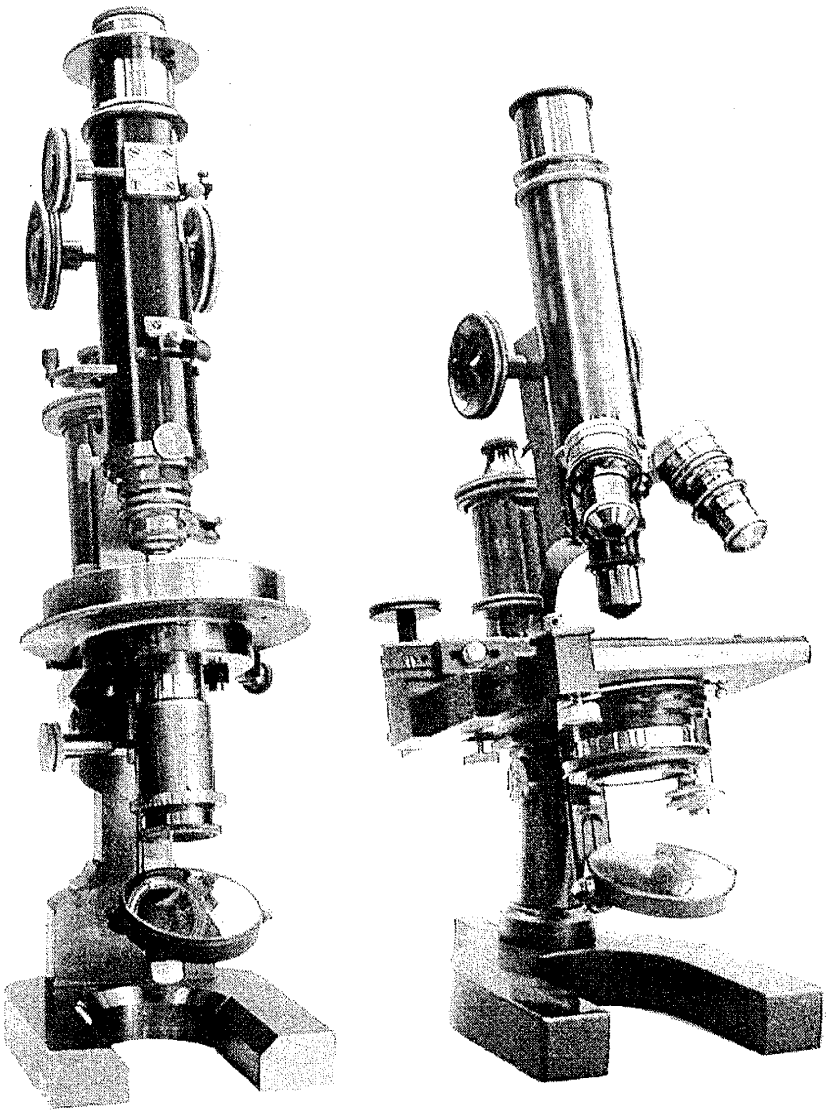
Journal of
THE MICROSCOPICAL SOCIETY OF SOUTHERN CALIFORNIA
Volume 5 Number 4 April 2000

Fuess Petro Stand

Allen Bishop



The Fuess Model 111a illustrated with a contemporary Bausch & Lomb Model BB. Both instruments were classed as "mid-size" in their time. The 111a was considered an advanced student's microscope of "moderate price" by Johannsen. Note the extra height of the Fuess' pillar to accomodate the long, narrow polarizer.

Among collectors microscopes and scientific instruments in general, there are "names" which arouse immediate recognition and stimulate the "search and procure" mode. One such name is Fuess.- Obviously German, this company was dedicated, for slightly over 100 years, to the manufacture of instruments that served, the physical sciences. Considering the important growth in the stature of these sciences during the

19th and 20th Centuries, the sundry (and there were many different) instruments and the high stature they enjoyed, Fuess instruments of any classification are prized rarities today.

Best known for their crystal goniometers, Fuess petrographic microscopes were featured in most if not all the classic texts on the sciences of Petrography and Crystallography. It is evident that production of any type of Fuess instrument was far lower in numbers than most of their contemporaries. Fuess sales and descriptive literature is also a prized discovery.

Illustrated on these pages is one of those fortunate finds, that class of discovery truly serendipitous, that any true collector deserves at least once in his or her life! MSSC member Ken Gregory happened on this Fuess Stativ IIIa in a Northern California antique mall. When the mall hostess foolishly admitted that nobody had looked at that old microscope" in "more than a year," Ken shrewdly talked the price down a couple of hundred dollars!

This instrument is a Model IIIa, actually one of the smaller stands offered by Fuess. The "a" suffix indicated that the stand was fitted with a more comprehensively equipped main tube which, according to Leiss, gave a larger field of view than the standard Model 111 tube. Johanssen does not make specific mention of this feature, but he does not give any description of the standard version. Johanssen describes the Model IIIa as "one of the best moderate-priced instruments for students' use..." Compared to a modern instrument, the "larger" field of view would seem minuscule to the modern observer.

The address on the rear of the stand's pillar indicates manufacture after 1912, when the company relocated to Florastrasse 3 in Steglitz. Once on the outskirts of southern Berlin, the Steglitz area is an absorbed suburb of the German capital. The instruments illustrated in Leiss and Johanssen are identical to Nr. 589 shown here, except for a more "conventional" appearing fine-focus control. This control is, however, shown on most all the other Fuess stands. We can conclude from this

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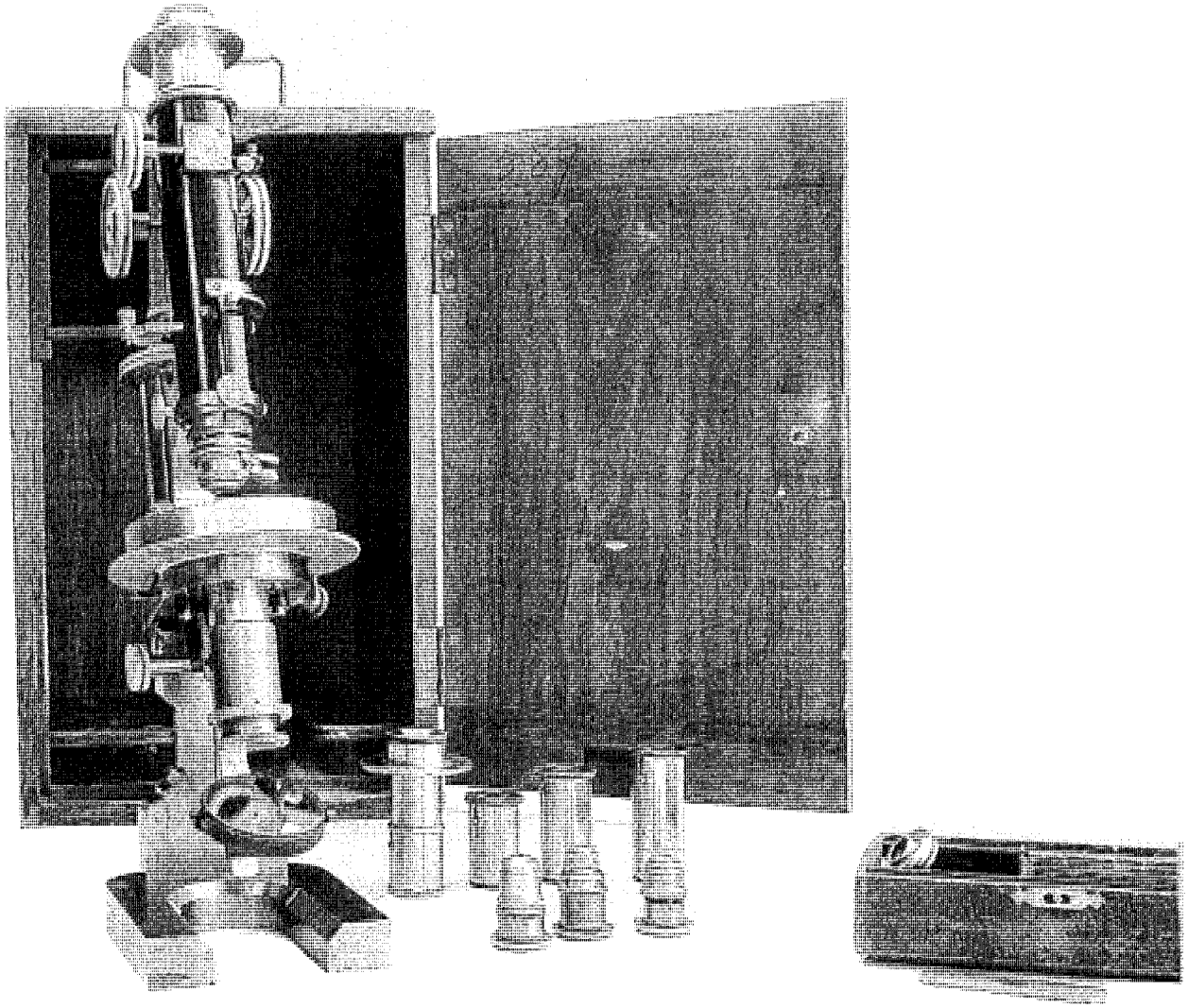


The cabinet is constructed of a very plain, sturdy wood - note the serial number hand-written at the top of the door. Alongside the instrument is an auxiliary condensor (non-polarizing), three eyepieces and the objectives. The objective on the far right is evidently not original to this outfit.

that the instruments pictured in the above reference sources are of earlier manufacture or as likely as not, Fuess "production" was eclectic. The significance of the 3-digit serial number is most likely reflective of low production, but lacking any knowledge of the company's serial numbering procedures, I am at a loss to speculate further.

While this instrument is built to close tolerances with obvious evidence of careful hand fitting, the gentle patina of age has not blurred the fact that this microscope was built for go - not show. Compared to contemporary products of any major manufacturer such as Zeiss or Reichert, the stand comes across as very plain. The cabinet by such maker's standards is positively more the product of a carpenter, not a cabinetmaker! But operation of the controls reveals a feel only shared with the best. Fully understanding the requirements of even a student petrographer, the rotary pol stage turns with an absolute ease and smoothness I have only occasionally felt. The stage/carrier trunion were obviously lapped together, then brought to a magnificent satin finish that requires but a whiff of light grease. A fingertip suffices to operate the focusing controls.

The instrument is equipped with three objectives, all Fuess:

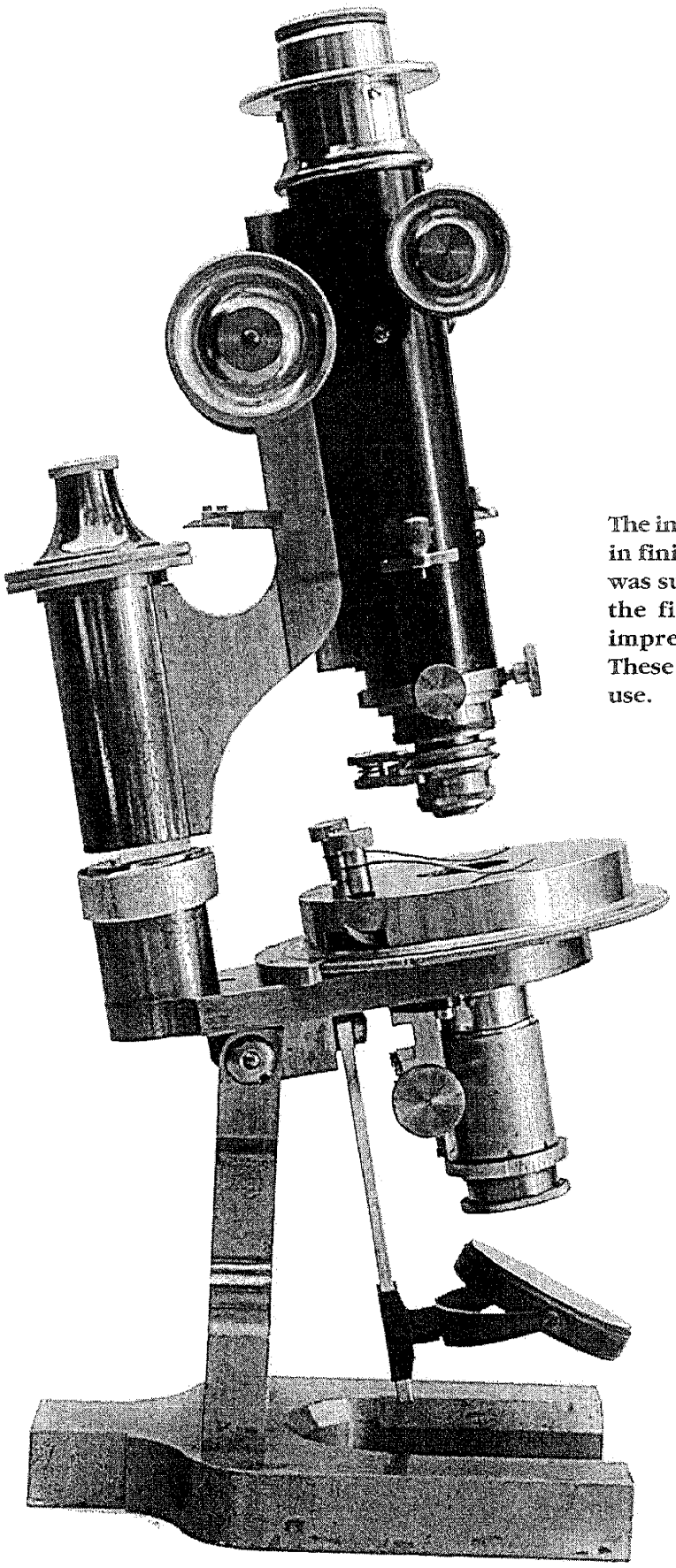
O - 31mm; 8X

4 - 14mm; 18X/0.26na

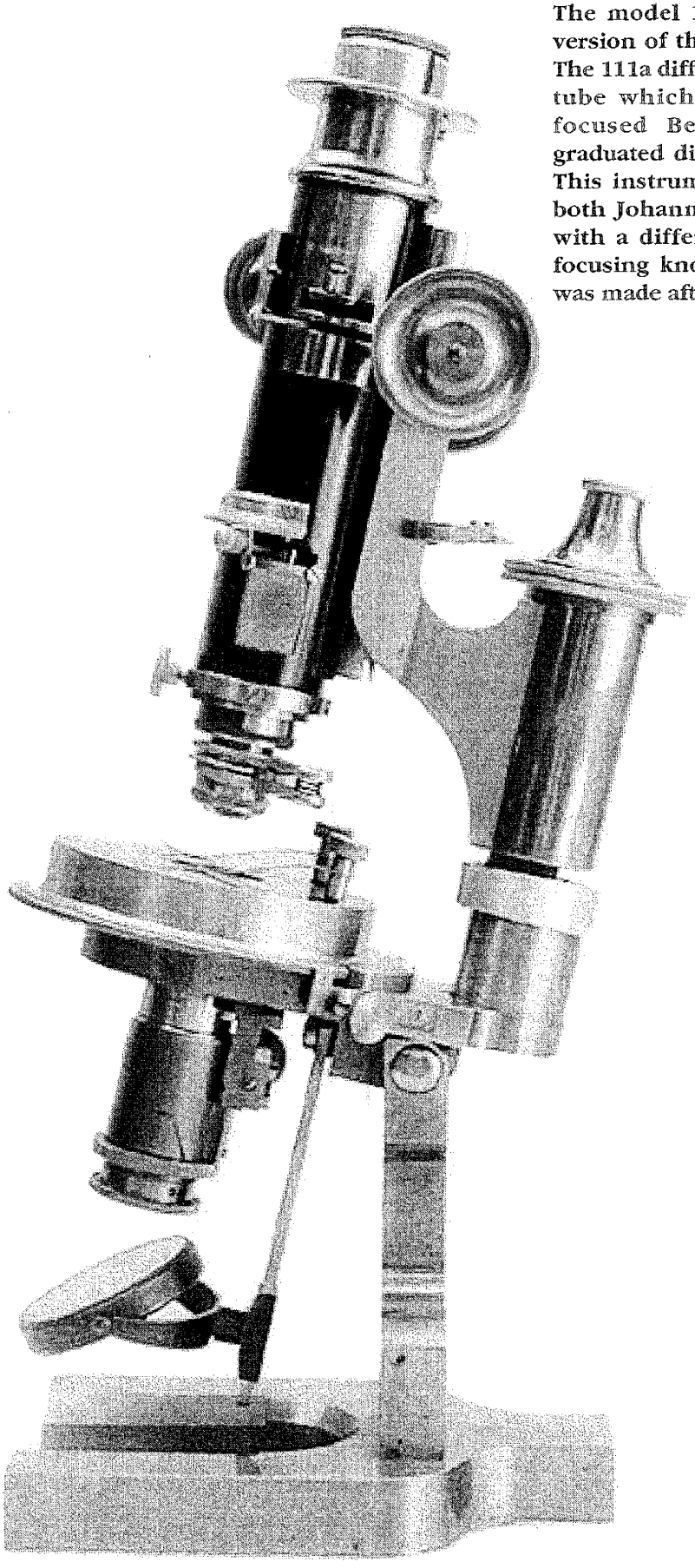
7 - 5mm; 50X/0.82na

Eyepieces:

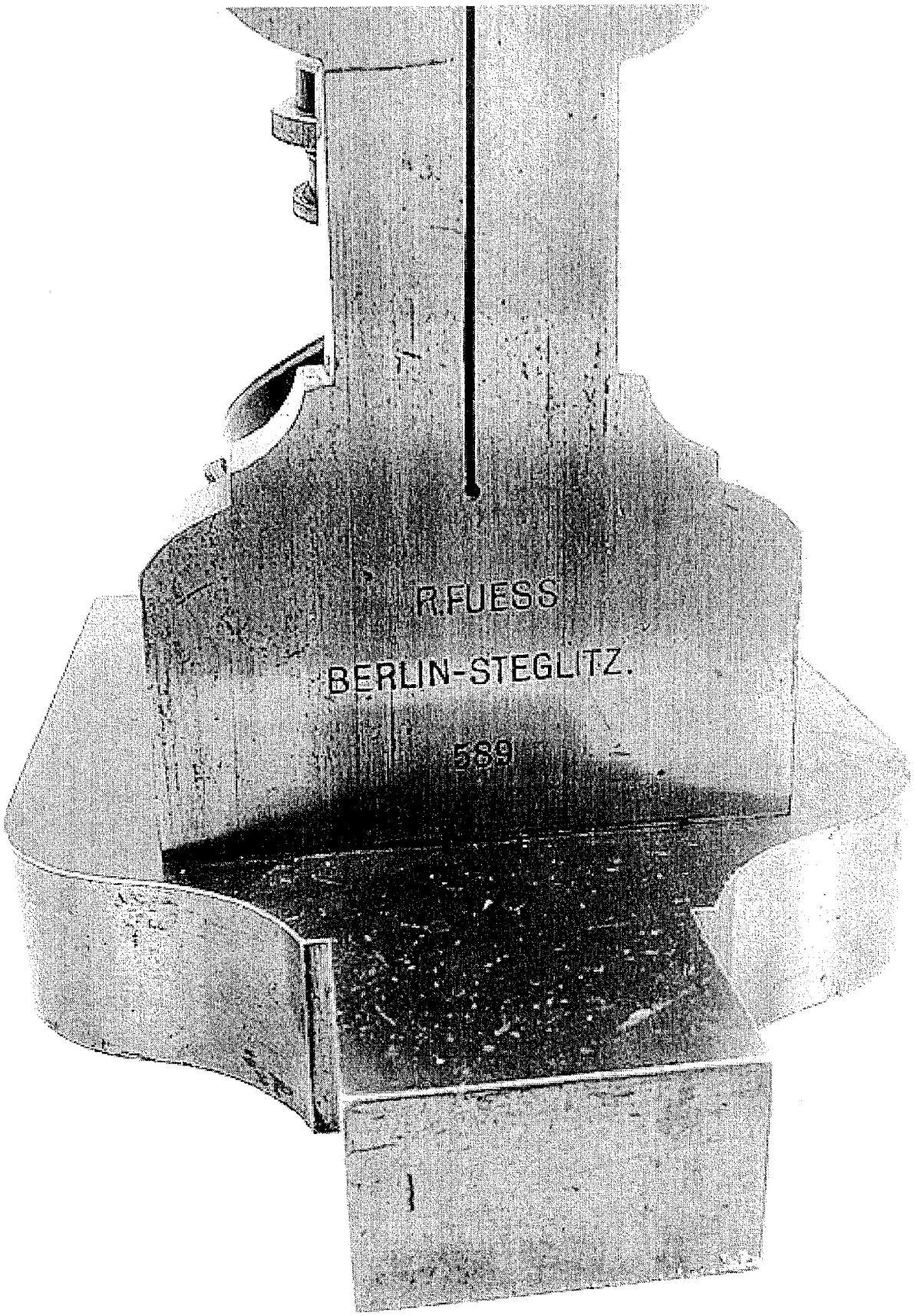
2 - 5.6X



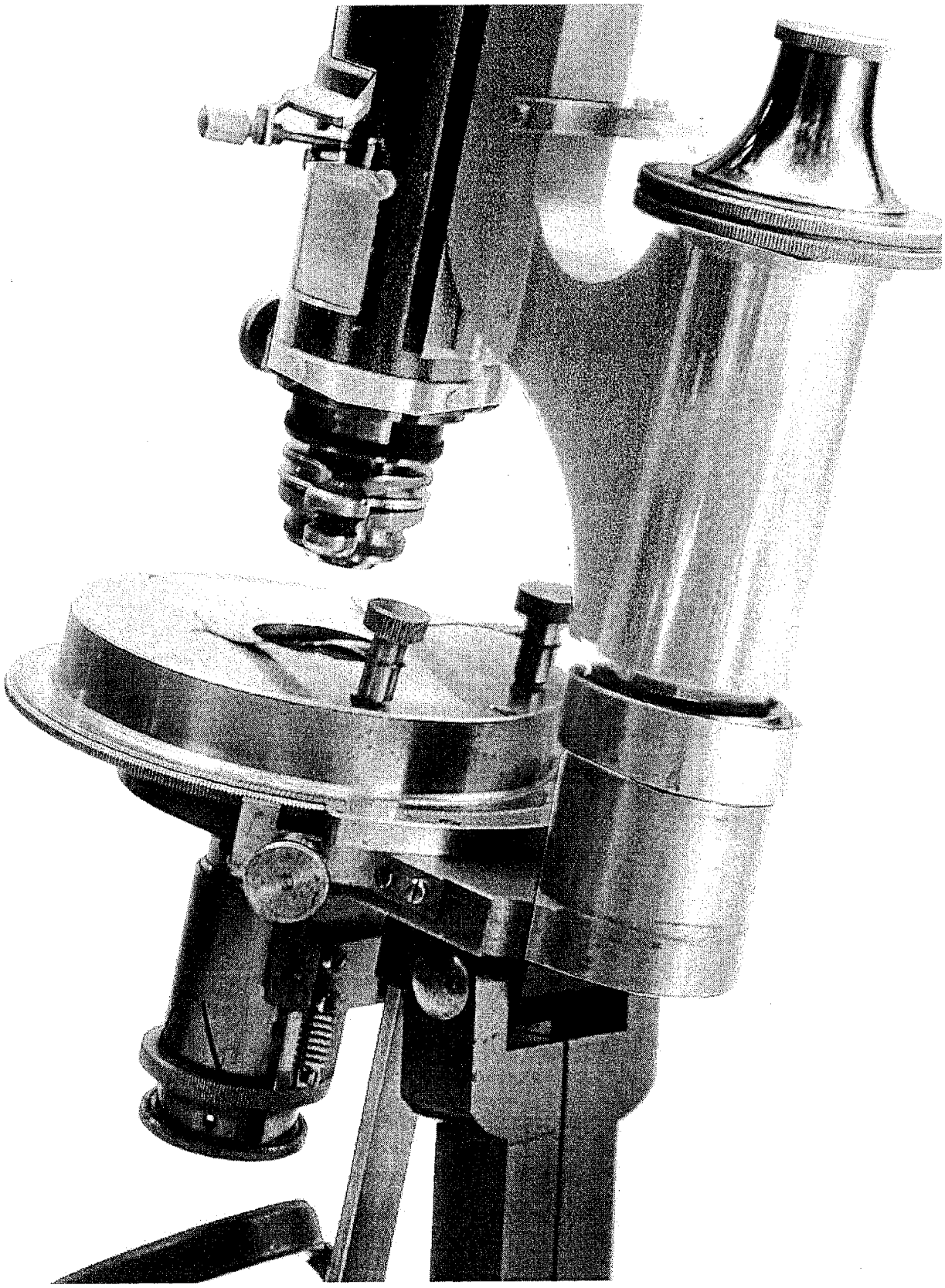
The instrument is primarily lacquered brass in finish, with a semi-gloss painted tube. It was surprising how plain and unassuming the finish on this microscope is. What impressed was the quality construction. These instruments were built for long, hard use.



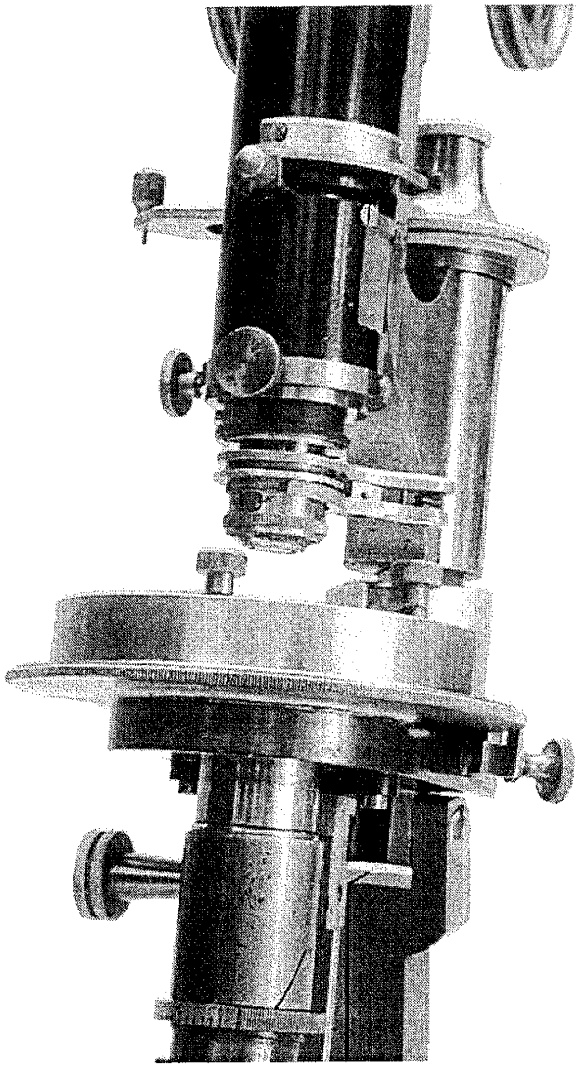
The model 111 was a simpler version of this, the Model 111a. The 111a differences were in the tube which featured a rack-focused Bertrand lens and graduated dial on the analyser. This instrument is pictured in both Johannsen and Leiss, but with a different arm and fine focusing knob. This insrument was made after 1912.



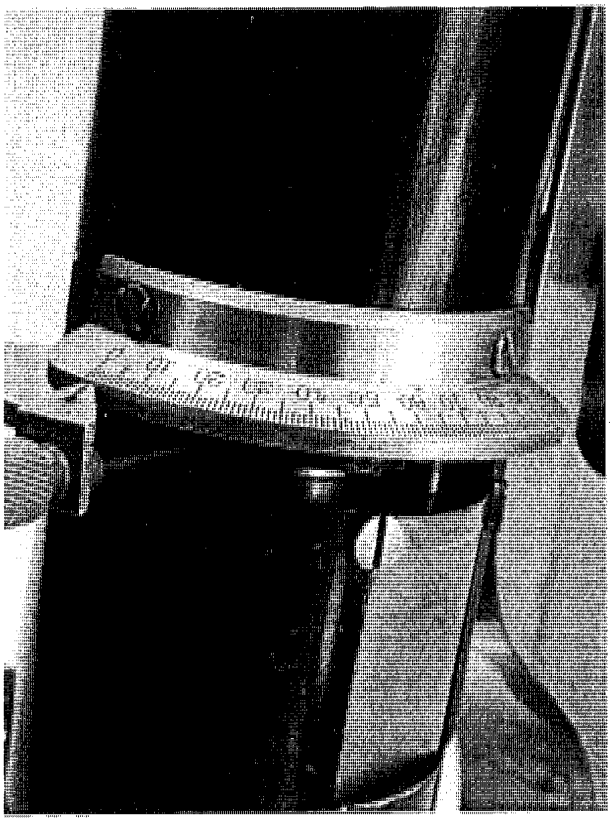
The only writing on the stand is engraved in simple block letters and numbers on the back of the pillar. Steglitz is a suberb of Berlin. The serial number, 589, most likely indicated low production figures.



The stage is hollow; inside, not visible, is the upper element of the condensor. It swings in or out of the optical path on a wig-wag lever. The stage operation is extremely smooth, operating on a gently tapered trunnion., The knob facng just below the stage is not a lock. It was intended to hold an accessory in place.



Objective centerng knobs are typical, as is the "clothespin" objective quick-detach.



Ninety degree sector scale for the analyser. When pushed out of the optical path, the operating/ index lever hangs precariously in space. Not visible higher up on the tube is the lever for the Bertrand lens iris. It is bent forward at almost 90 degrees. I thought the fragile lever had suffered a bump, but in his description of this instrument, Johanssen mentions that this was the way it was built in order to clear the Bertrand lens slider directly above.

3 - 8.3X

"C" - Magnification not known.'

References:

Burchard, Ulrich: History of the Development of the Crystallographic Goniometer. The Mineralogical Record, Nov. Dec., 1998, Vol. 29, No. 6.

Emmons, R.C.: The Universal Stage (With 5 axes of rotation). Geological Society of America. Publ. March, 1943.

Johanssen, Albert: Manual of Petrographic Methods. Orig. Second Ed. 1918; Reprinted in toto 1968 by Hafner Co., N.Y.

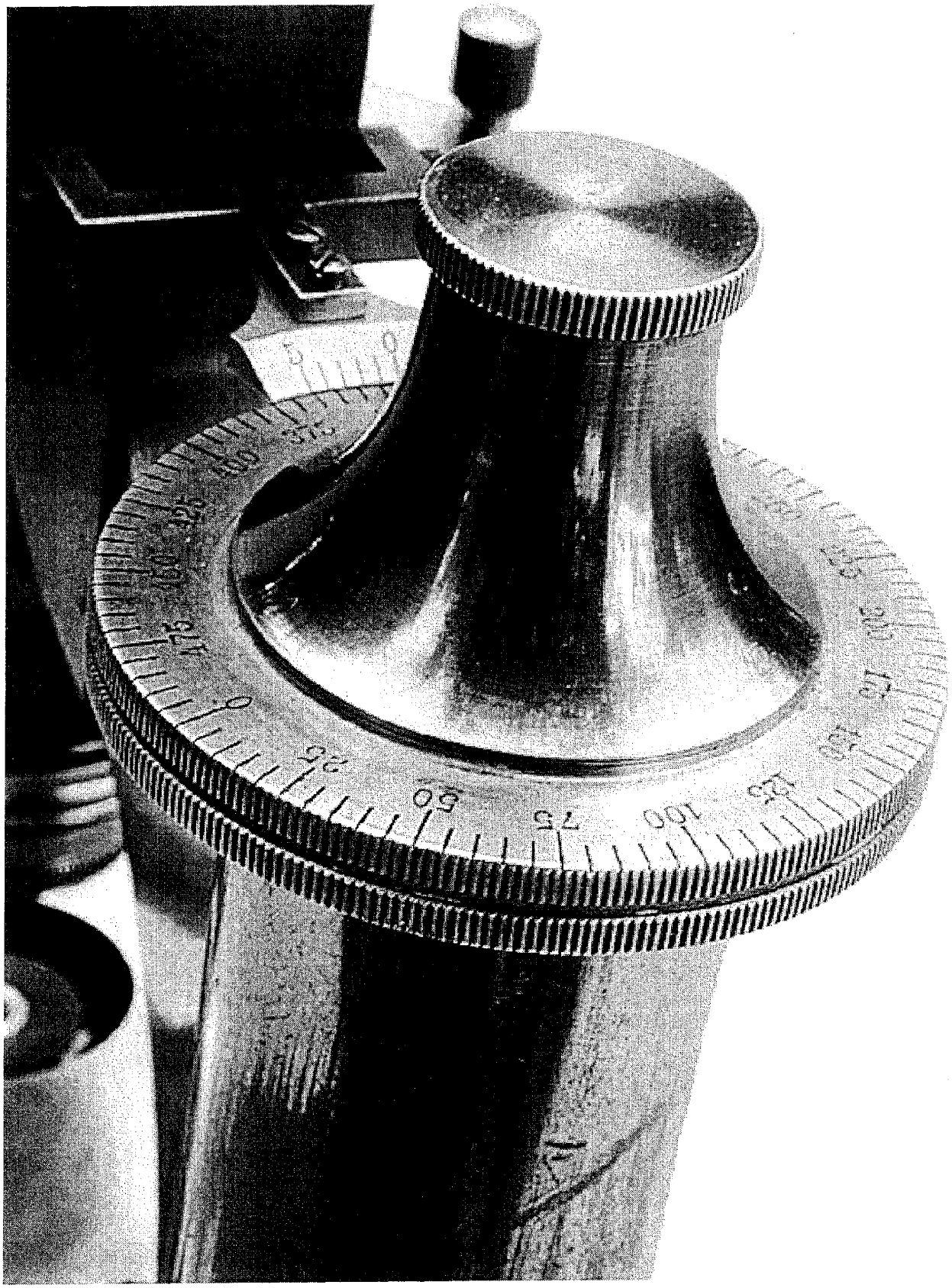
Leiss, C.: Die Optischen Instrumente der Firma R. Fuess deren Beschreibung, Justierung u. Anwendung. Leipzig, Verlag von Wilhelm Engelman, 1899. Reprinted 1988 by The Gemmary.

Muir, I.D.: The 4-Axis Universal Stage. Microscope Publ. Ltd., Chicago, 1981.

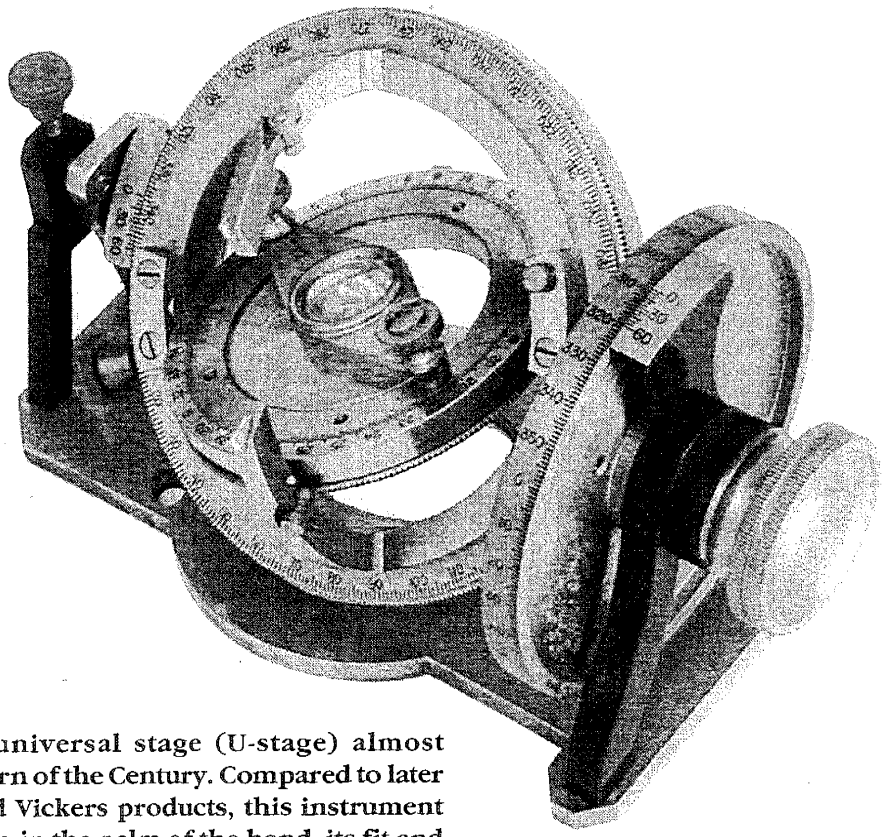
Terpstra, P. & Codd, L.W. : Crystallometry. Academic Press, N.Y. 1961.

Wood, Elizabeth: Crystals & Light: An Introduction to Optical Crystallography; 2nd Rev. Ed., Dover Publications, N.Y. 1977.

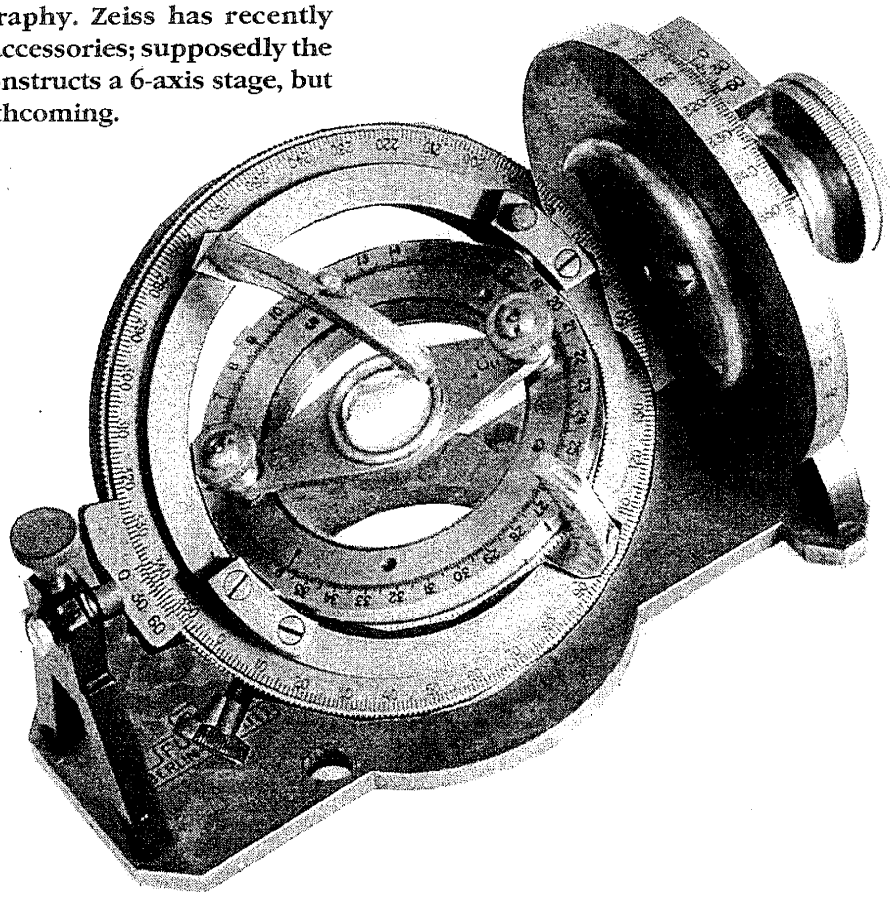
The above sources were referred to in the preparation of this article. Any MSSC member interested in learning about or expanding knowledge on the polarizing microscope will find these books of great value. As Alan deHaas has pointed out, an individual can self-teach up to a point with the ordinary light microscope,

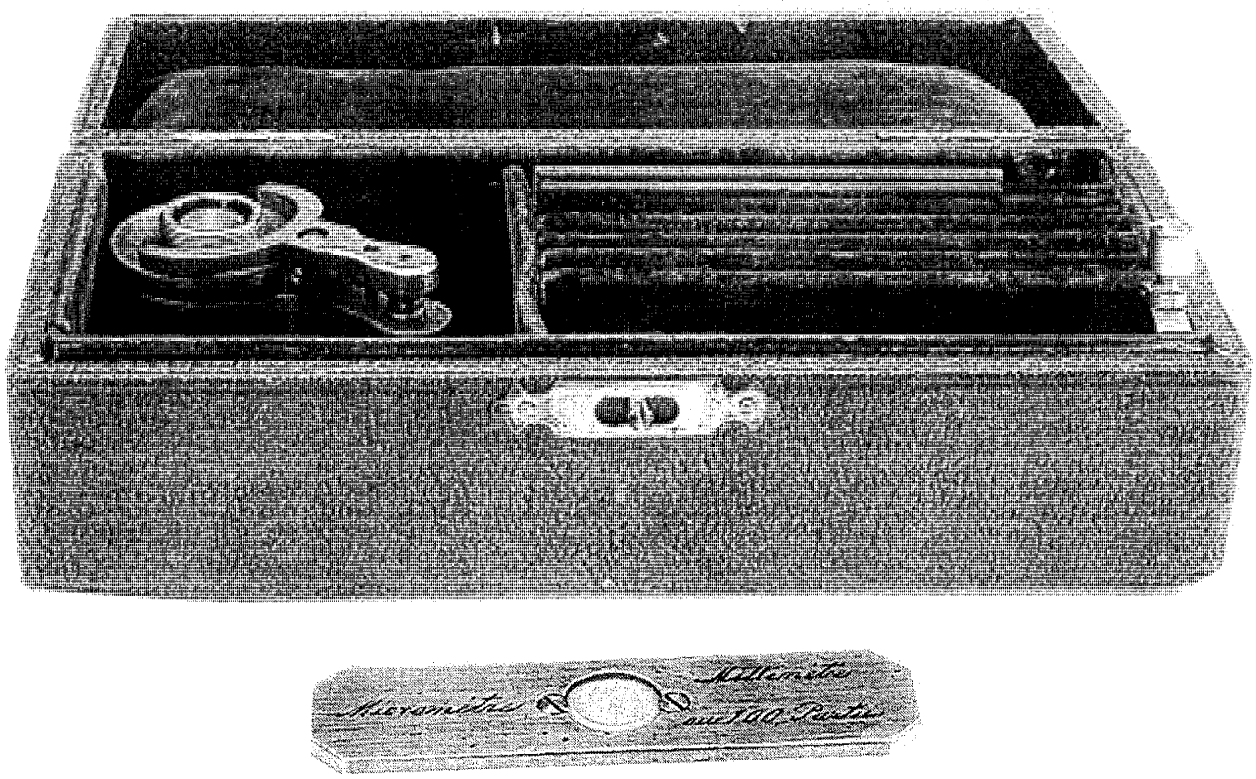


The fine focus is conventional in design and construction (for its time), but note the index scale on the arm. A stirrup attaches it to the arm, allowing it to pivot vertically and rest on the edge of the knob, while the two side screws on the stirrup allow the assembly to be shifted laterally; an adjustment for zeroing.



A 4-axis Federov universal stage (U-stage) almost certainly from the turn of the Century. Compared to later Leitz, Zeiss, B&L and Vickers products, this instrument is a miniature. Fitting in the palm of the hand, its fit and finish is simply exquisite. Note the 1/2 - folding "Wright arcs". Placed on the stage of a polarization microscope, interfacial angles of tiny crystals could be measured. Today, this instrument is an almost total anachronism in the science of crystallography. Zeiss has recently phased out their U-stage and accessories; supposedly the Russian LOMO factory still constructs a 6-axis stage, but no information has been forthcoming.





The accessory box provided with the stand contains the usual accessories, lenses etc. and included a small French stage micrometer.

but to learn operation of the Pol scope without an instructor is extremely difficult. Beyond the simplest level of recreational observation, the sciences of Petrography and Crystallography are almost impossible to comprehend without a working knowledge of light, optics and mathematics.

For purely historical research and/or appreciation, the Burchard article and the Leiss book are extremely interesting and readily available. Leiss requires an extensive familiarity with technical German.

For the person who wants to learn Crystallography, but hasn't a clue where to begin, look no further than Elizabeth Woods' little book. In print and readily available. Leiss is available from the Gemmary. The remaining titles are out-of-print and are collector's items.ANy, except an original copy of Leiss, should be obtainable through one of the booksearch sources on the web. I have had outstanding results simply working by phone and e-mail with Art Carduner Booksearch at **robinart@starlinx.com** or 215-843-6071.Also, check with The Gemmary for availability, especially the Leiss reprint. Emmons, Johannsen, Muir and Terpstra are extremely advanced texts, but fascinating to study nonetheless.

The Fuess Company

Allen Bishop

Rudolf Fuess (1838-1917)

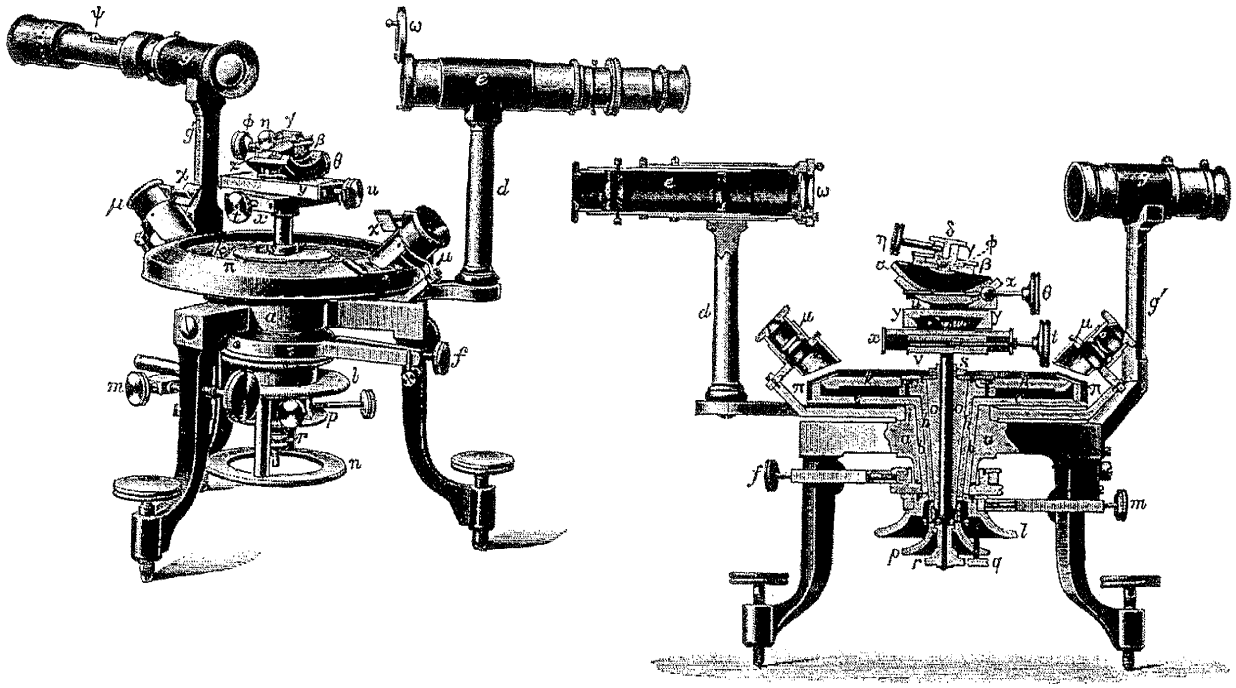
Paul Groth (1843-1927)

Most any person involved in the history and collecting of microscopes and other scientific instruments is familiar with the name Fuess. I would venture to say that beyond the recognition of the name, the collector has little or no further knowledge. How many students and collectors have even seen a Fuess product? Anything - even a component of some Fuess assemblage designed for special laboratory work? Hardly any.The output of the Fuess establishment was never intended for anyone except the professional scientist involved in research and the person who hoped to join the ranks of scientists.

Rudolf Fuess (9-28-1838/11-21-1917) was born in Moringen near Goettingen in what was until recently, East Germany. After completing the equivalent of a high-school education, he apprenticed under two mechanical artisans, Hermann Pfaff in Goettingen and later with Hugo Schroeder in Hamburg. By the time he was only 21 years old, in 1859, Fuess was in Berlin undertaking work on his own and opened a shop on 84 Mauerstrasse in 1865. Before he was 30 years of age, he was gaining a reputation and in 1870 he relocated to 46 Wassertorstrasse.

The primary direction Fuess took in professional products was determined by a professor of mineralogy named Paul Groth. Groth (1843-1927) began his career teaching, evidently as an adjunct at Berlin University, and ultimately became a full professor at Strasbourg. The earth sciences were of great importance in Western Europe and particularly Germany because of the large mining industry there. Groth and Fuess became colleagues, and Fuess constructed an optical crystal goniometer to Professor Groth's design. Groth was impressed with not only the quality of the instrument, but also the manner in which Fuess was able to simplify the design.

Fuess also made and marketed the more "rough and ready" petrographic equipment in the form of sectioning saws and polishing tools. These were sold to universities for their geo-petro laboratories. The company also made prepared petrographic thin section sets from basic rock and mineral examples up to research reference sets containing up to 1000 thin sections ready for microscopic observation.



Outline and section of the Fuess Model II goniometer
Tutton AEH. *Crystallography and Practical Crystal Measurement.* London, 2nd ed. (2 vols.) 1922

Fuess' next relocation was to 108 Jakobstrasse, where he now employed two apprentices, two opticians and five machinists/fitters.

In 1876, Fuess built his first polarizing microscope. It was unique in that the main tube was centerable. The company became known for its microscopes. Strictly for studies in the earth sciences, they were known for their innovative design and solid construction. Like all Fuess instruments, their production figures were far more limited than most other Continental manufacturers. Fuess worked with the Russian scientist, Federov the developer of the multi-axis universal rotation stage, or simply "U-Stage". Ultimately, the U-Stage was built by a number of makers, but few could match the superb quality and finish found on the Fuess examples. Today, any u-stage is a collector's piece; the Fuess the jewel in the crown.

The other instrument for which Fuess is known are his crystallographic goniometers. These devices, utilizing optical sights and collimators were the culmination of many decades of development among scientists to accurately measure the interfacial angles of multi-sided crystal structures. Again, Fuess did not have a monopoly of this highly specialized market, but his Model I and II were standards. The Model II and its derivatives became the most widely used of all. Today, these crystal goniometers are among the rarest and most prized of semimodern scientific instruments. The factory's final address was 3 Florastrasse in Steglitz, a district of Berlin.

The company continued to produce an ever-expanding range of instruments into the 20th Century. Spectroscopic instruments as well as equipment for geodesy, hydrography and solar research were designed and constructed. The founder's son, Paul Fuess perpetuated the operation, and with the rearmament of Germany in the 1930's, set up a manufacture in Potsdam to produce aircraft instruments. During World War II, the company employed up to 3,000 workers.

Unfortunately, the R. Fuess Company did not keep up with progress during the later 20th Century. Fuess was a company founded on the design and construction of precision mechanical implements; the age of electronics was not to be theirs. Officially, the company closed in 1976, almost a quarter century ago.

Today, any surviving product of Fuess could be considered a collector's item, but their polarizing microscopes and crystal goniometers are the best remembered. I wonder what they would be producing today were they still in operation. I like to imagine electron or atomic force microscopes. They would be the standard of the world.

MICROTOMES

Part II, Medium Size

John deHaas

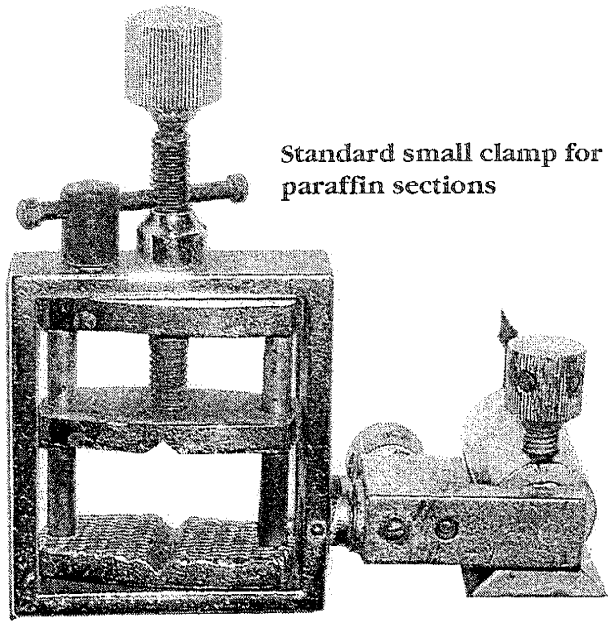
In this article, I show some small to middle size microtomes. The instruments range from about 8 to 12 in. Along the length of the instrument runs a groove or trough, triangular in section, which has three finely ground and polished lands. On these lands, runs a finely polishedtriangular steel block; the knife carrier. On top of this carrier aare the clamps for the knife. These are simple in small instruments, but complex to allow angular adjustments on the larger ones. For colloidin sections, the knife must be set at an angle of 45 degrees to the edge of the specimen. For paraffin sections, the knife must be precisely parallel to the specimen edge, otherwise ribbons cannot be cut. The specimens must be neatly trimmed all around. Large washers at the ends of the trough keep the block and knife from sailing off the instrument and perhaps seriously injuring the operator.

The vertical specimen holder is mounted on the side of the microtome. This holder runs in a dovetail groove and carries on its top the specimen held in a sturdy adjustable clamp. The specimen holder is connected to a fine cut micrometer screw which has on its bottom a large toothed ratchet wheel. This wheel, in turn, is engaged by a pawl which restricts the wheel motion over a preset number of teeth. In small instruments, the specimen cannot be raised less than 5 microns at a step. The Pall can be disengaged so that the specimen holder can be returned to its original height. The best specimen clamps are the so-called "Naples" clamps named after the famous zoological station of the same name where they were invented. These clamps can be moved in three planes which is required to obtain precise serial sections.

In microtomes with automatic advance of the specimen, there is a shaft coming down from the knife block which on the return stroke kicks an extension pin of the toothed wheel which moves it forward a preset number of teeth thus raising the specimen holder. Even most of the smaller microtomes can be equipped with a device for obtaining frozen sections. Some of the large sledge microtomes are very heavy and are actuated by a chain drive or lever motion. One of the best-liked of the larger microtomes is the I/O 860 instrument which can precisely cut sections as thin as one micron.

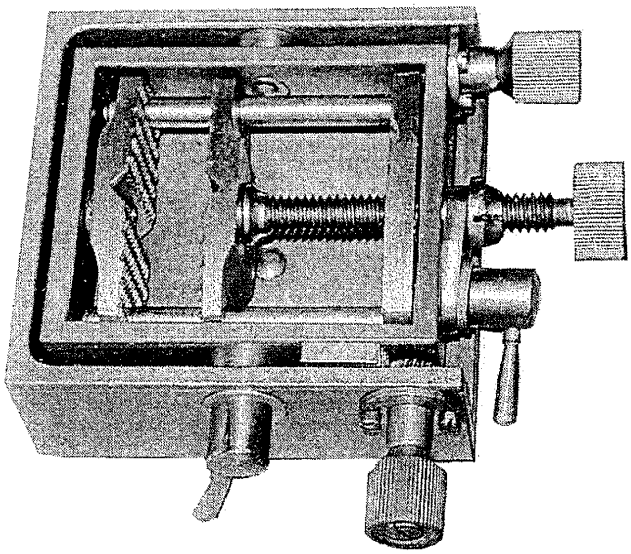
Some other examples of these middle size microtomes will be shown in the May issue of this Journal.

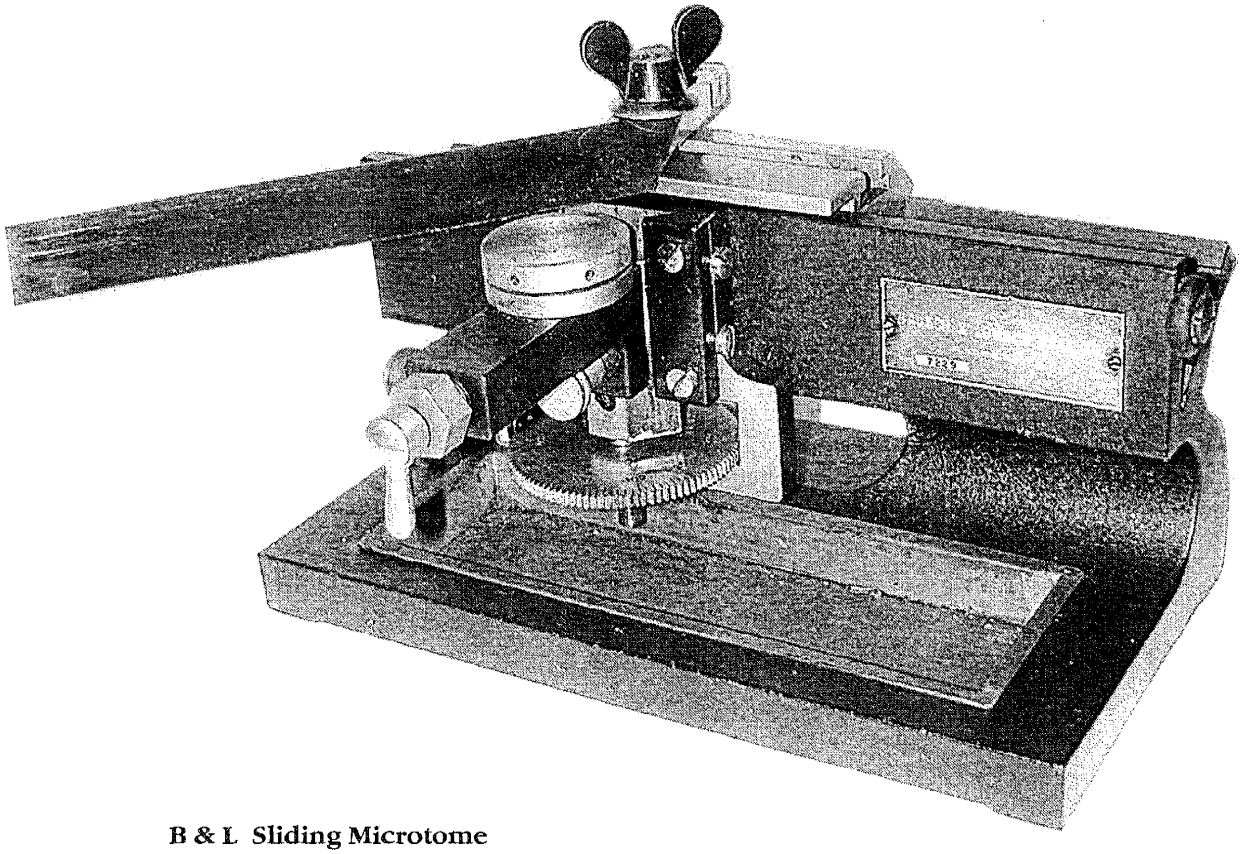
Part III will show large devices such as the rotary microtomes.



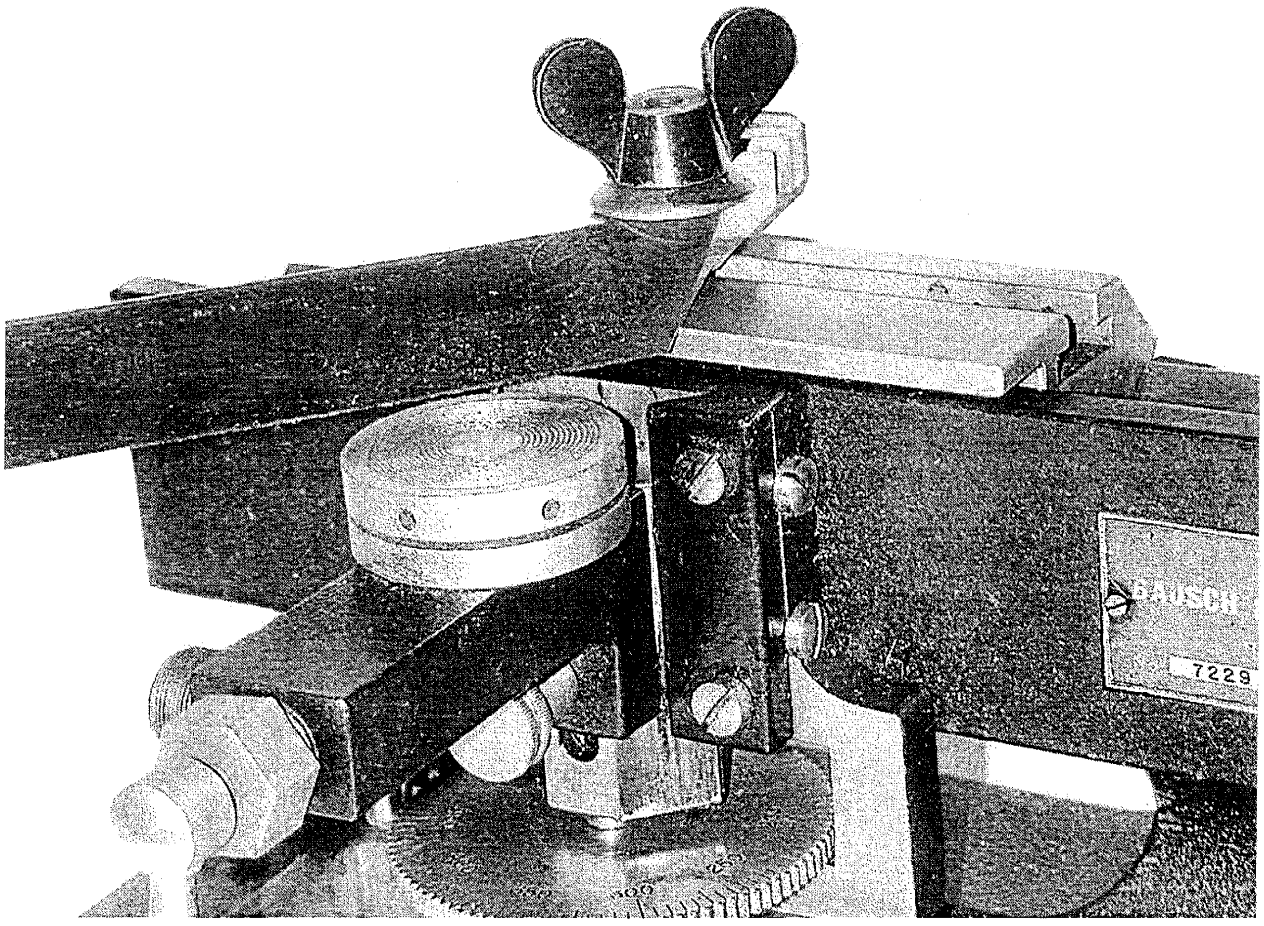
Standard small clamp for paraffin sections

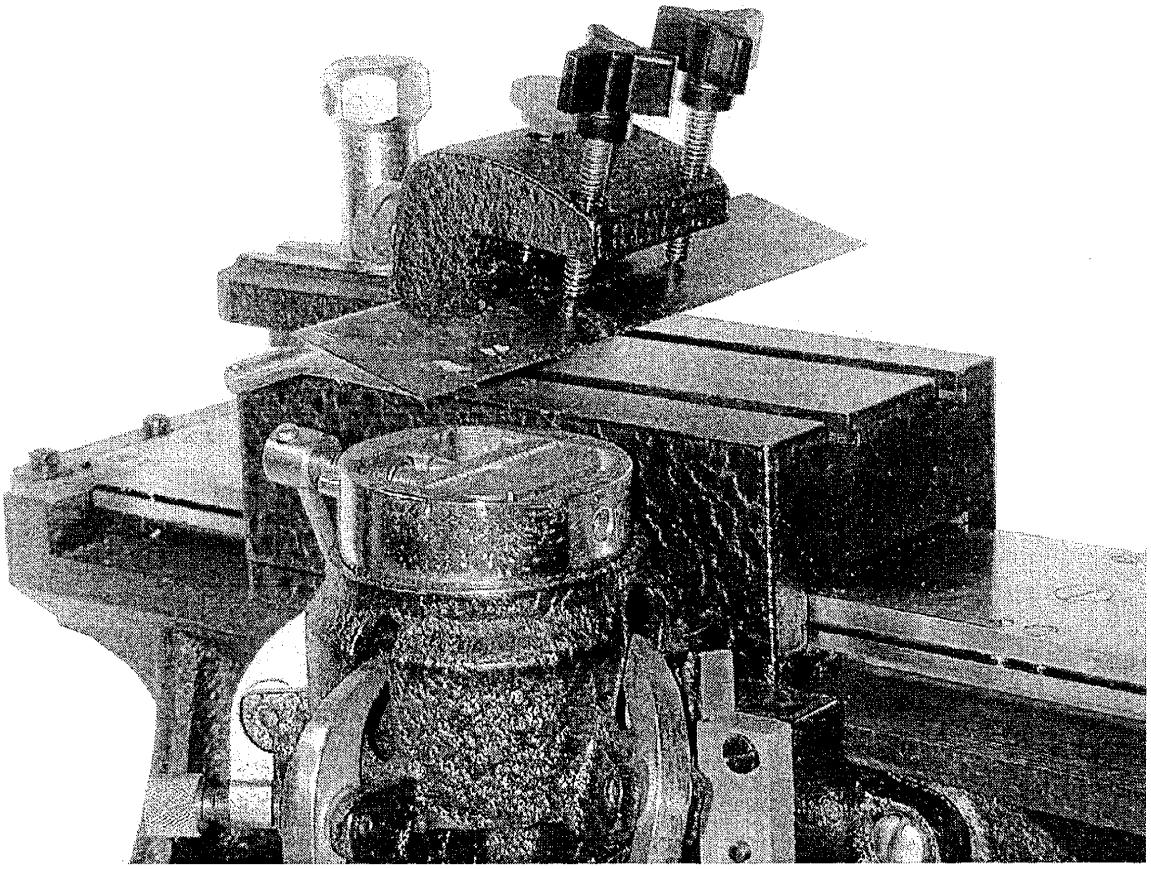
B & L Naples-Type Clamp

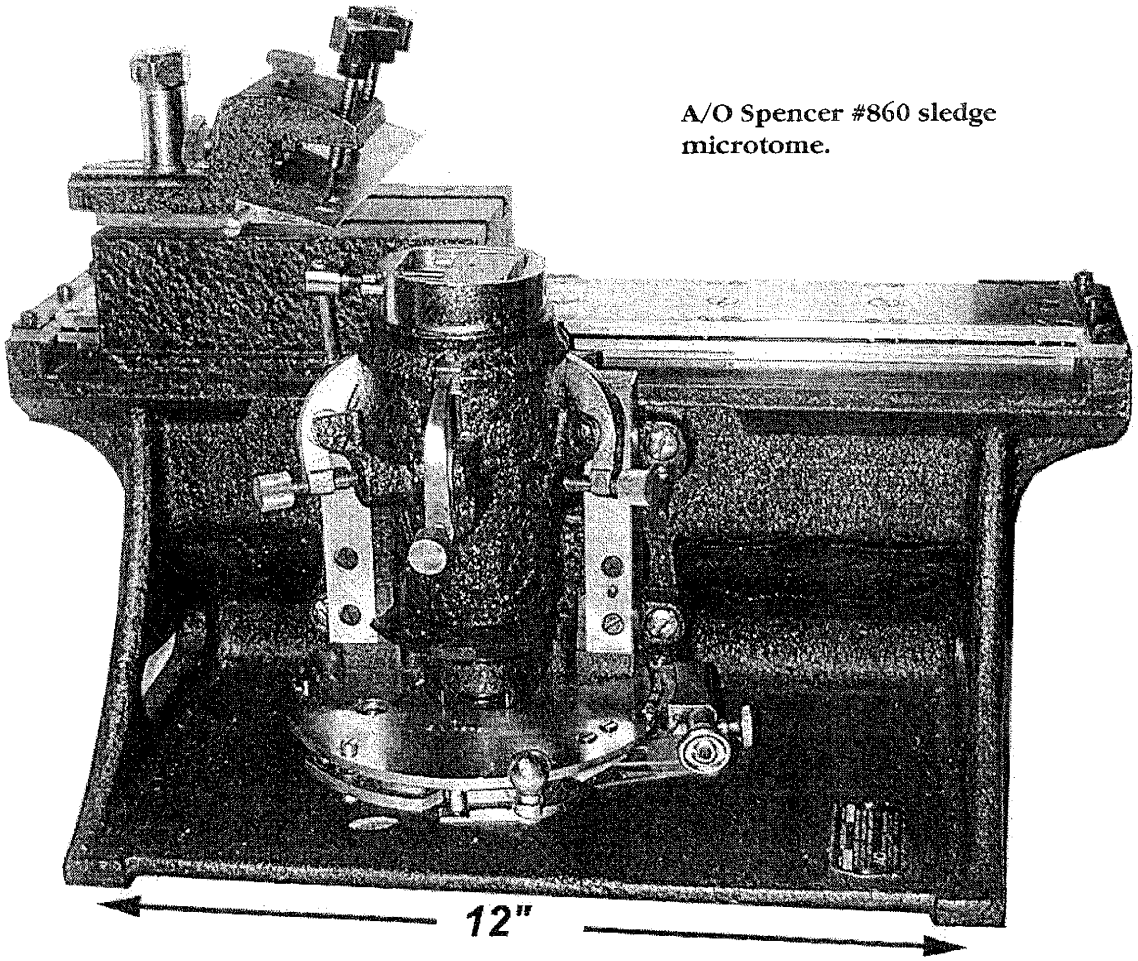




B & L Sliding Microtome
for frozen sections







A/O Spencer #860 sledge microtome.

MICROSCOPY IN AMERICA

PART II

SOME DIRECTORY LISTINGS OF NINETEENTH CENTURY AMERICAN MICROSCOPE MAKERS

Stuart L. Warter

Samuel E. Cassino's Naturalist's Directory, incorporated in later issues into his Scientists' International Directory, contains lists of people with interests in various areas of Natural History, including Microscopy. Among those listed are a number of known microscope manufacturers, designers, and patentees, either with legitimate interests in microscopy as a science, or as a source of income. Dated listings such as these often provide previously unknown or undocumented locations or even extended dates of activity, and in this instance, even some information on their interests and other occupations. With the intent of adding to the completeness of our knowledge of these artificers in the published record, I have extracted such names as I could find from six of these directories. The Naturalists' Directory for 1878 contains an index of listees by areas of interest; entries listing Microscopy were examined, and any names claiming manufacture of microscopes, or otherwise recognized from Padgitt's A Short History of American Microscopes as microscope designers, manufacturers, or holders of patents, were noted. The Naturalist's Directories for 1882, 1884, 1888, and 1894, contained in The Scientists' International Directory, and the Naturalists' Universal Directory For 1905 have no such index, so names from the earlier directories and from Padgitt's list were looked up individually. The list which follows gives locations from the directory for the year indicated - those from the editions later than 1878 have added an asterisk (*) if the listing for that year has been updated with the editor. Those without an asterisk, or with a question mark (?) have not been updated for the year. The directories are not complete, in that all eligible persons did not submit their names or update their listings from earlier editions, and thus were not included. Some retailers of microscopes whose names appeared on instruments, and sucH other names as I was aware of from other sources or examples, but not listed by Padgitt, were also included if listed by Cassino.

Bausch, Edw.
1878. Rochester, N.Y. Microscopy.
1882. B. and Lomb Opt. Co., Rochester, N.Y. Mic*
1884. As above.*
1888. As above.*
1894. As Above. Microscopy & Photography.*
1905. As above*

Bausch, J.J.
1882. B. and Lomb. Opt. Co., Rochester, N.Y. Mic*
1884. As above.*
1888. As above.*
1894. As above. Microscopy.*
1905. As above.*

Bulloch, Wm. H.
1878. 126 Clark St., Chicago, Ill. Optics, Microscopy, Collection.
1882. Manufacturer of Microscopes., 126 Clark St., Chicago, Ill. Optics. C.*
1884. F.R.M.S. Manufacturer of Microscopes., 99-101 W. Monroe St., Chicago, Ill. Optics. C.*
1888. As above. Optics, Lithol. C.*
1894. As above. Optics, Lithology, Collection.*

Cheyney, Jesse S.
1882. 517 N. 4th St., Phila., Penn. Mic., Histol., Bot. C*
1884. As above. Desires diatomaceous earth and diamond beetles from all countries.*
1888. 649 N. 44th St., Philadelphia, Pa. Mic., Gen. Histol., Bot.*
1894. As above. Physical Optics, Elec., Mic., Gen Histol., Bot.*
1905. 1322 Redfield St., Philadelphia, Pa. As Above*

Eaton, Amos. K.
1882. 65 Henry St., Brooklyn, N.Y. Micros.

Fasoldt, E.C.
1878. Albany, N.Y. Manufacturer of Microscopes.
[Not in Padgitt. Ernest Charles Fasoldt was a son of Charles Fasoldt, whose earliest activity in microscopy seems to have predated that of his better known father. Signed microscopes are known to exist.]

Goodspeed, P.P.
1882. Milford, Mass., Micros.
[Not in Padgitt. A microscope signed by Philander Goodspeed was offered for sale by Saul Moskowitz in 1980 (Historical Technology 120, p.25)]

Griffith, Ezra H.
1884. A.M., F.R.M.S., Fairport, Monroe, Co., N.Y. Mic. C. Ex.*
1888. As above. Mic.*

Grunow, Julius.
1878. 637 6th Ave., N.Y.C. Microscopy.
1882. Manufacturer of Optical Instruments, 70 W. 39th St., New York, N.Y. Optics in general.*
1884. Microscopes, Microscope Objectives, and other Optical Instruments. Otherwise as above.*
1888. As above. 621 6th Ave., New York, N.Y.*
1894. Microscopes, Mic. Objectives, and other Optical and Physical Instruments of precision. 621 6th Av., N.Y., N.Y.*

Gundlach, Ernst.
1878. Rochester, N.Y. Microscopy.
1882. As above.*
1884. As above.
1888. care Gundlach Optical Co., Rochester, N.Y. Elec., Mic, Astr.*
1894. As above. Electricity, Microscopy, Astronomy.

Ives, Frederic.
1894. 2150 N. 11th St., Philadelphia, Pa. Photog., Mic., Physics, Chem.*
1905. As above.?
[Not in Padgitt. Ives patented in 1903 a design for a binocular body utilizing Schwann (Swan) cubes (prisms). A binocular microscope base on this design was built in England by Richard Beck prior to WWI.]

Kleine, Charles B.
1882. 274 Eigth Ave., New York, N.Y. Micros*
1884. As above.
1888. As Above.*
1894. As above. Microscopy.*

Langguth, J. G.
1878. Chicago, Ill. Microscopy, Exchange.
1882. 48 E. Madison St., Chicago, Ill. Mic. C.*
1884. As above exc. 133 & 135 Wabash Ave., Chicago, Ill.*
1888. 1830 Fred'k. St., Lake View, Ill. Mic. C.*

Logan, James H.
1884. M.A., Pittsburgh, Penn. Daitoms, Mic., Protozoa, Infusoria, Hist. Of Vert. C.*
1888. Penn Building, Pittsburgh, Pa. Desmids, Diatoms, Mic., Histol, Protozoa.*
1894. Allegheny City, Pa. As above.*
1905. As above.

Lomb, Henry.
1882. Bausch and L. Opt. Co., Rochester, N.Y. Mic.*
1884. As above.*
1888. As above.*
1894. (Bausch and Lomb Optical Co.) Rochester, N.Y. Microscopy.

McAllister, Frank. W. (also spelled McAlister)
1884. 2 N. Charles St., Baltimore, Md. Mic., Photog., Optics. C.*
1888. 3 N. Charles St., Baltimore, Md. As above*
1894. As above. Microscopy, Photography, Optics, Collection.*
1905. As above.*

McAllister, Thomas H. (Also spelled McAlister)
1882. 49 Nassau St., New York, N.Y. Micros.*
1884. As above.*
1888. As above.*
1894. As above. Microscopy.*

McAllister, Wm. Y.
1882. 728 Chestnut St., Phila., Penn. Micros.
1884. As above.

Miller, Frank.
1878. 690 Brooklyn, N.Y. Microscopy, Entomology: Lepidoptera, Collection. Exchange.*
[May be the F. Miller of F. Miller and Brother]

Molera, Eusebius J.
1888. Civil and Electrical Engineer. P. O. Box No. 107., Branch A, San Francisco, California. Phys., Elec., Mic., Photog., Meteo., Ast., Bibliog., Arch., Eth., Philol. C.*
1894. Civil and Electrical Engineer. 40 California St., San Francisco, Calif. Physics, Electricity, Microscopy, Photography, Meteorology, Astronomy, Bibliography, Archaeology, Ethnology, Philology, Collection.
1905. 606 Clay St., San Francisco, Ca. As above.*

Pease, James L.
1884. L. Box 164, Chicopee, Mass. Manufacturer of specialties for the microscope. C.*
1888. As above.
[Not in Pagitt. Pease was granted a patent in 1883 for a "quick lens mount."]

Phin, John.
1878. Box 4875 N.Y.C. Microscopy.
1882. 14 Dey St., New York, N.Y. Mic.*
1884. As above.
1888. 294 Broadway, New York, N.Y. Mic.*
1894. 9 Barday St., New York, N.Y. Microscopy.*

Queen James W. & Co.
1884. 924 Chestnut St., Philadelphia, Pa. Makers of Philosophical and other scientific apparatus, etc.*
1888. As above.*
1894. 1010 Chestnut St., Philadelphia, Pa. Makers of the Acme Microscopes and Scientific apparatus generally; Insect Pins, Botanical Supplies, etc. Publishers of the Microscopical Bulletin (sample free), American agents Ch. Reichert's Microscopes and Objectives.*

Sayre, Lucius Elmer.

1894. Ph.G. Pharmaceutical Chem.And Materia Medica.*
1905. Dean, Ph.M., B.Sc., Lawrence, Kans. Materia Medica.*
[Not in Pagitt. Sayre was granted a patent in 1891 for a hand-held dissecting microscope.]

Schrauer, Leopold.
1882. 228 E 34th St., New York, N.Y. Micros.*
1884.As above.*
1888. 212 E. 34th St., New York, N.Y. Mic., Physical Apparatus.*

Sidle, John W.
1882. Philadelphia, Penn. Micros.

Smith, Hamilton L.
1878. Prof., Nat. Philos., Hobart Coll., Geneva, N.Y. Crypt. Bot.:Algae, Desmids, Diatoms; Foraminifera, Micros. Coll. Ex.
1882. Prof. Nat. Phil. and Astron., Hobart College, Geneva, N.Y. Astron., Mic., especially Diatoms, Foraminifera and Radiolaria. C. Ex.*
1884.As above.*
1888.As above.*
1894.As above.
[Not in Pagitt. Smith was granted a patent in 1866 for a vertical illuminator.]

Spencer, Chas.A.
1878. Geneva, N.Y. Manufacturer of Microscopes.
1882. as above.

Spencer, Herbert R. & Co.
1884. Successors to Charles A. Spencer & Sons, manufacturers of Microscopes. Geneva, N.Y.*
1888.... manufacturers of microscope objectives [only]. Otherwise as above.*

Stendicke, August
1884. 240 Pearl St., New York, N.Y. Optician.*
1888. 60 Third Ave., New York, N.Y. Optician.*
1894. 61 Fulton St., New York, N.Y. Optician.*

Thomas, Lancaster.
1894. 1932 Mt. Vernon St., Philadelphia, Pa. Min., Chem. Petrog., Mic.*
1905.As above. Min., Chem., Petrog., Mic., Lepid., Elec., Phys.*
[Not in Pagitt. Thomas was granted a patent in 1891 for the design of a coaxial coarse and fine adjustment mechanism.]

Tolles, Robert B.
1878. 40 Hannover St., Boston, Mass. Manufacturer of Optical Instruments.
1882.As above.*

Vorce, C. M.
1878. 164 Lake St., Cleveland, Ohio. Entomology, Microscopy, Collection, Exchange.
1882.As above. Ent. Con., Moll., Mic. C. Ex.*
1884.As above.*
1888. 5 Rouse Block, Cleveland, Ohio. Ent., Con., Moll., Mic., Photog. C. Ex.*
1894.As above. Entomology, Conchology, Molluscs, Microscopy, Photography, Collection, Exchange.*
1905.As above. Ent., Diptera, Emb., Mic. C. Ex.

Wale, George
1884. Montclair, Essex Co., N.J. Maker of Microscpes.*
1888.As above. Photographic instruments [only].*
1894. Marksboro, Warren Co., N.J. Photographic Instruments.*

Wales, Wm.
1882. Fort Lee, N.J. Micros.

Zentmayer, Chas.
1878. 147 So. 4th St., Philadelphia, Pa. Microscopy.
1882.As above.*
1884.As above.*
1888. 3021 Girard Av., Philadelphis, Pa. Mic.?

Zentmayer, Joseph
1878. 147 So. 4th St., Philadelphia, Pa. Manufacturer of Microscopes.
1882.As above.*
1884.As above.*
1888. 209 S. 11th St., Philadelphia, Pa. Manufacturer of Microscopes.*

Many of the listed individuals among those involved in design and production of microscopes were working microscopists; the designs of their products being the result of perceived needs or desires of the microscopists themselves, based upon their own personal and practical working experience. The numbers of such individuals (14 in 1878, 23 in 1882, 26 in 1884, 24 in 1888, 20 in 1894, and 10 in 1905) reflect the numbers of microscopists and microscopical organizations (see part I of this series) active in those years, with the peak of activity in the mid 1880's. Following this period of innovation, domestic manufacture resided only in two principal firms, whose use of mass-production methods resulted in greater availability and lower cost of instruments, but with a concommitant loss of variety in offerings.

REFERENCES

See Part I for references.

WORKSHOP of the Microscopical Society of Southern California

by: George G. Vitt, Jr.
Date: Saturday, 1 April 2000
Location: Ernie Meadows' residence

1. Jim Solliday exhibited a superb example of a Rubergall, Thomas. Culpeper type microscope, English, c.1805, stored in its original mahogany pyramid 18" tall case, Signed, "Tho's Rubergall Opt." to H.R.H. Duke of Clarence, 27 Covertry St. London". Brass Culpeper type, mounted on a crafted box-foot with drawer full of the usual accessories. External rack & pinion focusing. Other instruments by Rubergall have been found with the signature of, "Tho's Rubergall, Instrument maker to H.R.H. Duke of Clarence, 27 Coventry Street, Haymarket, London". He also sold Winter's museum microscope as well as telescopes and chronometers. Clay & Court establish the date of his shop at 1800, however, by 1840 the address had changed to 24 Coventry Street, London. Clifton indicates that Thomas Rubergall was listed as an Optician, Mathematical Instrument Maker, and Philosophical Instrument Maker. At some point early in his profession, he purchased a Royal appointment from the Duke of Clarence. An explanation of the importance of this association may be of interest. The Duke of Clarence was a Title to Prince William Henry, the third son of King George III. William was also made the Earl of Munster, Duke of Saint Andrew and in 1789, the Duke of Clarence. His older brother was George 4th and in 1830, William became William the 4th. William Henry began to sell appointments to his Titles sometime late in the 18th Century. In 1830, Rubergall also purchased a Royal appointment from William 4th.

2. Ken Gregory, on this April fools day, provided us with another product of his wit. After a preliminary diversion, he displayed, what he described as an early prototype of the Continental microscope, a Bausch and Lomb jughandle microscope whose base was an actual "horse-shoe" of the type one encounters in a game of horse-shoes. It was this style of base that gave rise to the term "horse-shoe base". It was beautifully finished and provided a stable base to the microscope, and a hearty chuckle from all in attendance.

3. Stuart Warter showed two microscopes: Large microscope: Early Acme #3 made by John W, Sidle of Lancaster, Pa,, and probably sold by J.W. Queen in Philadelphia in the early 1880's. Has calibrated sector disc for measuring angle of oblique illumination, Small microscope: Leitz stand 5, c.1883 brought along only to illustrate the use of cushioned jaw Craftsman Minibar clamps designed for one hand operation. Stuart had used these in the successful reconstruction of its badly shattered carrying case. He had obtained these extremely well designed and very useful clamps from Orchard Supply Hardware.

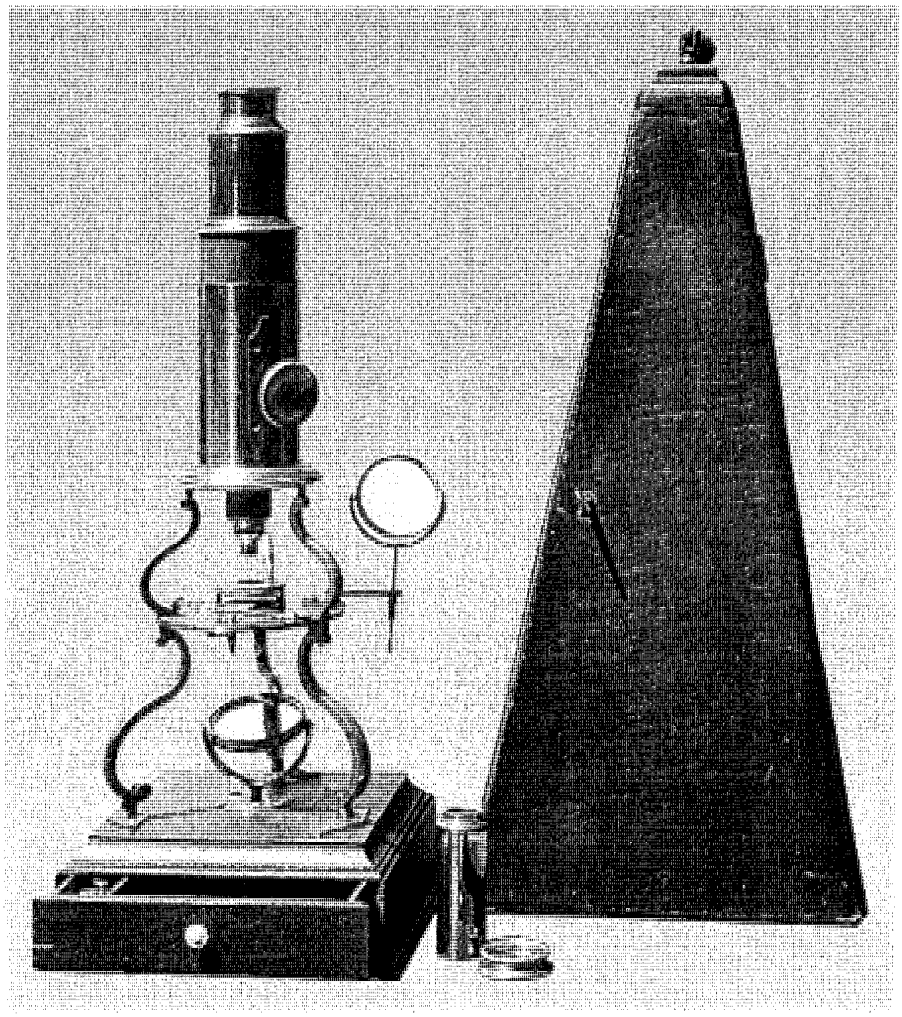
4. Jim Solliday showed a Culpeper style brass microscope, using R/P focus and with many accessories, in the original pyramid-shaped case, made by Thomas Rubergall, London, early 19th century. (In 1805, this gentleman obtained a royal appointment to the Duke of Clarence who was the 3rd son of King George III.) Accessories included a Culpeper type Lieberkuhn, a fish plate (for substage use), an aperture cone for higher power work, ivory slides, Bonanni spring stage, small live box, and adjustable bullseye. Jim then showed a marvelous early telescope (c.1820), 3x power, gilded, in mint condition, also by Rubergall. After conferring with George Vitt, Jim then spoke of making Norman Blitch an honorary life member, which won unanimous approval. (A vote at the April general meeting was also unanimous).

5. Jim Clark brought for sale a number of items from John Field, These included 6 excellent Japanese made hand refractometers of various measurement ranges, 2 camera lucidas, a microscope teaching head, and a Zeiss inverted microscope. These items 'went like hotcakes'.

6, Larry Albright showed a superb Charles Baker microscope, c.1950, stating that the quality of its construction and its features represented "the end of the great age of the microscope". It features concentric controls for fine/coarse focus and Waterhouse stops.

7. Izzy Lieberman showed a kaleidoscope made by "Illusions", Wildwood, CA, c.1989-91, which he had obtained on ebay. The images for the instrument are provided by a vertical glass tube, about the same diameter as the kaleidoscope tube, filled with water in which there is a vast number of pieces of vari-colored metal foil which are in a constant state of movement. Izzy also showed a French Stanhope microscope.

8. Gaylord Moss showed a fine commercially made hand-sized aluminum case that he had recently ordered for containing the very wide range, programmable photometer that had been designed, built, and programmed by Chris Brunt. This aesthetically pleasing and rugged case features a small compartment for the battery and



Culpeper style made by Thomas Rubergall, London, early 18th Century.

costs about $18 (well worth it!). There ensued a discussion in which Chris said that he would incorporate a capability for the use of an external photo detector, which would broaden the uses and flexibility of the instrument. Recommended was the incorporation of spectral filtration, in order to adjust the spectral sensitivity of its very wideband silicon detector.

9. Jack Levy showed some books: *Insects at Home*, by Rev. J.G. Wood, 1872; and 2 vol. of *British Fossilized Crustacea* by C. Bates & John O. Westwood, 1863. There ensued a short discussion of the Rev. Wood and the inordinately large number of books that he had written. It was the consensus, of those acquainted with this gentleman's history, that he was not above incorporating other people's works into his massive and very informative tomes. Otherwise, it would have been practically impossible for one man to amass within one lifetime such a vast amount of information!

10. Peter Fischer showed the excellent results he had obtained in digital photography through the use of a Fuji digicam mounted on his Wild M3C stereo microscope equipped with plan-Apo objective.

11. Larry McDavid showed a cased, Italian pocket electrometer, c.1890, in practically new condition. Its case had the inscription, "Lanasetoscopio, Bernini". Larry then described his method of photographing such subjects as scientific instruments. He uses an 8-ft. long bench where, well above one end of it, there is affixed a wide roll of seamless paper. By rolling the paper down the length of the bench and up at one end, he achieves a background of smooth tonality which is ideal for this sort of photography. For illumination he uses 300-watt, 3200 degrees Kelvin mini lights.

12. Alan de Haas showed a cased Heath microscope, c.1870, He pointed out that its coarse focus was through an inordinately narrow (2mm!) wide R/P which is situated at one corner of the triangular cross-sectioned main column. Being so small, this R/P was prone to damage. Fine focus is by a short lever to the objective. He then showed an intact glass ampoule containing 15 grains of gold chloride, contemporary to this microscope, and situated in a drawer of its case! There were also four thick glass plates, 1"x1.5", that were used to hold insects under pressure when being 'cleared' for long periods of time. He then showed a magnifier with a fire-polished lens.

13. Ernie Meadows said that he would provide us with tools to find and extract samples of flora & fauna located on his property, and that this might well be a fine workshop project.

We all thank Ernie for his hospitality in providing such a fine meeting place for our workshops.

Editor's Notes

I am always impressed by how much more inspiring it is to look at something through a microscope than to see the best picture of the same thing. Some of the effect may be due to the ability of the brain to integrate the focused image over a greater range as the objective is racked back and forth than one can see in the instant optical depth of field of a photograph.

Another factor though may be the subconscious knowledge that what one is seeing through the microscope is the real thing. We have seen so many counterfeit images in the movies and in print that the mind may be skeptical. However, when the object is really there, it is very convincing.

To me, some of the most awesome objects one can look at are insect parts. Religions and philosophies may argue about how they got that way, but no one argues that the design and construction of these small structures are not almost impossibly complex and elegantly well designed.

The shape of an insect foot, or the structure of a wing are worthy of study both for their aesthetics and for their functional design. I am not sure that anyone can yet fully explain the aerodynamic performance of the tiny spikes that cover the surface of a fly's wing. Even more so, the variation of the size and arrangement of the spikes over that surface. The best efforts of the Lockheed Skunk Works were probably less complex.

Obviously, the difference in the brushlike surface elements on a mosquito wing as compared to that of the fly has something to do with their relative size and the Reynold's number of their flight regimes relating their mass to the viscosity of the air. It is interesting to notice that the hairlike surface of the legs of some water beetles look almost identical to that on the wings of a gnat. Seemingly, the tiny gnat is swimming through air as thick to it as the water is to the much larger beetle.

There are two insect subjects, in particular, that I would like to be able to see in my own microscope.

The first is the hydraulic system that a spider uses to extend its legs. Spiders, unlike most other animals, have only contractor muscles in their legs, employing hydraulic pressure to extend them. What are the details of their system? Do they have tiny check valves in each leg so that if one gets a leak the whole system does not collapse? I believe the hydraulic controls on our aircraft have such failsafes. How does the spider do it? Also, would a detailed look explain why the spider, unlike the insects found the hydraulic system better than a set of extender muscles?

In the second subject, some time ago there was an article in Biophotonics showing electron microscope photos of a "gear shift" notched lever in the wing connection of a fly. It was explained that the fly powers its wings from the resonant vibration of the sides of its thorax. This is a very efficient system, but only at a given resonant frequency. To gain speed flexibility, the fly uses a 3-position lever arm to vary the coupling to the wing and presumably the drive amplitude while keeping the frequency relatively constant.

I would be interested to hear from anyone who has seen either the spider hydraulics or the fly gear shift lever.

Gaylord Moll