. They provide images of objects that are not reversed as is typical with compound high power microscopes (Wade, 1998). Their design is derived from the monocular compound microscope, but here with dual paired microscopes working in unison.

Mr. Greenough was living in Europe at the time he designed his stereomicroscope. He met Ernst Abbe, of the Carl Zeiss Company, at a hotel in the university city of Jena, Germany in 1886. Greenough drew a, now famous, diagram of his stereomicroscope for Dr. Abbe. At the time, Zeiss was possibly Europe's leading microscope maker, and the timing of the meeting was fortuitous. Ernst Abbe was the world's leading expert on optics, and had become Zeiss' partner about a decade earlier in 1875. Dr. Abbe owned about 45% of the Zeiss Company. He had the technical abilities to understand and improve Greenough's concepts, and was in a position to insure its development.

Greenough microscopes are designed for relatively low magnifications and long working distances. They are typically provided with the capability to adjust the separation of both binocular tubes to accommodate the interpupillary distance appropriate for individual users.

As Marvin Reimer notes (Reimer, 1962), [Greenough] stereomicroscopes are low magnification instruments of necessity. Two objects cannot occupy the same space simultaneously. So, there is a physical limitation on how close the objectives can come to each other. That is, at some point they can be brought no closer.

Although the concept for Greenough's microscope was presented to Dr. Abbe in 1886, it took some engineering modifications before Zeiss produced the first commercial Greenough stereomicroscope in 1897, Fig. 41. This was known as the *Greenough double microscope of Zeiss design*.

The Zeiss company has continued the Greenough design for over 115 years. Zeiss catalogs for its Stemi (<u>Stereomicroscope</u>) series use the tag line, "*Conceived by Greenough, Realized by Zeiss*".

A discussion, including engravings, of a slightly later Zeiss Greenough stand, and an engraving of its light paths can be found in The *Journal of the Royal Microscopical Society* (RMS), (RMS, 1898).

The illustration of this microscope, Fig. 42, shows its debt to the first Zeiss Greenough, Fig. 41. It includes changes such as a one-piece stand with substage mirror. It shows the hand-rests and relative dimensions of components of the microscope's body, and provides a link from the original Zeiss Greenough as it evolved to Zeiss Stands XA and XV, Figs. 43 and 46.



Figure 42. Fig 77 (RMS, 1898)

Fig. 43 shows a Zeiss, Jena stereo Greenough design about three decades later, c. 1930/31. Stand XA is one of the variations of Stand X which was sold in different configurations depending on use. Zeiss used the following designators for Stand X, **A** for upright (from German <u>a</u>ufrecht), **b** for boom, and **c** for <u>c</u>orneal stands.



To quote from the Zeiss catalog of 1934,

In these [Greenough] binocular image erecting microscopes, two complete tubes, each with one objective and one eyepiece and inclined at an angle of eight degrees to the perpendicular, are combined into a "double tube" ... [T]he observer receives a stereoscopic impression of the object, whilst the exit pupil is fully utilized. ... The instruments of this class are principally intended for dissecting purposes at low magnifications ... With the necessarily small numerical aperture of the objectives, magnifications exceeding 100 X must, however, be considered empty magnification.

- (Zeiss, 1934)

Zeiss notes that regardless of the configuration chosen for Stand X, all versions of this stand used the same double Greenough tubes (Zeiss, 1934). This Zeiss Greenough microscope, like the Bausch and Lomb Greenough of roughly the same decade, Fig. 51, is provided with removable, replacement objectives in its standard configuration.

Removable objective sets for Stand X were available in seven different objective magnifications. This Stand was also available, somewhat later, with a conventional-style triple turret, for purchasers comfortable with three magnification options. For these purchasers Zeiss modified this stand so that objective sets, shown here with Stand XA, could be used on a rotatable turret. Although this turret was, obviously, an afterthought and looks "tacked on", it allows magnification changes to be made without the need to remove and replace objective sets.

Stand X was designed primarily for dissecting, so it's no surprise that hand-rests are provided in the standard package. The example here comes with three pairs of objectives 4x, 8x, and 12x that are similar in size to the same objective magnifications on Zeiss's Stand XV, Figs. 45 - 47. There are three pair of eyepieces, two Huygens 7x and 15x, and a surprisingly high magnification, 28x orthoscopic, high considering the low numerical aperture of this stereomicroscope's objectives.

Thus, depending on the combination of objectives and eyepieces, there are nine different possible magnifications, although some combinations provide only empty magnification. Considering the non-availability of computer-design lens software at the time of its design, Stand XA provides surprisingly sharp images. It comes with a pair of angled wooden hand-rests, the proximal edge or each connecting to the sides of the microscope's stage and the distal edges resting on the same surface the microscope rests on.

It allows for both incident light and transmitted light via a 70mm substage mirror. However, an external light source is required for incident lighting. The microscope is stored in a purposebuilt wood case that holds the hand-rests, the three objectives pairs, and eyepieces. Stand X was manufactured from 1926 to 1942. Because of their intended use as dissecting instruments, it is usual for stereomicroscopes made in the first half of the 20th century to come with detachable "hand-rests", such as shown here. These hand-rests are typically made of metal and wood, and occasionally all metal.

The Zeiss microscope in Fig. 44 rests on a horseshoe base, and provides coarse focusing via rack and pinion, adjustable using either the left- or right-side knobs. Although this is a Greenough stereomicroscope, it is apparent from its stage clips, stage opening, and substage mirror that its design owes much of its heritage to the biological binocular compound microscope. It has a relatively large and rotatable circular substage plate (not visible in the photo) that provides options for opaque white and black backgrounds, and an opening containing a short open cylinder to hold a condenser or other lens, as is common in biological microscopes. The Zeiss' 1934 catalog (Zeiss, 1934) shows Stand X with a slide on its stage, lending further support to assumptions of its biological compound microscope heritage.

This microscope in its case with accessories weighs 16 pounds 9 ounces, and without its case 7 pounds 2 ounces. It is approximately 13 inches tall as shown, and with its hand-rests attached about 19 inches wide. Clearly, this was designed as a bench top instrument, rather than for field use.

The relatively low magnification of stereomicroscopes is accompanied by relatively low resolution, compared to higher power compound microscopes. However, this resolution loss is not an issue as more of an object is seen. That is, resolution reduction is balanced by an increased field of view.

### Some Early Greenough Makers and Their Models

"Early" could be defined chronologically as e.g., before 1950, or in conjunction with some event such as WWII. Here I use 'early steromicroscopes' to refer to black stereomicroscopes. Later models most frequently used colors, other than black, e.g., beige, gray, brown, etc. Therefore, color is an excellent, but not assured, way to discern quickly whether a model is early or later. Perhaps more importantly, it can be used as a "best guess estimate" of optical capability, as most black microscopes lack the computer designed lenses of more modern instruments. Thus, buyers should consider black instruments primarily as collectibles, as these likely would not perform up to modern professional standards. However, some early models come very close optically, and some are considerably better mechanically than more modern instruments using plastics.

Instruments of more modern design are discussed in later Parts of this paper. The prices asked for earlier black stereomicroscopes can be greater than the prices asked for instruments that are more modern. That is, prices are not, by themselves, an indication of optical or mechanical quality.

#### ZEISS

Zeiss continued to make Greenough stereomicroscopes after their introduction in 1897, and still makes them today.

Fig. 44 shows a Zeiss Stand X, similar to that of Fig. 43. However, here the Stand has a triple turret, to allow easier magnification changes. This model had one of the earliest turrets made for Greenough microscopes. The turret here is thin and requires care in changing magnifications to avoid bending the assembly. This potential problem was eliminated by Zeiss in later models.



Figure 44. A Zeiss 'Double tube X with revolving nosepiece', c. 1935.

A contemporary Zeiss catalog notes,

If the observer can always make do with as few as three paired objectives, a still more rapid exchange may be had by arming the double tube X with the triple revolving nose piece ... In this case, all that is necessary is to turn the disk of the nosepiece in order to swing any pair of objectives into line with the axes of the double tube.

If the revolving nosepiece is to be employed, room must be provided for it by a recess in the prism body. The revolving nosepiece cannot be used with a double tube not having the recess.

— (Zeiss, 1937)

Although the turret design is somewhat delicate, this model is fully functional and the arrangement provides exceptional images. The inserts in Fig. 44 show this turret from above and below, illustrating both its flexibility and fragility. The turret, in addition to providing magnification changes using the mounted lens sets, allowed for the removal and insertion of objective lens pairs on dovetail sliders, offering magnification options beyond those available with the originally installed sets. These objective pairs were similar to the objective sets in the single magnification Stand X of Fig. 43, i.e., a variety of magnification choices were available.

Below the stage, of Fig. 44 is a large circular rotating disk providing three backgrounds: a black or white background for incident illumination, and a cylindrical opening for transmitted illumination. To reflect transmitted light the microscope has both plane and convex substage mirrors. The short, open cylinder for transmitted light allows for the insertion of a lens or condenser in the light path. This arrangement again demonstrates the heritage Stand X, and other relatively early Greenoughs, owe to the biological compound microscope.

This microscope could be used for dissecting with the attached hand-rests, but with its multiple magnifications it was, perhaps, most commonly used as a general-purpose instrument.

Perhaps the penultimate of the early black Zeiss stereomicroscopes was the Zeiss Stand XV.



Figure 45. Zeiss Stand XV objectives detail

Greenough-style stereo instruments use paired dual microscopes, each with their own objectives. Thus, the standard-style nosepiece, used on a traditional compound microscope, when used on а Greenough stereomicroscope has larger а diameter to hold the dual objectives needed for each magnification change. In spite of these size considerations, a number of companies used traditionalstyle turrets.

The Zeiss Stand XV, c. 1930s, uses a standard-style quadruple turret with four pairs of objectives, Fig. 45. It is a quite large instrument. It is also one of the most fascinating examples of a Greenough-style of stereomicroscope.

As expected, this turret design on a stereo instrument makes the microscope's width significant, and gives it a unique and unmistakably attractive appearance. There were only 730 copies of Stand XV made between 1934 and 1942 (Gubas, 2008, 2012). In addition, some Stand XVs were destroyed during World War II, and lost to natural attrition over time, so this model is relatively rare.

With its metal hand-rests attached, the Stand XV's stage and hand-rests are somewhat reminiscent of a Klingon *Bird of Prey* warship from the TV and movies series *Star Trek*, Fig. 46. While developed for function, this Stand is also an attractive work of modern art and design.

The example shown here has four pairs of objectives with 2x, 4x, 8x, and 12x magnifications. It comes with two sets of eyepieces, 8x and 12x. It is housed in a wood case with built in storage areas for the microscope, its hand-rests, stage plates, and extra lens sets.

On page 19 of the Zeiss catalog of 1937 (Zeiss, 1937), here Fig. 47 (left), there is an engraving of this model with accessories and attached electric illumination, where this model is identified as a *Stereoscopic Dissecting Microscope Stand XV*. In Fig. 47 (right) there is a copy of a page from an old CZJ Technical Handbook, discussing this microscope and presenting the same engraving in smaller format. Here the microscope is identified in German.

With its clean lines and rectangular non-horseshoe base, this model was a precursor of things to come.





Figure 47. Engraving of Zeiss Stand XV, and page describing this microscope from old CZJ handbook. Both are shown courtesy and with permission of Carl Zeiss Microscopy, LLC

Stand's XV's unenclosed objectives, Fig 45, which are similar to other contemporary manufacturer's models, possibly made them less stable than the enclosed, and better structurally supported, later objective pairs that followed, e.g., Fig. 48. However, my Stand XV's objective sets show no signs of instability.

Perhaps, because of its large size, relatively high price, and limited sales, Zeiss discontinued production of the Stand XV after the war.

### Well-Known Greenough Stereomicroscope Makers

Although Zeiss introduced the Greenough, other makers followed quickly. These relatively early 20th century stereomicroscopes closely followed Zeiss' Greenough design and were popular, as can be confirmed by the extensiveness of contemporaneous advertisements, and the number of these instruments available today on the used market.

#### American Optical (Spencer Lens Company)

The American Optical (AO) Company and the C. A. Spencer & Sons Company started as independent entities. AO began in 1833 as an eyeglasses manufacturer in Southbridge, Massachusetts. Charles A. Spencer began in the late 1930s as, perhaps, the earliest successful American microscope manufacturer, working initially out of Canastota, New York and after a number of moves out of Buffalo, New York. New York State was also the home of the Bausch and Lomb Optical Company. In 1935, AO bought the Spencer Lens Company, and after this purchase, many of their microscopes carried the AO Spencer designation, eventually changing to simply AO.

Figs. 48 - 50 show three black American Optical (AO) stereomicroscopes, two Models 25s and one model 27.

The first Model 25 has objectives with magnifications of 2x, 3x, and 4x, although the markings on the turret indicate 1x, 2x, and 3x (i.e., here the 4x objective is in the 1x position marked on the turret). The example here was obtained with 9x and 12x eyepieces. It is approximately 14" tall in use. Its body is shiny black with aluminum-toned fittings. It has, as might be expected for microscope that might be used for dissection, two 3-3/4" long metal stage mounted hand rests.

The second Model 25, has a slightly different textured paint finish and also has provisions for three objectives. Here only two are present, a 0.7x, and a 2x. The 0.7x objective is in the position marked on the turret for 1x. This stereomicroscope was obtained with 15x eyepieces, one of the two default options. There is only a single dioptric adjustment mechanism on the left eyepiece tube. This is similar to the earlier Model 25. If the detachable horseshoe base for providing transmitted light is not present, then this microscope was referred to by AO as a Model 26.

Models 25 and 26 could be obtained with either vertical or inclined binocular bodies. Here inclined bodies are shown. These models could also be provided with single, dual, or triple nosepieces.





Model 27 has a fixed magnification and clips under the objective to hold a protective glass cover. These clips are often mistaken as available to hold slides, i.e., as slide holders. However, as these clips move with the focusing adjustment mechanism, they cannot serve that purpose.

Unusually, this model has two independent rack and pinion focusing mechanisms and a locking knurled screw, these options allow for a significant variation in height. The fixed objectives available were 1x, 2x, and 3x. The default 10x eyepieces 10x allow magnifications for this model of from 10 - 30x. Working distance for the above objective options was 89mm, 70mm, and 48mm respectively.

Later variations of Models 25 – 27 came in a combination of colors, including some without black.



#### Bausch & Lomb

The Bausch and Lomb (B&L) Greenough microscope in Fig. 51 is shown here with two pairs of detachable and exchangeable objectives. [Notice the B&L design is similar to the first Zeiss Greenough.]

In 1929 the price of this B&L microscope with one pair of 40mm objectives and 10x eyepieces was USD \$126, with a second pair of objectives \$149.50, and with a set of three paired objectives \$177.50.

To provide a sense of the size and weight of these early Greenough designs, the B&L Greenough Microscope shown in Fig. 51 is, approximately 13" tall and weighs 9 pounds. It comes with a substage mirror for transmitted light. As with the Zeiss models discussed previously, external illumination is required for lighting.

To assist in size and weight comparisons, it is helpful to compare this B&L to an early J Swift and Son brass stereomicroscope of the Riddell-Stephenson design. The Swift stereomicroscope, based on the Riddell-Stephenson design, preceded this B&L by almost three decades. The Swift microscope is approximately 14-1/2" tall and weighs 6 pounds 11.8 ounces, i.e., taller, but lighter, than the B&L stereomicroscope shown below.





Fig. 52 is a photograph through the microscope in Fig. 51, with 55mm objectives mounted. It shows a portion of the Treasury seal on a U.S. one dollar bill. It represents one of the applications, i.e., checking for counterfeit currency, for which these microscopes were used.

As can be seen from the picture, images through this, over 80 year old, microscope still come into sharp focus, with good contrast, and are reasonably flat across the full field of view.

Bausch and Lomb also marketed a range of stereomicroscopes using drum-like turrets rather than the replacement objectives option of Fig. 51 in some 'K' style stereo instruments. These were available with either tilted or untitled body tubes Figs. 53 and 54. Allen (Allen, 1940) shows pictures of some B&L K style stereomicroscopes. These instruments were sold for, perhaps, three decades, with only modest changes over time.





#### Beck

The English manufacturer Beck, has a microscope heritage which can be traced back to Victorian monocular brass microscopes, and to stereomicroscopes of the Wenham prism design. A Beck Greenough stereomicroscope is shown in Fig. 55. The microscope shown came with three pairs of Beck eyepieces, two low power versions, and one high power example. The microscope also includes a clear glass plate, shaped identically to the semi-opaque plastic plate shown in the Figure. This is a relatively small microscope. It is approximately 10" tall in working position, and weighs 5 pounds, 2.2 ounces. It images, size and weight make it suitable for use in the field. It has a jug handle stand (particularly popular in the 1st quarter of the 20th century, but also found on some later microscopes), its body design closely follows that of early Greenough models.



#### Nikon

One of the first, if not the first, Nikon stereomicroscope was their 1954 SM, Stereo Microscope, Fig 56. It does not appear to have been sold in the US market. Its three objective pairs are moved into place by two large, 43mm (1.7 inches) knurled knobs of the sides of the body. The magnifications are marked 6/10, 15/24, and 40/60. The first number of the pairs is in black and the second is red. The three magnifications depend on the eyepieces. The example shown here is equipped with 20x eyepieces. The SM has an approximate working distance of about 82mm (3.2 inches), and the FOV at the lowest power is about 16mm (0.63 inches). In use, the SM is about 13-3/4 inches (34.9cm) tall. It weighs about 6.07kg (13 pounds, 6 ounces).

It is interesting that this stereomicroscope c. 1954, like its predecessors, has attachment screws for the use of hand rests for dissection.



### Reichert

One of the premiere European makers in the 20th century was Reichert of Austria. Later, along with AO, B&L, Leitz, Zeiss, etc., they became part of a larger Leica holding company.

Carl Reichert of Vienna founded his Optische Werke company. c. 1875. He learned the trade while working for Ernst Leitz, and married into the Leitz family. He then moved to Wien (Vienna) and opened his own company. This possibly explains the strong congruence between early Leitz and Reichert designs.

One of Reichert's Greenough stereomicroscopes c. 1930 is shown in Fig. 57. This microscope provides for removable and replaceable objectives pairs and substage illumination. It is non-tilting and so is less comfortable to use than some other stereomicroscopes, but it provides outstanding images.

This Reichert stereomicroscope is relatively heavy, weighing in at almost 9 pounds. It is about 13" tall in working position. It is, thus, quite similar in specifications, e.g., size and weight, to the c. 1929 Bausch and Lomb Greenough microscope shown in Fig. 51. This similarity also includes the use of "remove and replace" objective pairs to change magnifications, the presence of a substage mirror, and the "straight down" viewing angle. This Reichert provides sharp images, but with a limited field of view.



### Lesser Known Early Makers of Greenough Microscopes

In addition to the better-know quality makers who manufactured Greenough stereomicroscopes there were a number of lesser-known makers whose production was none-the-less to a high standard. These include Beck Kassel (CBS), Hertel & Reuss Optic, Watson, etc.

#### Beck Kassel CBS (Chistoph Beck and Son)

Beck Kassel CBS was founded in 1892 by Georg Christoph Beck (or simply Christoph Beck) in the home of his parents. He and his sons later went on to made microscopes, stereomicroscopes, binoculars, and other optical instruments.

In 1918 the company was concentrating on the production of binoculars. By the late 1930s, Beck Kassel CBS had made over 50, 000 binoculars. Early in 1944 they changed the company name to Chr. Beck und Söhne KG, although it appears the name Beck Kassel CBS would continue to appear on their production.

Under the ownership of Christoph Beck and Franz Beck, the Company produced both telescopic sights and binoculars for the German Army during WWII, and consequently, their factory was destroyed c. 1944. They were out of business for about 4 years. After the end of the war in 1945, they returned to producing, primarily, binoculars in 1948. In 1972, Beck und Söhne KG Kassel medical microscopes were still advertised.

Some decades later, the manufacture of inexpensive Asian made binoculars took its toll on the company. Beck Kassel CBS made higher-end binoculars than those typically made in Asia at the time. However, the Asian products proved impossible to compete with, on what was essentially a non-level playing field. In the early 1980s Beck Kassel CBS produced its last instrument, and closed its doors.

The CBS stereo microscope in Fig. 58 has a single pair of 10x PK eyepieces and a single pair of 4x objective pair. The objective pair is on a slider and so can be easily interchanged for other magnifications. It is provided with 10x eyepieces, and a single dioptric mechanism on the right-hand eyepiece tube.

The microscope is about 12" (30.48cn) high in use, and weighs about 7 pounds, 14 ounces. The body is a shiny black while the transmitted light substage is a textured black. By use of the rear knurled screw, the body can be separated from the substage and used as an incident light only instrument. The microscope is shown with a watch plate on the stage as it can be used with liquid subjects. The presence of a smaller concentric circle below the level of a clear stage plate allows for the insertion of a reversible black / white substage background plate.

As with e.g., Olympus and Meiji today, Beck Kassel CBS made fixed and turret models of essentially the same microscope. The microscope in Fig. 58 has a single pair of 10x PK eyepieces and two pair of objectives, 2x and 4x. The objectives are selectable via a less common, for its time, drum turret that rotates orthogonally to the stage plate.

This microscope has a working distance of about 2-1/4" (57.15mm) with the 2x objective lens. Using the 2x objective its field of view is approximately 1/4" (6.35mm). It weighs about 8 pounds 3.6 ounces. It, as the fixed objective CBS microscope discussed first, has a shiny black body and a textured black substage.

By the presence of the stage with stage clips, and the substage mirror for transmitted illumination, along with the design of its frame and horseshoe base, this microscope clearly shows its standard compound microscope heritage.

Fig 59 shows a similar model with a vertically rotating turret.





### Hertel & Reuss Optik

Hertel & Reuss Optik was headquartered 67 at Quellhofstrasse, Kassel, Germany. The company was founded in 1927, by Otto Hertel and Eduard Reuss. In the 1970s they had between 250 and 400 employees. The H&R example shown in Fig. 60 has two pairs of eyepieces marked 'a' and 'b', rather than with their magnifications, 6x and 12.5x.

It also has two pair of interchangeable objectives, 2x and 4x. The microscope weighs about 6 pounds 2.6 ounces. It has a working distance of about 2", a height of about 13", and a field of view of about 5mm using the 2x objective.



Figure 60. Hertel and Reuss, Kassel, Germany, Greenough stereomicroscope

### Watson Barnet

(Watson Barnet is now a subsidiary of Pye Instruments Group, which is majority owned by Philips)

William Watson founded his company in c. 1837 at City Road, Clerkenwell, London. However, according to Bracegirdle (Bracegirdle, 1996), the first Watson microscope was not made until 1876, at which time the company was known as W. Watson & Son, and located at 313 High Holborn, London. The name was later changed to W. Watson and Sons, after a second son became part of the company. The company was still located at the 313 High Holborn address. William Watson died in 1881 and the last Watson microscope was made c. 1970.

The company initially gained renown with their non-stereomicroscopes, the well-made Van Heurck models, with two rack and pinion mechanisms allowing English or Continental length microscope tubes to be used. These models included the Grand Model Van Heurck, the Royal, and the No. 1. The Circuit Stage, and Club are usually considered belonging to this group. These instruments were based on the designs, and named for, the famed Belgian microscopist Henri Van Heurck .

To quote a company catalog,

The distinguishing features of the Van Heurck Microscopes are the facilities which they offer for work of the most extracting description. The mechanical movements are complete and comprehensive. The construction is unique — the principal parts being dovetailed together — not merely screwed resulting in an unequaled rigidity of the whole instrument.

-Watson Catalog (c. late 19th century)

Fig. 61 shows an early W. Watson and Sons, Ltd. Greenough stereomicroscope. This microscope has a triple turret providing objective pairs of 1.25x, 2.5x, and 5.0x along with paired 10x eyepieces. Therefore, total magnifications are 12.5x, 25x, and 50x. It is approximately 11" (279.4 cm) tall in working position; it weighs about 6 pounds, 8.8 ounces (2.97 kilograms). Its wide horseshoe base and relatively low center of gravity make it very stable.



Greenough microscopes can provide excellent 3D images, and with modern computer-designed objectives and eyepieces have relatively wide fields and high resolutions for their magnifications.

Most makers stopped producing "black" stereomicroscopes during the 1950s.

Later made Greenough stereomicroscopes are discussed in the next Part of this paper.

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#### R. Jordan Kreindler: leona111rjk@gmail.com

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